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Special Issue: Transforming Asian Health Equity: Findings from the Population Study of Chinese Elderly (PINE)/PIETY Study

Guest Editors: Bei Wu, PhD, Wei Zhang, PhD
Principal Investigator for PINE Study: XinQi Dong, MD, MPH

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Publication of this supplement is made possible by Rutgers University Institute for Health, Health Care Policy and Aging Research.
Advancing Asian Health Equity: Multimodal Approach to Translate Research into Practice and Policy

Minority populations are increasing rapidly in the United States, with the Asians the fastest growing population. Preliminary research showed marked disparities in relationship to health and well-being, but numerous barriers also exist that prevent quality research from being conducted and disseminated. Of particular note, research on Asians is challenged by the aggregation of Asians as a racial group, rather than examining the experiences of specific ethnicities. The Asian racial group consists of more than 20 ethnic groups with distinct languages, cultures, histories, and experiences in the United States. Additionally, Asians in the United States are commonly characterized as part of the so-called model minority, masking the difficulties Asians may face in the United States and projecting a message of uniform prosperity within and among each ethnic subgroup.

The largest Asian ethnic subgroup, the Chinese, has an estimated 4 million people in the United States, but significant gaps remain in the existing research to understand the health and well-being of the Chinese population and improve their health equity despite preliminary knowledge that US Chinese face significant barriers and health disparities. This paucity of knowledge may be exacerbated by the lack of minority representation among researchers and a lack of funding for minority aging research. In the past 10 years, less than 1% of National Institutes of Health (NIH) funding was awarded to research focused on US Asians, and Asian investigators were less likely to receive funding than white investigators. In sociology, investigators of Asian descent are 74% less likely than white sociologists to receive any government funding (coefﬁcient = −.436 (.120), P < .001; and −.238 (.085), P < .001; respectively). In a study examining clinical research projects funded by NIH between 1992 and 2018, only 0.17% of the total NIH budget went to projects focused on Asian American, Native Hawaiian, and Paciﬁc Islander participants. Of those 529 projects, many only reference health disparity populations more broadly and may not meaningfully include Asian American populations. Thus there are indications that not only do Asian older adults face barriers in participating in research due to linguistic and cultural issues, but also there are signiﬁcant systemic research pipeline barriers to support research about Asian populations and their health and research led by Asian investigators. Given the population size and growth of Asians in the US, along with insufﬁciencies in our current understanding of health among US Asian populations, action at federal levels is needed to close this funding disparity. Without additional support of research projects focused on Asian populations, our ability to improve the health and well-being is compromised.

To address these gaps in our knowledge and support research conducted in Asian populations, this issue of the Journal of the American Geriatrics Society compiled 17 articles that examine the health and well-being of Chinese older adults through the Population Study of Chinese Elderly (PINE) and PIETY studies, the largest epidemiological cohort studies of Chinese older adults and Chinese adult children in the United States. The articles in this issue are organized on these themes: methods of data collection, elder abuse, cognitive function, psychological well-being, social relationships, and health behaviors.

Regarding methods of data collection, Dong et al provide details on how to use mobile technologies to conduct in-person multilingual survey research with underrepresented minority immigrant populations. On the theme of elder abuse, four articles examine the risk factors and consequences of violence across the life course. Pertaining to cognitive function, four articles investigate cognitive function in the context of immigration, psychological distress, social engagement, and oral health. Another three articles focus on psychological well-being among Chinese older adults and its relationship to physical health over time. Regarding social relationships, three articles concentrate on various facets of the social contexts of Chinese families including filial piety from the perspectives of the older adult and their adult children and older adults’ capability for social engagement. Lastly, two articles explore patterns of health behaviors among Chinese older adults to

DOI: 10.1111/jgs.16110

JAGS 67:S476–S478, 2019
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0002-8614/19/$15.00
understand potential predictors and consequences of certain health behaviors.  

**IMPLICATIONS**

These articles not only shed light on the current experiences of the Chinese community in the United States, but they also offer solutions on improving the research participation of minority older adults in the United States and ultimately reducing health disparities. With studies like the PINE study and the recent establishment of an Asian Resource Center for Minority Aging Research (RCMAR) funded by the National Institute on Aging, we have begun to see greater support toward these efforts. The PINE study has completed three waves of data collection with more than 90% of participants completing follow-up interviews. This sustainability in participant retention has been possible through more than 10 years of continuous community outreach and engagement in Chicago Chinese communities according to the principles of community-based participatory research. This localized approach has been successful in supporting data collection for the largest epidemiological cohort study of Chinese older adults in the United States, but increased efforts should be made on national and international stages to understand the experiences of Asians and their health to fill these critical gaps in our knowledge.

The Asian RCMAR supports early-stage investigators from across the country in conducting research pilots along the themes of trauma, resilience, and health outcomes among Asian older adults. This occurs through a four-core and three-board structure to support the administration, research education, analysis and methodology, and community participation for current and future research and researchers. Executive, internal, and external board members help guide the direction of the Asian RCMAR and have backgrounds ranging from nonprofit to academic to social work, and they work with Asian populations across the world. The Asian RCMAR’s Measurement and Analysis Core provides resources in conducting secondary data analysis of large survey data sets worldwide to understand the health of global Asian populations, with support from senior statisticians. Given the high prevalence and growth of immigration, we believe an international perspective is needed to contextualize, understand, and improve the health of Asian populations. Further, the Community Liaison and Recruitment Core takes a multilevel approach to integrate community stakeholders and members in all components of research studies from design to implementation to dissemination. We hope the trajectory of the Asian RCMAR will not only support innovative research on Asian older adults and support early-stage investigators interested in these issues, but also lead national and international conversations and future initiatives to promote health equity in minority groups. Future research and funding efforts should be dedicated to building and sustaining innovative research projects and infrastructure to improve the pipelines of Asian researchers and research on Asian older adults given the significant need and disparities. Given inequities in funding for Asian investigators in behavioral and social science and a relative dearth of funded research examining the health and well-being of US Asians, we call for the NIH and NSF to consider Asians as an underrepresented minority in funding opportunities, especially regarding behavioral and social science research. In the coming decades, the United States will likely be challenged by the growth of the minority and immigrant older adult population, and it will be increasingly critical to build on current research and expand research support in these populations to understand current inequities and how to promote health equity for all.  

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Survey research is an essential component of epidemiological research to understand the health of older adults. However, there are several limitations to conventional data collection methods that may serve as barriers for recruitment and retention of research participants, especially from minority populations. With recent technological advancements, our research team developed an innovative data collection and management system to address linguistic and cultural barriers, data quality, data security, and data preparation issues. This platform has been utilized in the Population Study of Chinese Elderly in Chicago since 2011. Future use and improvement of this system will facilitate research among minority older adults and increase research participation and representativeness to ultimately understand and improve the health and well-being of diverse populations. J Am Geriatr Soc 67:S479–S485, 2019.

Key words: aging; minority; survey methods; technology

Conducting survey research is an essential tool to understand population health among older adults. Traditional forms of survey data collection include paper-based, in-person, telephone, mail, computer-assisted, and/or internet surveys, but these approaches have practical limitations that influence the recruitment and retention of participants and quality of collected data, especially among special populations, such as older adults and minorities. Many of these methods rely on the availability and proper use of technology by the respondent (telephone, internet), additional data entry to facilitate analyses (mail-in and in-person paper-based surveys), and literacy and comprehension skills of the respondent (internet and mail-in surveys). Older adults have less access and facility with technology and may have physical impairments (ie, eyesight, hearing, motor skills) that may increase barriers to participation in research. Minority populations also historically have less reliable access to technology and have higher rates of limited English proficiency, which could impact response rates and selection bias. Additionally, these methods often make it difficult to monitor data quality in real time by project coordinators, as data cannot be reviewed or aggregated in a timely manner.

In-person surveys are a preferred medium of data collection for special populations, such as minority older adults, as the interpersonal connections between interviewer and participant can mitigate some barriers to research participation, such as historical distrust in research, literacy and comprehension issues, and technological barriers. In-person surveys also reduce missing data, improve data quality, and are the best way to gather linguistically and culturally appropriate data. However, in-person survey strategies have also come with significant limitations, including reliance on paper-based collection, which can be heavy, can add to clutter, is unable to have automatic skip patterns, is unable to be monitored in real time, and may reduce data accuracy at the collection and input stages. For surveys involving both interviewers and participants who may speak multiple languages, these barriers may be compounded due to the need for multiple dialects or languages to be available at any given time.

There is a great need for recruitment and retention of underserved populations, such as minority older adults in survey research, but popular methods of data collection have not been conducive for addressing these needs. Therefore, the research team of the Population Study of Chinese Elderly in Chicago (PINE) developed a custom data collection system to facilitate in-person interview of Chinese older adults to build on the existing advantages of in-person survey data collection and address language, data security, environmental, monitoring, and analytic limitations of existing systems. This novel data collection platform has removed many barriers and automated many processes to allow interviewers to form
interpersonal connections with participants. Given this technological platform, PINE has been able to successfully recruit and retain participants: the original cohort of 3157 Chinese older adults who were first interviewed between 2011 and 2013 and has since had a follow-up rate of 89.4% for time 2 and 90.4% for time 3. This platform may have been especially useful in maintaining high rates of follow-up while examining sensitive issues, such as psychological well-being, family relationships, and life course violence in PINE.16-45 The aims of this article are to outline the development, implementation, operations, and future capacities of a novel data collection platform that has been used in collection for PINE since 2011. Ultimately, this article could serve as a guide to aid population health researchers in the design and implementation of digital survey platforms to facilitate large-scale epidemiological studies with minority older adults.

PINE STUDY OVERVIEW

PINE is a population-based prospective cohort study of community-dwelling Chinese older adults, aged 60 years and older, in the greater Chicago, IL, area. PINE represents the largest epidemiological study of Chinese older adults in the Western countries. The baseline interviews were conducted between July 2011 and June 2013 with an original cohort of 3157 Chinese older adults. From the original cohort, 89.4% completed the first follow-up interviews between 2013 and 2015, and 90.4% completed the second follow-up interviews between 2015 and 2017. In-home interviews were conducted by trained multilingual and multicultural research assistants in participants’ preferred language or Chinese dialects, including English, Mandarin, Cantonese, Toishanese, and Teochew.

Survey Platform Overview and Core Functions

Survey Platform Overview

In below sections, details for each of the core functions are described, including (1) data collection web application; (2) report site; and (3) security features. An overview of technical details of the core functions is included in Table 1.

Data collection web application comprises five tiers: (1) staff tier; (2) web tier/presentation tier; (3) business tier; (4) data access tier; and (5) data tier (Figure 1). The staff tier consists of wireless devices, such as iPad/iPhones, android phones, desktops, or laptop computers. The JAVA EE Server makes up the web tier and business tier—it is also referred to as the study operation tier. Data are transmitted through wireless services to a secure server in real time. The data access tier is composed of Hibernate ORM, whereas the data tier includes the database server. The database is the fifth tier of the application. The application uses the MySQL 5.7.24 community edition database, which is open source, highly scalable, and a reliable, relational database system. The MySQL database management system is written in C and C++, while being compatible with various operating systems, such as Linux, Windows, and MacOS.

Once data have been entered into the database, multiple features are designed and architected to optimize quality monitoring and data security. Additionally, enhanced security measures are implemented to ensure safety of collected data and participant information.

| Table 1. Core System Functions and Technical Details |
|---------------------------------|------------------------------------------------|
| **Platform functions** | **Technical details** |
| Data platform technical details | The data platform is an interoperable mix of multiple technologies, frameworks, and programming languages, such as J2EE/JAVA, MySQL, JSP, HTML, CSS, JavaScript, Bootstrap, hibernate, Spring Framework v4.0, and Struts Framework v2.0. The application is designed using the MVC design pattern and architecture, where the “model” portion represents the application database and respective entities (details in Figure 2). |
| Core function 1: Survey site: data collection | Survey site is written in a JAVA Enterprise Edition platform using servlets, JSP, and EJB technologies. The application is deployed in Apache Tomcat Server. We have merged the Struts v2.0 framework and the Spring Framework v4.0; the Struts Framework empowers the use of the centralized file-based configuration, the form bean creation, and the validation, while the Spring Framework is used for IOC and loose coupling to make the application extensible to new functionalities and requirements. |
| Core function 2: Report site: quality monitoring | The report site has been designed with the BI, analytics, and reporting requirements of study/survey data. It is developed using the JavaServer Pages technology (standard: JSR 245) and has been deployed in the Apache Tomcat Servlet container. |
| Core function 3: Security | We have custom built and configured the run-time environment in the MacOS Server to run database and data collection web applications. |

Abbreviations: CSS, cascading style sheets; EJB, Enterprise Java Beans; HTML, Hypertext Markup Language; IOC, inversion of control; J2EE, Java 2 Enterprise Edition; JSP, Java Server Pages; JSR, Java Specification Request; MVC, model view controller.

Survey Site: Data Collection

The survey site can be accessed via the web application (technical description of the survey site can be found in Table 1). It is divided into two different sections based on user roles and responsibilities: administrator and interviewer. The administrator has the ability to create staff accounts, participant...
accounts, instruments, questions, answer choices, data banks, and interviews. The administrator has access to all the interviews, assigned staff, and participant list. Additionally, the administrator has the ability to monitor the progress of the interviews and assign interviewers to any given interviews based on language preference and location. Administrator accounts can edit all participant's information, contact information, and deceased status. After logging into the site, the interviewer will see the list of interviews it has to complete and the list of participants assigned to any given survey. The interviewer has the ability to both start the new interview and resume the previous ongoing interview. The interviewer also can edit the assigned participant's information, edit contact information, and report deceased information.

**Report Site: Quality Monitoring**

The report site communicates with the application database in real time to facilitate analysis and to generate real-time reports.

Primary components of report sites are study management, study reports, and study assignment, which is further...
divided into the following subcategories: coding tool; assignments; eligibility; status; scheduling; contact; deceased report; completion reports; and incompleteness reports. Same to the survey site, the report site also has two user roles. The administrator can do the following: assignment, reassignment, code measurements, generate progress reports, and view incompleteness and completion reports. The completion report shows the list of participants who did not complete the particular interview, assigned staff, and the progress status, whereas the completion report shows the list of participants who did complete the interviews and assigned staff. The interviewer can view the completion report, completion report, contact list, and wrong address report.

**Security**

Database, web services, and web application are enclosed in a private virtual subnet whose internet protocol addresses are hidden from the outside world. Our different layers of infrastructure built around database and web applications help us detect and respond quickly to threats before an actual breach can occur. Passwords are hashed using PBKDF2 (password-based key derivation function 2), thereby making it impossible for perpetrators to decipher it, even with direct access to the application database. Such security measures ensure safety of participant information and collected/archived data.

**Fieldwork Operations**

The modular architecture of the application facilitates the development of a wide variety of multilingual surveys. Based on individual study requirements, new instrument categories could be designed and entered into the system. Automatic skip patterns can be programmed in the system if needed for particular measurements. For the consecutive waves, the instrument, questions, and choices can be copied over using SQL scripts by the database administrator. Similarly, questionnaire data can be copied over for the different cohorts if those fall under the same interview category. These functions ensure streamlined operations of multiple studies and data collection for longitudinal studies. A unique identifier is assigned to each interview and is thereby used throughout the interview lifecycle. Standard naming conventions are followed for the purpose of naming the interviews, such as “PINE baseline interview,” to assist in longitudinal study design.

Once the interview is designed, a group of staff is allocated based on the physical location and language preferences of participants. A group of participants who are filtered based on study criteria and age requirements are assigned to each staff for the interviews and follow-ups. Assigned staff can contact the participants either in person or via telephone or letter, with the requirement of contact being recorded each time. The following seven purposes of contacts are listed in the application: (1) request participation in a study activity; (2) schedule or confirm study appointment; (3) collect study data; (4) provide study information/answer family study questions; (5) contact requested or initiated by subject; (6) appointment cancellation; and 7) gather subject’s contact information from family members/trusted people. Such information on the contact forms enables interviewers to customize recruitment strategies for each participant based on his/her previous record(s).

Administration is handled by the staff, project administrator, and database/application administrator at different levels of the interview process. Data get validated each time they enter the system through the application framework. The staff interactively engages participants during the survey/interview process to make sure that the participant understood all the questions and choices properly. An illustration of the interviewer interface is provided in Figure 2. Cross follow-ups are implemented to increase the reliability and validate interview data.

The submission of the interview can happen on the same day when the interview started or later. Sometimes, however, the interviews span over multiple days, depending on participant’s availability. Intermediate stages of interviews are captured in the application and database, with the option of follow-ups to be scheduled and interviews to be resumed from the previous question. The interview submission falls under the fourth and fifth phases of the interview lifecycle. The staff member reviews the questions and answers and validates the content before proceeding to the final submission. After the final submission, the interviews are locked, which means further edits are disabled. This lockdown allows for the maintenance of the integrity of collected data.

**Quality Monitoring**

The quality of the survey data is primarily focused on all the team members involved both directly and indirectly in the study. Quality monitoring is conducted at different levels of the application and interview life cycle. The survey application validates the data automatically through different checks implemented using the application framework, custom functions, and regular expressions. For example, the telephone number field should only contain numbers between 0 and 9, the maximum size of the field should be 10 (integer), and no special characters and alphabets are allowed. Similarly, the email address, date of birth, and other fields are validated through the respective validation interceptors. Given that the data are automatically structured and cleanly inserted into the database tables, the study coordinators are able to request deidentified, randomized data extractions of surveys conducted over a desired period of time, to review the answers, proper completion of interviews, and pilot testing of the surveys. Such regular data monitoring activities allow the study team to identify data quality issues timely and ultimately enhance quality of collected data.

**DISCUSSION**

In response to the limitations of existing forms of data collection, we have developed a novel, adaptable, digital platform to conduct in-person interviews that is especially helpful in addressing barriers to research among minority older adults. Namely, this multilingual data collection, monitoring, and storage system helps to overcome issues related to linguistic and cultural differences, historical distrust in medical research, and access to participants. Regarding other barriers to conducting epidemiological survey-based research, our platform can additionally address issues related to data quality and monitoring, security, and streamlined data set preparation.

This innovative platform addresses multiple challenges related to collecting data in minority older adult populations (Table 2). All survey questions are accessible in programmed, translated languages during field operations, so interviewers can easily switch to the needed language and reduce the need to either provide impromptu translations and/or carry around
multiple hard copies of the survey in different languages. Especially, minority older adult populations have high proportions of those who do not speak English, and surveys that only use English are unable to represent the experiences of these minority populations.11-14 The data collection platform can be accessed via touch-screen tablet devices, which are less bulky and cumbersome for interviewers to navigate in the field. The handheld nature of these devices allows for greater eye contact between interviewer and participant, which, in turn, can improve interpersonal interviewing and data quality, as the interviewer and participant can focus more on “having a conversation” vs data collection and extraction. Furthermore, the platform ensures greater uniformity of collected data. Last, interviewers can recruit difficult-to-reach or busy individuals for study participation and immediately interview them while maintaining data quality and security, which reduces the potential burden of participation. Combined, these features have allowed our research team to collect high-quality survey data with an understudied and underserved population of minority older adults and have contributed to high follow-up interview rates.

For survey research, our data collection platform can also address concerns regarding data quality and monitoring, security, and streamlined data set preparation for analysis purposes. The platform has automatic built-in skip patterns to reduce interviewer error in the field. All collected data are immediately sent to our secure database server, and no data are stored on individual tablet devices, ensuring that data cannot be lost between collection and input into the database. In addition to the survey content, time stamps are recorded, so study coordinators can determine how long an individual survey took and whether questions were asked in order. These features allow study coordinators to systematically review the quality of the data and identify needs for supplemental trainings. Regarding data set preparation, variable naming and coding can be easily recorded in the database and can apply to

Figure 2. Interviewer interface during fieldwork. (A) Interview and participant selection home page. (B) Interview and participant selection home page in Chinese characters. (C) Interview table of contents and start page. (D) Sample question-and-answer selection interface, displaying a trigger question and single- and multiple-choice answers.
and abilities to program in multiple languages remove significant barriers to reaching, recruiting, and interviewing minority populations in the United States by alleviating physical barriers to data collection and allowing interviewers to focus on interviewing a participant more conversationally. Moving forward, this system can be adapted for off-line use and in many additional languages; the flexibility with this system can significantly reduce time and effort spent in study operations without sacrificing quality. Ultimately, we plan for this platform to be available to external researchers to assist in the collection, storage, and analytic processes of related projects.

CONCLUSION

Survey research is a cornerstone of epidemiological research. With advances in technology, data collection systems can be adapted and improved to address barriers to research facing minority and vulnerable populations. By alleviating some of the barriers to participation in research, researchers can leverage innovative data collection platforms and may be able to improve recruitment and retention of minority older adults and representativeness of study samples, thus leading to a better understanding of how to improve health and well-being of minority aging populations.

ACKNOWLEDGMENTS

Financial Disclosure: Dr Dong was sponsored by P30AG059304, R01AG042318, R01MD006173, R01NR014846, and R34MH100443.

Conflict of Interest: The authors have no conflicts to report.

Author Contributions: Study concept and design: Dong. Acquisition of data: Dong. Analysis and interpretation of data: Dong, Kong, Mendhe, and Bergren. Drafting of the manuscript: Dong, Kong, Mendhe, and Bergren.

Sponsor’s Role: The sponsors played no role in the preparation of the manuscript.

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OBJECTIVES: To examine the associations between violence experiences including phenotypes (psychological, physical/sexual abuse, financial exploitation, caregiver neglect) of child maltreatment (CM), intimate partner violence (IPV), and elder abuse (EA).


PARTICIPANTS: A total of 3157 community-dwelling older adults (aged ≥60 y).

MEASUREMENTS: Cases of CM, IPV, and EA.

RESULTS: Prevalence of violence was 11.4% for CM (physical/sexual = 10.2%; psychological = 2.4%), 6.5% for IPV (psychological = 5.3%; physical/sexual = 2.8%), and 15.2% for EA (caregiver neglect = 11.2%; psychological = 9.8%; financial exploitation = 9.3%; physical/sexual = 1.2%). After adjusting for potential confounding variables, CM psychological was associated with increased risks for IPV psychological (odds ratio [OR] = 7.60; 95% confidence interval [CI] = 4.29-13.45), IPV physical/sexual (OR = 4.06; CI = 1.71-9.63), EA psychological (OR = 3.79; 95% CI = 2.20-6.51), and EA financial exploitation (OR = 2.07; 95% CI = 1.12-3.81). CM physical/sexual was associated with increased risks for IPV physical/sexual (OR = 1.86; 95% CI = 1.02-3.38), EA psychological (OR = 1.70; 95% CI = 1.20-2.42), and EA financial exploitation (OR = 2.38; 95% CI = 1.72-3.30). IPV psychological and physical/sexual were associated with 5 to 8 times increased risks for EA psychological, 6 to 9 times increased risks for EA physical/sexual, and 3 times increased risks for EA financial exploitation.

CONCLUSION: Healthcare professionals working with older adults should be informed that a history of violence might further predispose a person to different types of EA. The cumulative impact of violence should also be considered when providing services or care to violence victims. J Am Geriatr Soc 67:S486–S492, 2019.

Key words: life course; interpersonal violence; elder abuse; child maltreatment; intimate partner violence

Child maltreatment (CM), intimate partner violence (IPV), and elder abuse (EA) are common types of interpersonal violence linked to increased morbidity, mortality, social, and healthcare costs. In addition, interpersonal violence was further categorized into phenotypes of psychological, physical, sexual, deprivation, and neglect that may differ in their manifestations, causes, and consequences.

Evidence suggests that EA affects 11% of older adults in the United States each year and is often underestimated due to methodological and reporting issues. To understand the interconnectedness of violence and prevent older people from experiencing psychological, physical, and sexual abuse, financial exploitation, and caregiver neglect, it is important to examine the antecedents of violence. Although research has examined multiple potential risk factors surrounding interpersonal violence, limited information is available regarding the direct effect of past violence experience on reexperiencing violence.

Studies found that early adversities have long-lasting effects on late-life socioeconomic status, health, and psychological well-being. More specifically, violence studies discovered a phenomenon of revictimization of sexual abuse among adults who were victims of childhood sexual abuse. However, revictimization has been insufficiently examined among the older populations, and less is known about the interconnectedness of different violence phenotypes over the life course, particularly among the rapidly growing minority populations.

Building on prior research, our study sought to examine the interconnectedness of life course violence among (1) CM and IPV, (2) CM and EA, and (3) IPV and EA within a Chinese older population in Chicago.
METHODS

Study Population

The present study used baseline data of the Population Study of Chinese Elderly in Chicago (PINE) project collected during 2011-2013 among a representative sample of the Chinese aging population in the greater Chicago area. The eligibility criteria included community-dwelling older adults aged 60 years and older and older adults who were self-identified as Chinese. With informed written consent, participants were interviewed face to face in the language of their preference (Cantonese, Toishanese, Mandarin, or English). Data were collected using web-based software that recorded English and Chinese (traditional/simplified) simultaneously. The study was approved by the institutional review board of the Rush University Medical Center.

Dependent Variable: Phenotypes of Elder Abuse

Primary outcomes were self-reported phenotype EA cases including psychological, physical, and sexual abuse, financial exploitation, and caregiver neglect measured by 56 items. Psychological and physical abuse were assessed by eight and ten items from the Conflict Tactic Scale, respectively. Sexual abuse was assessed by a question asking about experiences of being touched in private areas when unwanted. Financial exploitation was assessed by 17 items. Caregiver neglect was assessed by 20 items of unmet needs in key activities of daily living among individuals living with at least one person. Affirmative response(s) to any item were considered EA cases. The measurement was reviewed by a community advisory board of more than 20 community organizations led by a geriatrician and showed good content, convergent, and predictive validity.

Independent Variable: Child Maltreatment and Intimate Partner Violence

We used the 5-item Extended Hurt-Insult-Threaten-Scream (E-HITS) scale to assess psychological, physical, and sexual aspects of CM (before age 18 y) and IPV (within age range 18-59 y). Participants were asked to recall whether they had been physically hurt, insulted, threatened with harm, screamed and cursed at, and a private part touched when it was unwanted during each age-related period. Experience of any of the items was considered CM or IPV cases. The E-HITS scale was administered among a Chinese population to assess IPV, which suggested adequate internal consistency, concurrent, and discriminant validity.

Confounding Variables

Basic sociodemographic and general well-being information were controlled for analysis as potential confounding variables. Basic sociodemographic information included age (years), sex (male and female), education (years of education completed), personal annual income (US dollars), marital status (married or not married), living arrangement (number of people lived with), years in the United States, number of children, country of origin (mainland China, Hong Kong, Taiwan, United States/Canada, or others), and language preferences (Cantonese/Toishanese or Mandarin/English). Overall health status, quality of life, and health changes were measured using three questions extracted from the Short Form-36 Health Survey, which has been translated and tested in Chinese populations.

Data Analysis

We used $\chi^2$ tests to compare the experience of IPV by the presence of CM and EA by the presence of CM and IPV. To further determine the associations between CM with IPV, CM with EA, and IPV with EA, we computed multiple logistic regression models with an increasing number of covariates. Covariates in the fully adjusted model included all confounding variables as previously described. Additionally, we regressed CM and IPV in the same models to test their independent associations with EA phenotypes. The results showed no major change in terms of the significance of the associations. All statistical analyses were conducted using SAS v.9.2 (SAS Institute Inc, Cary, NC).

RESULTS

Frequencies of Intimate Partner Violence by Child Maltreatment

The prevalence of CM was 11.4%, with 10.2% physical/sexual and 2.4% psychological abuse. The prevalence of IPV was 6.5%, with 5.3% psychological and 2.8% physical/sexual abuse. Table 1 presents the frequencies of IPV by the presence of CM. Overall, IPV was more prevalent among individuals

<table>
<thead>
<tr>
<th>Intimate partner violence</th>
<th>Psychological</th>
<th>Physical/Sexual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Any, n (%)</td>
<td>None, n (%)</td>
</tr>
<tr>
<td>Child maltreatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any</td>
<td>20 (26.3)</td>
<td>56 (73.7)</td>
</tr>
<tr>
<td>None</td>
<td>144 (4.7)</td>
<td>2916 (95.3)</td>
</tr>
<tr>
<td>Physical/Sexual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any</td>
<td>24 (7.5)</td>
<td>297 (92.5)</td>
</tr>
<tr>
<td>None</td>
<td>141 (5.0)</td>
<td>2681 (95.0)</td>
</tr>
</tbody>
</table>
with CM experiences (26.3% vs 4.7%; 9.2% vs 2.6%; 5.0% vs 2.5%).

Frequencies of Child Maltreatment and Intimate Partner Violence by Elder Abuse

The prevalence of EA was 15.2%, with 11.2% caregiver neglect, 9.8% psychological, 9.3% financial exploitation, and 1.2% physical/sexual abuse. Table 2 shows the frequencies of EA by CM and IPV. In general, EA (psychological, physical/sexual, financial exploitation) was more prevalent among individuals who indicated CM and IPV experiences.

Associations between Child Maltreatment, Intimate Partner Violence, and Elder Abuse

Tables 3, 4, and 5 present the fully adjusted model results of associations between CM, IPV, and EA. In general, CM, IPV, and EA were positively associated with exceptions in certain phenotypes. In Table 3, CM psychological was positively associated with IPV psychological (OR = 7.60; 95% CI = 4.29-13.45) and IPV physical/sexual (OR = 4.06; 95% CI = 1.71-9.63). CM physical/sexual was positively associated with IPV physical/sexual (OR = 1.86; 95% CI = 1.02-3.38). In Table 4, CM psychological was positively associated with EA psychological (OR = 3.79; 95% CI = 2.20-6.51) and EA financial exploitation (OR = 2.38; 95% CI = 1.72-3.30). Table 5 shows that IPV psychological and physical/sexual abuse were positively associated with all EA phenotypes except caregiver neglect. IPV psychological and physical/sexual were associated with 5 to 8 times increased risks for EA psychological, 6 to 9 times increased risks for EA physical/sexual, and 3 times increased risks for EA financial exploitation.

DISCUSSION

The study evaluated life course interpersonal violence experiences among a US Chinese population. It demonstrated that victimization can repeat across the life course in forms of various violence phenotypes including psychological, physical/sexual abuse, and financial exploitation.

According to the findings, psychological abuse may persist across three different life stages. Individuals with a history of CM psychological were at 4 times a higher risk of reexperiencing IPV and EA psychological abuse. Individuals with a history of IPV psychological were at an 8 times higher risk of reexperiencing EA psychological abuse. Studies found that children who experienced psychological abuse are more likely to develop poor emotional health and social skills as adults, perhaps challenging interpersonal relationships and exposing them to greater risks of subsequent violence.

Physical/sexual abuse was also found to persist across the life course. Individuals with a history of childhood physical/sexual abuse were at 2 times higher risk of reexperiencing IPV physical/sexual, and individuals with a history of IPV physical/sexual were at 9 times higher risk of reexperiencing EA physical/sexual abuse. It is interesting
to note that female sex and currently not being married were positively associated with IPV physical/sexual but had no significant association with EA physical/sexual abuse. This indicates that although IPV cases may involve more women physically or sexually abused in marital or romantic relationships, EA physical/sexual abuse may involve more cases perpetrated by persons other than a partner.

These findings expanded our understanding of the phenomenon of revictimization that was predominantly examined in sexual abuse research among younger cohorts.13,30 Discussions about the mechanism of revictimization were focused on individual-level aspects. For instance, it was argued that victims might develop a sense of helplessness and unworthiness that leads to higher risks of further violence.31-34 It is important for future conceptualizations and empirical studies to examine multilevel conditions and factors that might contribute to repeated violence.

Another interesting finding is that psychological and physical/sexual abuse (CM and IPV) experiences were associated with 2 to 3 times higher risks of experiencing EA financial exploitation. Prior longitudinal analyses examining individual-level aspects (eg, sociodemographics and financial knowledge) found little about predictive factors of financial exploitation.32-34 Future research may consider how financial exploitation coexists and interacts with other forms of violence. More importantly, contextual and accumulative adversities experienced by the victims need to be evaluated for their relations with financial exploitation as potential risk factors.

Unlike other EA subtypes, caregiver neglect had no significant association with any past violence experiences. The contrast aligns with previous findings and indicates that risk factors may vary across different phenotypes.35,36 It is interesting that childhood witnessing and directly experiencing violence were linked to higher risks of experiencing EA caregiver neglect in other studies36,37 but not in the Chinese population.

In the context of immigration and traditional Confucian filial piety, adult children are often primary caregivers of older adults in a family. We suspect that familial factors such as children caregiver burden, acculturation discrepancy, and the intergenerational gap may play particularly important roles in caregiving among Chinese families.38-43

Our research has limitations, and the findings should be interpreted with caution. First, self-reported violence data depending on retrospective memories might be subject to recall and report bias. Second, accuracies of using the E-HITS to measure CM and IPV among the US Chinese population warrant further psychometric examinations. A few phenotypes of violence were not captured by the E-HITS such as childhood neglect. Third, IPV and EA physical and sexual abuse cases were rarely reported, and therefore we were not able to analyze them as separate phenotypes. Closer examinations are needed for both groups in future studies. Fourth, several potential confounders of violence were not available, such as sexuality, immigration status, other adverse life events, and perpetrator characteristics. Fifth, our cross-sectional data were unable to determine how IPV might mediate the relationship between CM and EA. Longitudinal studies are needed for mediation analyses. Last, even though personal annual income was controlled to recall and report bias. Second, accuracies of using the E-HITS to measure CM and IPV among the US Chinese population warrant further psychometric examinations. A few phenotypes of violence were not captured by the E-HITS such as childhood neglect. Third, IPV and EA physical and sexual abuse cases were rarely reported, and therefore we were not able to analyze them as separate phenotypes. Closer examinations are needed for both groups in future studies. Fourth, several potential confounders of violence were not available, such as sexuality, immigration status, other adverse life events, and perpetrator characteristics. Fifth, our cross-sectional data were unable to determine how IPV might mediate the relationship between CM and EA. Longitudinal studies are needed for mediation analyses. Last, even though personal annual income was controlled as a potential confounder, additional income information (eg, household income) should be collected in future studies for a better representation of socioeconomic status.

Despite the limitations, the study has practical implications for professionals working with older populations. In primary care settings, EA cases without noticeable injuries (eg, psychological abuse) are likely to remain undetected. Limited evidence is available for accuracies, effectiveness, benefits, and harms for screening and intervention of interpersonal violence.44-46 By acknowledging the linkages of violence over the life course, professionals could be more aware that a history of violence might indicate higher risks

Table 3. Associations between Child Maltreatment with Intimate Partner Violence

<table>
<thead>
<tr>
<th></th>
<th>IPV psychological</th>
<th>IPV Physical/sexual</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR (95%CI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>.96 (0.94-0.99)**</td>
<td>.97 (0.94-0.99)**</td>
</tr>
<tr>
<td>Sex</td>
<td>1.01 (0.99-1.14)</td>
<td>1.00 (0.99-1.10)</td>
</tr>
<tr>
<td>Education, y</td>
<td>.97 (0.93-1.01)</td>
<td>.97 (0.93-1.01)</td>
</tr>
<tr>
<td>Personal annual income</td>
<td>1.12 (0.99-1.28)</td>
<td>1.12 (0.99-1.27)</td>
</tr>
<tr>
<td>Living arrangement</td>
<td>.92 (0.83-1.02)</td>
<td>.92 (0.83-1.02)</td>
</tr>
<tr>
<td>Marital status</td>
<td>.42 (0.26-0.66)***</td>
<td>.43 (0.30-0.64)***</td>
</tr>
<tr>
<td>Children, n</td>
<td>.95 (0.84-1.08)</td>
<td>.94 (0.84-1.07)</td>
</tr>
<tr>
<td>Years in United States</td>
<td>.99 (0.98-1.01)</td>
<td>.99 (0.98-1.01)</td>
</tr>
<tr>
<td>Country of origin China</td>
<td>.50 (0.30-0.84)**</td>
<td>.45 (0.27-0.74)**</td>
</tr>
<tr>
<td>Cantonese/Toishanese preferred language</td>
<td>.42 (0.26-0.69)**</td>
<td>.42 (0.24-0.81)**</td>
</tr>
<tr>
<td>HS</td>
<td>1.40 (1.12-1.76)**</td>
<td>1.42 (1.13-1.77)**</td>
</tr>
<tr>
<td>HC preceding year</td>
<td>1.08 (0.87-1.35)</td>
<td>1.08 (0.87-1.34)</td>
</tr>
<tr>
<td>QOL</td>
<td>1.07 (0.83-1.39)</td>
<td>1.07 (0.83-1.38)</td>
</tr>
<tr>
<td>CM Psychological</td>
<td>7.60 (4.29-13.45)***</td>
<td>4.06 (1.71-9.63)**</td>
</tr>
<tr>
<td>CM Physical/sexual</td>
<td>1.43 (0.89-2.29)</td>
<td>1.46 (0.89-2.38)**</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; CM, child maltreatment; HC, health changes; HS, health status; IPV, intimate partner violence; OR, odds ratio; QOL, quality of life.

*P < .05, **P < .01, ***P < .001.
### Table 4. Associations between Child Maltreatment and Elder Abuse

<table>
<thead>
<tr>
<th></th>
<th>EA psychological</th>
<th>EA physical/sexual</th>
<th>EA financial exploitation</th>
<th>Caregiver neglect</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR (95% CI)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>.99 (.97-1.01)</td>
<td>.99 (.97-1.01)</td>
<td>.98 (.93-1.03)</td>
<td>.99 (.97-1.01)</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td>1.51 (1.14-1.99)**</td>
<td>1.52 (1.15-2.01)**</td>
<td>1.45 (0.93-3.02)</td>
<td>.60 (.45-0.79)</td>
</tr>
<tr>
<td>Education, y</td>
<td>1.05 (1.02-1.09)**</td>
<td>1.05 (1.02-1.06)**</td>
<td>1.05 (9.61-1.15)</td>
<td>1.07 (1.03-1.10)</td>
</tr>
<tr>
<td>Personal annual income</td>
<td>.92 (.81-1.03)</td>
<td>.92 (.81-1.03)</td>
<td>.74 (4.81-1.3)</td>
<td>.73 (4.71-1.2)</td>
</tr>
<tr>
<td>Living arrangement</td>
<td>.97 (.90-1.04)</td>
<td>.96 (.90-1.04)</td>
<td>.72 (5.55-95)*</td>
<td>.72 (5.55-95)*</td>
</tr>
<tr>
<td>Marital status</td>
<td>.82 (.61-1.11)</td>
<td>.83 (.61-1.11)</td>
<td>1.27 (5.52-94)</td>
<td>1.27 (5.52-94)</td>
</tr>
<tr>
<td>Children, n</td>
<td>.95 (.86-1.04)</td>
<td>.95 (.86-1.04)</td>
<td>1.11 (1.87-1.41)</td>
<td>1.11 (1.87-1.41)</td>
</tr>
<tr>
<td>Years in United States</td>
<td>1.00 (.99-1.01)</td>
<td>1.00 (.99-1.01)</td>
<td>.99 (.96-1.03)</td>
<td>1.02 (1.01-1.03)**</td>
</tr>
<tr>
<td>Country of origin China</td>
<td>.70 (.45-1.06)</td>
<td>.66 (.43-1.02)</td>
<td>.35 (1.28-89)</td>
<td>.35 (1.28-89)</td>
</tr>
<tr>
<td>Cantonese/Toishanese preferred language</td>
<td>.60 (4.94-84)**</td>
<td>.61 (4.84-85)**</td>
<td>.55 (2.29-133)</td>
<td>.55 (2.29-133)*</td>
</tr>
<tr>
<td><strong>HS</strong></td>
<td>1.45 (1.23-1.72)**</td>
<td>1.45 (1.22-1.79)**</td>
<td>1.63 (1.04-2.57)*</td>
<td>1.63 (1.04-2.57)*</td>
</tr>
<tr>
<td><strong>HC</strong></td>
<td>1.07 (.91-1.26)</td>
<td>1.07 (.91-1.26)</td>
<td>.95 (6.31-44)</td>
<td>.95 (6.31-44)</td>
</tr>
<tr>
<td><strong>QOL</strong></td>
<td>.99 (82.1-20)</td>
<td>1.01 (83.1-22)</td>
<td>1.41 (84.2-35)</td>
<td>1.41 (84.2-35)</td>
</tr>
<tr>
<td><strong>CM Psychological</strong></td>
<td>3.79 (2.2-6.51)**</td>
<td>3.88 (2.12-6.44)</td>
<td>2.07 (1.32-3.81)*</td>
<td>2.07 (1.32-3.81)*</td>
</tr>
<tr>
<td><strong>CM Physical/sexual</strong></td>
<td>1.70 (1.20-2.42)**</td>
<td>2.01 (84.84)</td>
<td>2.38 (1.72-3.30)**</td>
<td>2.38 (1.72-3.30)**</td>
</tr>
</tbody>
</table>

**Abbreviations:** CI, confidence interval; CM, child maltreatment; EA, elder abuse; HC, health changes; HS, health status; OR, odds ratio; QOL, quality of life.

*P < .05, **P < .01, ***P < .001.

### Table 5. Associations between Intimate Partner Violence and Elder Abuse

<table>
<thead>
<tr>
<th></th>
<th>EA Psychological</th>
<th>EA Physical/Sexual</th>
<th>EA Financial exploitation</th>
<th>Caregiver neglect</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR (95% CI)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>1.00 (.98-1.01)</td>
<td>.99 (.98-1.01)</td>
<td>.98 (.93-1.03)</td>
<td>.99 (.97-1.01)</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td>1.52 (1.14-2.01)**</td>
<td>1.40 (1.06-1.85)**</td>
<td>1.29 (6.1-72)</td>
<td>1.29 (6.1-72)</td>
</tr>
<tr>
<td>Education, y</td>
<td>1.06 (1.02-1.09)**</td>
<td>1.05 (1.02-1.09)**</td>
<td>1.05 (9.61-15)</td>
<td>1.05 (9.61-15)</td>
</tr>
<tr>
<td>Personal annual income</td>
<td>.88 (7.81-100)*</td>
<td>.92 (8.1-103)</td>
<td>.73 (48.1-10)</td>
<td>.73 (48.1-10)</td>
</tr>
<tr>
<td>Living arrangement</td>
<td>.98 (91.1-6)</td>
<td>.96 (80.1-104)</td>
<td>.72 (5.54-94)</td>
<td>.72 (5.54-94)*</td>
</tr>
<tr>
<td>Marital status</td>
<td>.98 (72.1-35)</td>
<td>.88 (6.5-120)</td>
<td>1.58 (6.73-370)</td>
<td>1.58 (6.73-370)</td>
</tr>
<tr>
<td>Children, n</td>
<td>.95 (86-105)</td>
<td>.94 (86-105)</td>
<td>1.14 (89-146)</td>
<td>1.14 (89-146)</td>
</tr>
<tr>
<td>Years in United States</td>
<td>1.00 (.99-1.01)</td>
<td>1.00 (.99-1.01)</td>
<td>.99 (91.6-103)</td>
<td>.99 (91.6-103)</td>
</tr>
<tr>
<td>Country of origin China</td>
<td>.73 (47-115)</td>
<td>.65 (42-101)</td>
<td>.36 (13-98)*</td>
<td>.36 (13-98)*</td>
</tr>
<tr>
<td>Cantonese/Toishanese preferred language</td>
<td>.70 (50-150)*</td>
<td>.65 (47-92)*</td>
<td>.61 (24-150)</td>
<td>.61 (24-150)</td>
</tr>
<tr>
<td><strong>HS</strong></td>
<td>1.40 (1.18-1.66)**</td>
<td>1.42 (1.20-1.69)**</td>
<td>1.52 (9.26-24)</td>
<td>1.52 (9.26-24)</td>
</tr>
<tr>
<td><strong>HC</strong></td>
<td>1.06 (90-126)</td>
<td>1.07 (91-126)</td>
<td>.94 (62-143)</td>
<td>.94 (62-143)</td>
</tr>
<tr>
<td><strong>QOL</strong></td>
<td>.98 (80-19)</td>
<td>1.00 (82-21)</td>
<td>1.40 (83-234)</td>
<td>1.40 (83-234)</td>
</tr>
<tr>
<td><strong>IPV Psychological</strong></td>
<td>7.81 (5.44-11.2)**</td>
<td>5.66 (2.56-12.51)**</td>
<td>2.55 (1.67-3.90)**</td>
<td>2.55 (1.67-3.90)**</td>
</tr>
<tr>
<td><strong>IPV Physical/sexual</strong></td>
<td>4.76 (2.93-7.74)**</td>
<td>8.54 (5.33-20.64)**</td>
<td>3.00 (1.74-5.17)**</td>
<td>3.00 (1.74-5.17)**</td>
</tr>
</tbody>
</table>

**Abbreviation:** CI, confidence interval; CM, child maltreatment; EA, elder abuse; IPV, intimate partner violence; HC, health changes; HS, overall health status; OR, odds ratio; QOL, quality of life.

*P < .05, **P < .01, ***P < .001.
of experiencing repeated violence. It is also important for professionals to consider the cumulative effect of violence on victims and incorporate it into their practice.

With respect to research, more longitudinal studies could enhance our understanding of risk factors of different types of interpersonal violence and further inform targeted prevention and intervention strategies. These strategies ought to be tested through rigorously designed randomized controlled trials regarding their benefits and harms. As indicated by this study, violence experiences should be studied in multilevel and life course frameworks to better understand how adversities might accumulate with age and contribute to disparities in late-life safety, health, and well-being.

In part due to the “model minority” stereotype, aging Asian Americans have been underrepresented in research addressing health disparities. Together with the research gap, several social and cultural barriers have hindered the development of appropriate and effective screening and intervention tools. For example, violence might be unreported in the presence of a higher social tolerance of violence, collectivist emphasis on family harmony, the concept of saving face, and stigmatization toward victims in the Chinese communities.

The present findings challenge the so-called model minority stereotype by showing that violence is a prevalent and long-lasting phenomenon among the US Chinese population. More efforts are necessary to understand the sociocultural contexts of violence and to transfer the knowledge into culturally relevant resources for racial/ethnic minority populations.

In conclusion, the study presents evidence about the interconnectedness of life course violence that has practical implications for social service and healthcare providers. Researchers, practitioners, and policymakers should coordinate their efforts for systematic knowledge and solutions for violence and enhance health equity among diverse aging populations.

ACKNOWLEDGMENTS

Author Contributions: Study concept and design; collection, management, analysis, and interpretation of the data; and preparation of the manuscript: Wang and Dong.

Conflicts of Interest: The authors have declared no potential conflicts of interest regarding the research, authorship, and/or publication of this article.

Sponsor’s Role: Xinqi Dong was sponsored by P30AG059304, R01AG042318, R01MD006173, R01NR014846, R34MH100443, R34MH100393, 90EJI00015, and 90EJI00016. The sponsors had no role in the design, conduct, writing, or decision to publish this manuscript. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or the Administration for Community Living.

REFERENCES

Typology of Family Relationship and Elder Mistreatment in a US Chinese Population

Mengting Li, PhD,*† Man Guo, PhD,‡ Meredith Stensland, PhD,‡ Merril Silverstein, PhD,§¶ and XinQi Dong, MD, MPH*

OBJECTIVES: To examine the associations between typology of family relationship and risk of elder mistreatment (EM).

DESIGN: Population-based epidemiological cross-sectional study.

SETTING: Community-dwelling older adults in the greater Chicago area.

PARTICIPANTS: A total of 3157 US older Chinese immigrants.

MEASUREMENTS: EM was measured by a brief screening tool. Latent class analysis was used to construct typologies of family relationship from eight indicators, evaluating the structural, associational, functional, affectual, and normative aspects of family relationship. Logistic regression models were used to test the associations between typology of family relationship and EM.

RESULTS: Unobligated ambivalent type (44.77%) was the most common family type among US older Chinese immigrants. The prevalence of EM was around 15%, with 475 participants reporting experience of EM. Unobligated ambivalent (odds ratio [OR] = 1.90; 95% confidence interval [CI] = 1.54-2.34) and detached (OR = 1.78; 95% CI = 1.32-2.42) family types were associated with greater risk of EM; tight-knit (OR = .34; 95% CI = .27-.44) family type was associated with lower risk of EM. The relationship between commanding conflicted family type and EM was not significant.


Key words: elder mistreatment; family relationship; intergenerational relations; latent class analysis; Chinese

The National Center of Elder Abuse defines elder mistreatment (EM) as any knowing, intended, or careless act that causes harm or serious risk of harm to an older person—physically, mentally, emotionally, or financially. EM is associated with significant adverse health outcomes. Family is the fundamental social institution in which older adults are embedded. While serving the needs of older family members, the family is also an important context for studies on EM. Older adults who receive greater assistance from family were at a higher risk of EM. Many EM victims preferred to endure abusive situations to avoid direct confrontation and to preserve family harmony and face. Because family is a critical setting where EM takes place, research to understand family dynamics and EM is important for prevention and intervention strategies of EM.

Early research on family relationship and EM often focused on one or two indicators of relations. For example, high family stress and low cohesion were found to be associated with EM. A shared living environment was associated with higher risks of EM. However, individuals are engaged in different dimensions of family relationship simultaneously. It is difficult to understand the associations between family relationship and EM without considering the linkage among different dimensions of relations and the underlying family structure manifested by a combination of individual dimensions. It remains unclear how multiple dimensions of family relationship would affect EM.

To address this gap, a typology approach that examines the overall patterns of multifaceted social relations/behaviors

From the *Institute for Health, Health Care Policy and Aging Research Rutgers, The State University of New Jersey, New Brunswick, New Jersey; †School of Nursing, Rutgers, The State University of New Jersey, New Brunswick, New Jersey; ‡School of Social Work, University of Iowa, Iowa City, Iowa; †School of Sociology, Maxwell School of Citizenship and Public Affairs, Syracuse University, Syracuse, New York; and the §Department of Human Development and Family Science, David B. Falk College of Sport and Human Dynamics, Syracuse University, Syracuse, New York.

Address correspondence to Mengting Li, PhD, Institute for Health, Health Care Policy and Aging Research, Rutgers The State University of New Jersey, 112 Paterson Street, 4th Floor, New Brunswick, NJ 08901. E-mail: mengting.lj@rutgers.edu

DOI: 10.1111/jgs.15892
is a useful tool to understand the complex family relationship.16 By not assuming a unitary construct from different dimensions, the typology approach is better able to capture the complexity and variation in the bundle of attributes that make up the family relationship. As a typology method, latent class analysis (LCA) is a person-centered approach that groups units of analysis (ie, family relationship in this study) based on similarities in the patterned interdependencies of the characteristics that describe them.17 Built on the results of prior research on the typological structure of family relationships among Chinese older adults, this study examined the potential linkages between different structures of family relationships and the likelihood of older adults experiencing EM. Guided by the intergenerational solidarity paradigm,18 we examined the combinations of solidarity components, including structural, associational, functional, emotional, and normative relations, to capture the complexity and variation of family relationship.19

Demographic shifts in older populations in the United States call for research and policy to deepen understanding of the aging experience of minority older adults. Chinese Americans constitute the largest segment of the Asian American population.25 US older Chinese immigrants rely heavily on their families due to language and cultural barriers, which put them at a higher risk to experience EM.21-23 Meanwhile, immigration and acculturation processes have profound effects on the family relationship of minority older adults.24 In prior research using our study sample, four family types were identified: tight-knit, unobligated ambivalent, detached, and commanding conflicted.19 Tight-knit family type is a traditional Chinese family type that highlights filial piety and social exchange between generations. Unobligated ambivalence is described as lack of traditional family norms of filial piety, together with coexistence of contradictory feelings about the relationship, featured by both high emotional closeness and high family conflict. Detached family type is characterized by low intergenerational engagement on all the domains. Commanding conflicted family type refers to predominantly upward support and high family conflicts between aging parents and adult children.

This research examines the associations between these four typologies of family relationship and EM among US older Chinese immigrants. Specifically, we tested two hypotheses: (1) Older adults in the tight-knit family type were less likely to experience EM, and (2) older adults in unobligated ambivalent, detached, and commanding conflicted family types were more likely to experience EM.

METHODS

Sample

Data were derived from the Population Study of Chinese Elderly (PINE), a community-engaged, population-based epidemiological study from 2011 to 2013 of US older Chinese immigrants 60 years and older in the greater Chicago area. Participants were self-reported as Chinese, and the baseline cohort was 3157 people, with a response rate of 91.9%.25-27 Face-to-face home interviews were conducted by trained multicultural and multilingual interviewers. The study was approved by the institutional review board at Rush University Medical Center in Chicago, Illinois. Written informed consent was obtained from all participants.

Dependent Variable

Elder Mistreatment Screener

To screen EM, we used a 10-item instrument (score range = 0-10) modified from the Hwalek-Sengstock Elder Abuse Screening Test (H-S/EAST)28 and the Vulnerability to Abuse Screening Scale (VASS).29 Participants were asked whether the listed mistreatment instances have happened to them since they were 60 years old: (1) family conflicts at home, (2) felt uncomfortable with someone in the family, (3) felt that nobody wanted them around, (4) been told by someone that they gave too much trouble, (5) been afraid of someone in the family, (6) felt that someone close tried to hurt or harm them, (7) been made to stay in bed or been told they were sick when they were not, (8) been called names or put down, (9) been forced by someone to do things, and (10) had belongings taken without permission. To protect the privacy of participants and ensure the quality of EM data, the interview was conducted at the participants’ homes without family members nearby. The modified scale from H-S/EAST and VASS demonstrated good reliability in our sample, with a Cronbach α of .80.

Independent Variable

Typology of Family Relationship

Our prior study used LCA to construct typologies of family relationship.19 Indicators for LCA are commonly dichotomized to prevent problems with sparseness.30 Eight indicators for measuring structural, associational, functional, affectual, and normative aspects of family relationship were dichotomized in the present study: (1) living arrangement (1 = living with children), (2) frequency of contact (1 = having weekly contact with children), (3) upward support (1 = children helped with activities of daily living or instrumental activities of daily living), (4) downward support (1 = taking care of grandchildren), (5) emotional closeness (1 = feeling very or extremely close to children), (6) conflict (1 = children being demanding or critical), (7) filial expectation (1 = having high filial expectation), and (8) filial receipt (1 = children provided high filial piety). The model specification and evaluation were described elsewhere.19 Through comparing the Akaike information criterion (AIC) and the Bayesian information criterion (BIC), the four-class model was chosen, representing unobligated ambivalent, tight-knit, detached, and commanding conflicted types. We created four dichotomized variables for each family type and examined the relationships between the four typologies of family relationship and EM.

Covariates

Covariates included demographic factors, socioeconomic status, and health-related factors. Demographic factors used in the analyses were age (in years) and sex (self-reported). Economic status measures were composed of education (years of education completed) and annual personal income. Medical comorbidities were measured by a
count of diseases including heart disease, stroke, cancer, high cholesterol, diabetes, high blood pressure, fractured hip, thyroid disease, and osteoarthritis.

Data Analysis
Multivariate logistic regression models were used to test the associations between typologies of family relationship and EM. Model A was adjusted for age and sex. Education and income were added to model B. Model C added medical comorbidities to the previous model. In addition, all models (models A-C) were repeatedly using each family typology with respect to EM outcomes. Odds ratios (ORs), 95% confidence intervals (CIs), and significance levels were reported for multivariate analyses. All statistical analyses were conducted using SAS software v.9.4 (SAS Institute, Cary, NC).

RESULTS
The study sample had a mean age of 72.8 years (standard deviation [SD] = 8.3 y). More than half of the participants (57.9%) were female. Most participants (78.9%) had the equivalent or less of a high school education. Most of them (85.1%) had an annual income of less than US $10000. The two most common family types among US older Chinese immigrants are unobligated ambivalent (44.77%) and traditional tight-knit (40.11%), followed by detached (10.28%) and commanding conflicted (4.84%).

The prevalence of EM in our study sample was about 15%, with 475 of 3157 participants reporting experience of EM. The results of bivariate analyses showed older adults with EM and those who did not experience EM differed significantly in their likelihood of having three types of family relations: unobligated ambivalent, tight-knit, and detached. Older adults with tight-knit family relations were less likely to report EM (7.85%), followed by those who had commanding conflicted (14.96%), unobligated ambivalent (19.51%), and detached family relations (21.79%) (Table 1). Education, medical comorbidities, and unobligated ambivalent, tight-knit, and detached typologies had significant correlations with EM (Table 2).

With respect to the relationship between typology of family relationship and EM while controlling for other covariates, unobligated ambivalent (OR = 1.90; 95% CI = 1.54-2.34) and detached (OR = 1.78; 95% CI = 1.32-2.42) family types were associated with greater risk of EM; tight-knit (OR = 0.34; 95% CI = 0.27-0.44) family type was associated with lower risk of EM. The relationship between commanding conflicted family type and EM was not significant (Table 3).

DISCUSSION
Due to the demographic development of increased life expectancy, the shared life span of parents and adult children is extended. This is not only an opportunity, but also a risk for the arrangement of intergenerational relations, resulting in a series of consequences related to older adults’ health and well-being. Our study is among the first to examine the relationship between typology of family relationship and EM among US older Chinese immigrants. Supporting our first hypothesis, we found that tight-knit type is a protective family type against EM for older immigrants. Partially supporting our second hypothesis, the results further showed that unobligated ambivalent and detached family types were associated with higher risks of EM.

Older immigrants in tight-knit families enjoyed close relationship with adult children and received high instrumental support from them. Caregiver burden is a significant risk factor associated with EM and mental health. However, in tight-knit families, adult children may interpret caregiving as less burdensome due to their filial values. An existing study showed tight-knit type was the most stable family type and less likely to change to other family types over time. Future research could investigate whether tight-knit family type could prevent EM over time.

As the most common family type among US older Chinese immigrants, unobligated ambivalent is a family type unique to immigrant families. The experience of ambivalence possibly evokes stress and consequently diminishes well-being. Immigrant parents and children may experience different paces of acculturation, and the cultural value discrepancies result in misunderstandings and ambivalence. Lack of filial obligation was one of the salient characteristics of unobligated ambivalence families in our sample. The erosion of filial piety values may make older adults more susceptible to EM and had negative impacts on mental health. At any given point in the life course, family relationship can be in a relative state of conflict or solidarity, depending on how ambivalence has been resolved. Family-focused interventions could help resolve ambivalence in family relationships. Early research suggested using strategies such as confrontation, rationalization, and acceptance to resolve ambivalence. Older family members are likely to have limited options in negotiating ambivalence. Social policy could provide more resources for them to relieve ambivalence.

Detached type was an isolated family typology with adult children being less engaged with their aging parents across all dimensions of solidarity. The isolated environments put older adults in vulnerable situations. Studies consistently

<table>
<thead>
<tr>
<th>Table 1. Characteristics of Participants by EM</th>
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<tr>
<td>Age, y, mean ± SD</td>
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<tr>
<td>Education, y, n (%)</td>
</tr>
<tr>
<td>Income, n (%)</td>
</tr>
<tr>
<td>Medical comorbidities, mean ± SD</td>
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<tr>
<td>Unobligated ambivalent type, n (%)</td>
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<tr>
<td>Tight-knit type, n (%)</td>
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<tr>
<td>Detached type, n (%)</td>
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<tr>
<td>Commanding conflicted type, n (%)</td>
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</tbody>
</table>
suggested that isolation and a lack of social support were important risk factors for EM.2,43 One study in Chicago found that having a social network size of fewer than two persons was associated with greater risk of EM.44 A study targeting Chinese older adults reported that being isolated from others was significantly associated with self-reported EM.45 Home care providers are suggested to identify isolated elders, provide medical care, and arrange support.

In our sample, commanding conflicted families were characterized by high family conflicts and authoritative status of aging parents with predominantly upward support and high filial expectation. The political economic theory suggested that the changing role of older adults removes them from the workforce and reduces their independence. They are gradually marginalized in their families, thereby leading to potential for EM.46 In contrast, the high status of older adults in commanding conflicted families may protect them against EM. Compared with detached families, commanding conflicted families kept higher level of intergenerational exchange, although sometimes negative exchange. The way of openly

Table 2. Correlation Matrix Between Study Variables

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Female</th>
<th>Education</th>
<th>Income</th>
<th>Medical comorbidities</th>
<th>Unobligated ambivalent type</th>
<th>Tight-knit type</th>
<th>Detached type</th>
<th>Commanding conflicted type</th>
<th>EM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>−0.03</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td>−0.06&lt;sup&gt;a&lt;/sup&gt;</td>
<td>−0.19&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.00</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Income</strong></td>
<td>0.05&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.04&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.01</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Medical comorbidities</strong></td>
<td>0.24&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.05&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.10</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unobligated ambivalent type</strong></td>
<td>−0.02</td>
<td>−0.01</td>
<td>−0.05&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.03</td>
<td>−0.00</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tight-knit type</strong></td>
<td>−0.01</td>
<td>0.08&lt;sup&gt;a&lt;/sup&gt;</td>
<td>−0.05&lt;sup&gt;b&lt;/sup&gt;</td>
<td>−0.08&lt;sup&gt;a&lt;/sup&gt;</td>
<td>−0.02</td>
<td>−0.75&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Detached type</strong></td>
<td>0.02</td>
<td>−10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.03</td>
<td>0.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>−0.02</td>
<td>−0.32&lt;sup&gt;a&lt;/sup&gt;</td>
<td>−0.26&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Commanding conflicted type</strong></td>
<td>0.02</td>
<td>−0.02</td>
<td>−0.05&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.02</td>
<td>−0.02</td>
<td>−0.19&lt;sup&gt;a&lt;/sup&gt;</td>
<td>−0.16&lt;sup&gt;a&lt;/sup&gt;</td>
<td>−0.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.00</td>
<td></td>
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<tr>
<td><strong>EM</strong></td>
<td>−0.00</td>
<td>0.03</td>
<td>0.16&lt;sup&gt;a&lt;/sup&gt;</td>
<td>−0.00</td>
<td>0.05&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>−0.16&lt;sup&gt;a&lt;/sup&gt;</td>
<td>−0.06&lt;sup&gt;a&lt;/sup&gt;</td>
<td>−0.01</td>
<td>1.00</td>
</tr>
</tbody>
</table>

<sup>a</sup>P < .001.
<sup>b</sup>P < .01.
<sup>c</sup>P < .05.

Table 3. Association Between Typology of Family Relationship and EM

<table>
<thead>
<tr>
<th></th>
<th>EM Odds ratio (95% confidence interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model A</strong></td>
<td><strong>Model B</strong></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>.99 (.98-1.01)</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>1.16 (.95-1.43)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td>1.10 (1.08-1.12)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>.98 (91-1.07)</td>
</tr>
<tr>
<td><strong>Medical comorbidities</strong></td>
<td>1.94 (1.58-2.37)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Unobligated ambivalent type</strong></td>
<td>.99 (.98-1.00)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>.99 (.98-1.00)</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>1.25 (1.01-1.54)&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td>1.10 (1.08-1.13)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>.96 (88-1.04)</td>
</tr>
<tr>
<td><strong>Medical comorbidities</strong></td>
<td>.34 (27-.44)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Tight-knit type</strong></td>
<td>.99 (.98-1.00)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>1.20 (.98-1.48)</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>1.10 (1.08-1.13)&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td><strong>Income</strong></td>
<td>.98 (91-1.07)</td>
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<td><strong>Medical comorbidities</strong></td>
<td>1.75 (1.30-2.34)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Detached type</strong></td>
<td>1.75 (1.30-2.34)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>.99 (.98-1.00)</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>1.15 (.94-1.42)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td>1.10 (1.08-1.13)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>.99 (92-1.08)</td>
</tr>
<tr>
<td><strong>Medical comorbidities</strong></td>
<td>1.08 (1.01-1.16)&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Commanding conflicted type</strong></td>
<td>1.02 (.62-1.67)</td>
</tr>
</tbody>
</table>

<sup>a</sup>P < .001.
<sup>b</sup>P < .01.
<sup>c</sup>P < .05.
discussing family relationship and high volume of contact with children may benefit the well-being of older adults.

These results should be interpreted with caution. First, our study examined a sample of Chinese older immigrants living in the greater Chicago area. The findings may not be generalizable to Chinese older adults in other geographic areas. Second, only a small number of participants reported EM in the commanding conflicted typology which may be an insufficient sample size to detect a statistical difference. Future research should explore the relationship between the commanding conflicted typology and EM. Third, this was a cross-sectional study, and so the direction of causality would be strengthened by a longitudinal study on family typology and incident EM. Fourth, it is unclear which subtype of EM (eg, psychological mistreatment, physical mistreatment, and financial exploitation) was influenced by family relationship. Future research should investigate the relationship between typology of family relationship and subtypes of EM. Fifth, this quantitative study provided limited information about how EM took place in unobligated ambivalence and detached family types. Future qualitative studies are needed to explore the underlying mechanism leading to EM in different family environments. Sixth, there were heterogeneities among different generations of Chinese older immigrants. Future study should test the family typologies of the first, second, and third generations, and whether the generations of older immigrants would moderate the relationship between family typology and EM.

Despite these limitations, this study has important theoretical and practical implications. Family relationship has increasingly gained importance in meeting the increasing demand for care in the aging society, a trend acknowledged by social science researchers and policymakers alike.47 Early research on family relationships and EM focused on the dyad relationship between victim and perpetrator, whereas less is known about the influence of the family environment in which older victims are embedded on the etiology of EM. It is not only the relationship between the victim and the perpetrator, but also the relations with other family members that make older victims vulnerable and marginalized within the family. Our study advanced knowledge regarding the relations between family environment and EM in later life and identified tight-knit type as the most optimal family type for avoiding EM.

Culturally customized services are suggested for minority older immigrants. Because most minority older adults relied on family networks to meet their needs, there was potential for the burden and family conflict to grow greater and result in EM. However, service provision has lagged in meeting these needs.48 Minority EM victims may have difficulty accessing culturally relevant services or face discriminatory treatment.49,50 Immigrant families preserving filial obligation values would protect older adults against EM. In addition, social programs could help improve older adults’ acculturation to reduce intergenerational conflicts and ambivalence, and promote harmony within immigrant families.

ACKNOWLEDGMENTS

Conflict of Interest: The authors report no conflict of interest.

Author Contributions: Study concept and design: Dong and Li. Acquisition of data: Dong. Analysis and interpretation of data: Dong, Li, and Guo. Drafting of the manuscript: Dong and Li. Critical revision of the manuscript for important intellectual content: Dong, Li, Guo, Stensland, and Silverstein. Statistical analysis: Dong and Li. Obtained funding: Dong. Administrative, technical, or material support: Dong and Li. Study supervision: Dong, Guo, and Silverstein.

Sponsor’s Role: Dr. Dong was supported by R30AG059304 R01AG042318 R01MD006173 R01NR014846 R34MH100443.

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OBJECTIVES: Research has examined the relationships between positive social support (PSS) and elder mistreatment (EM) but less is known regarding the negative aspect of social support (NSS), especially among minority groups in the United States. This study aimed to investigate the relationships between PSS/NSS from different sources and EM among US Chinese older adults.

DESIGN: Population-based cross-sectional study.

SETTING: Greater Chicago, IL, area.

PARTICIPANTS: A representative sample of Chinese older adults aged 60 years or older (N = 3157) from the Population Study of ChInese Elderly in Chicago in 2011 to 2013.

MEASUREMENTS: We applied a 10-item widely used instrument to assess EM. PSS and NSS from spouse/family members/friends were measured by a 12-item scale. Multivariate logistic regression analyses were conducted to examine the relationships.

RESULTS: After adjusting for confounders, higher levels of overall PSS from all three sources, including spouse, family members, and friends (odds ratio [OR] = 0.88 [95% confidence interval {CI} = 0.85-0.91]), were associated with lower risk of EM. But participants with a higher level of overall NSS from all three sources (OR = 1.51 [95% CI = 1.41-1.61]) were more likely to experience EM. The results on the relationships between PSS from spouse (OR = 0.70 [95% CI = 0.64-0.76]), PSS from family members (OR = 0.73 [95% CI = 0.68-0.79]), and EM were similar to overall PSS. But PSS from friends had a nonsignificant association with EM. Greater levels of NSS from spouse (OR = 1.84 [95% CI = 1.64-2.07]), family members (OR = 2.36 [95% CI = 2.03-2.75]), and friends (OR = 1.69 [95% CI = 1.32-2.17]) were associated with increased risks of EM.

CONCLUSION: Higher levels of SS were not always associated with lower risks of EM among US Chinese older adults. NSS might have counter effects. Future qualitative or longitudinal research needs to explore detailed cultural explanations and casual relationships between SS and EM.


Key words: positive social support; negative social support; elder mistreatment; minority aging

Elder mistreatment (EM) is a world-wide public health issue, which has been defined as “single, or repeated act, or lack of appropriate action, occurring within any relationship where there is an expectation of trust, which causes harm or distress to an older person.” The prevalence of EM varies among different populations. A national study on older adults in the United States showed that the prevalence of EM was more than 10%. The rate was much higher in Asia. The adverse effects of EM on mental and physical health were well-established, including increased risks of psychological distress, hospitalization, and mortality. In addition to other protective factors for EM, such as high levels of community cohesion and collective efficacy, consistent research results have shown that social support (SS) plays an important role in EM.

Studies in Europe, the United States, and China reported that greater levels of SS reduced the risks of different types of EM. On the other hand, SS could have a negative dimension, causing disputes, criticism, and conflicts, which is generally referred to as social strain or negative SS (NSS). Solidarity-conflict model suggests that positive SS (PSS) and NSS coexist in close relationships, including nonfamilial ones. It has been documented that NSS to is associated with depression, chronic illnesses, and...
EM. However, most existing studies focus on PSS and EM. The evidence on the relationship between NSS and EM remains limited, particularly among US ethnic groups. Being nonwhite was associated with an increased risk of EM. Moreover, it is difficult to apply the same results to diverse populations without considering the culture context.

As the oldest and largest Asian American group in the United States, the population of the Chinese community was approximately 4.9 million in 2015. Almost 80% of them were foreign born. With almost every one in six (15%), the prevalence of EM among US Chinese older adults was higher than that reported in the US National Elder Mistreatment Study (11.4%). This number may be underreported because Chinese older adults refrain from disclosing potential abuse to maintain family harmony and face. Not only the aging process, but also immigration stress, such as language barriers, financial constraints, and other social changes, increase their needs for SS and risk for being vulnerable.

Due to traditional cultural values, Chinese older adults tend to seek support from family, especially their spouses and adult children, rather than friends. However, compared to friendship, spouse and child relationships are involuntary, creating both affections and conflicts. It has been reported that family conflict serves as a risk factor for EM. In addition, generation disparities in Eastern and Western values and practices could lead to social strain and insufficient family SS for Chinese older adults. Given the changes in environment and culture collision, spousal and family support may not be accessible all the time. Friends would be the potential support source. The European study has demonstrated that higher levels of SS from friends were associated with lower risks of EM. However, the relationship between NSS from friends and EM is unclear. It is, therefore, important to know which aspect of SS, and from which source, has influences on EM in this unique group. The various sources and variation in SS and EM have not been examined among US Chinese older adults. This study aimed to examine the associations between overall PSS/NSS and EM and the associations between PSS/NSS from spouse/family members/friends and EM among Chinese older adults in the United States.

METHODS

Population and Settings

The data were drawn from the Population Study of Chinese Elderly in Chicago (PINE), a community-engaged epidemiological study of Chinese older adults (60 years and older) in the Greater Chicago area from 2011 to 2013. Of 3542 eligible participants approached, 3157 participants agreed to participate (response rate = 91.9%). Face-to-face home interviews were conducted by trained interviewers in multiple languages and dialects to meet participants’ needs. Details of the study design and procedure have been published. This study was approved by the Institutional Review Board of the Rush University Medical Center.

Independent Variables: Social Support

The 12-item SS scale, adapted from the Health and Retirement Study, is divided into two categories: PSS and NSS. PSS was assessed by two questions from three sources (six items in total): how often you can open up to your spouse/family members/friends if you need to talk about your worries; how often you can rely on your spouse/family members/friends for help if you have a problem. Study participants rated the extent to which they experienced each item using a three-point scale (1 = hardly ever, 2 = sometimes, and 3 = often). The average score of six items was considered as overall PSS, ranging from 6 to 18 (Cronbach’s α = 0.73). PSS score from spouse/family members/friends was calculated separately by two questions, ranging from 2 to 6. A higher score indicates a higher level of PSS.

NSS was measured by asking two items from three sources (six items in total): how often your spouse/family members/friends have too many demands for you; how often your spouse/family members/friends criticize you. Study participants were asked to rate the extent to which they experienced each item using a three-point scale (1 = hardly ever, 2 = sometimes, and 3 = often). The overall NSS score was averaged from items, ranging from 2 to 18 (Cronbach’s α = 0.63). Different sources of NSS were calculated separately, ranging from 2 to 6. A higher score indicates a higher level of NSS.

Dependent Variable: Elder Mistreatment

In this study, we used the modified Vulnerability to Abuse Screening Scale and the Hwalek-Sengstok Elder Abuse Screening Test to assess EM. The scale consists of 10 items asking the participants if they have experienced any of the following since they turned 60 years old: (1) family conflicts, (2) felt uncomfortable with family members, (3) felt that nobody wanted them around, (4) been told by someone that they gave too much trouble, (5) afraid of family members, (6) someone close tried to hurt or harm them, (7) been neglected or confined, (8) been called names or put down by someone close, (9) been forced by someone to do things, and (10) had belongings taken without permission. An affirmative “yes” to any of 10 items was considered as experiencing EM. The modified scale demonstrated satisfactory psychometric properties, with a Cronbach’s α of 0.80 in our study sample.

Covariates

The covariates used in this study were basic sociodemographic characteristics (age, sex), socioeconomic status (education, income), family structure indicators (marital status, living arrangement, and number of children alive), immigration-related factors (number of years living in the United States, number of years living in the community, language preference), and health-related characteristics (medical condition: sum of nine self-reported disease conditions including heart disease, stroke or brain hemorrhage, higher blood sugar or diabetes, high blood pressure, hypercholesterolemia, cancer, a broken or fractured hip, thyroid disease, and osteoarthritis, inflammation, or problems with joints; scores ranged from 0-9).

Statistical Analysis

We summarized the scores of PSS and NSS from varied sources by EM, using the unpaired t-test to contrast the differences
between the groups with and without EM. The associations between SS variables and EM in Chinese older population were examined by multivariate logistic regressions, adjusting for the covariates. A series of logistic regression models were conducted using the step-wise procedure to identify potential confounding effects of the covariates: the first model (model 1) adjusted for age and sex. Education and income were added to model 2. Family structure indicators were added to model 3. Immigration factors were added into model 4. Medical condition was added to model 5. All data analyses were performed in SAS, version 9.2 (SAS Institute Inc., Cary, NC).

RESULTS

Scores of PSS and NSS by the Presence of EM

Sample demographic characteristics and social network results have been published.22,30,31 Table 1 shows the scores of PSS and NSS from various sources by EM. Participants who experienced no EM had significantly higher overall PSS scores than those with EM (12.94 ± 3.14 vs 12.07 ± 3.43). Likewise, participants without EM had greater levels of PSS from spouse (4.33 ± 1.75 vs 3.95 ± 1.75) and family members (4.93 ± 1.22 vs 4.40 ± 1.44) than those with EM. However, there was no significant difference between two groups in PSS from friends (3.61 ± 1.48 vs 3.66 ± 1.54). In contrast, compared to participants with EM, the overall NSS score was significantly lower among those without EM (6.44 ± 1.14 vs 7.46 ± 2.02). Similar results were found between two groups in NSS from spouse (2.31 ± 0.71 vs 2.83 ± 1.14), family members (2.13 ± 0.45 vs 2.51 ± 0.91), and friends (2.05 ± 0.30 vs 2.14 ± 0.47).

Associations Between Variations in SS and Risk for EM

Table 1. The Scores of Positive Social Support and Negative Social Support From Different Sources by the Presence of Elder Mistreatment

<table>
<thead>
<tr>
<th>Variable</th>
<th>Yes (N = 474)</th>
<th>No (N = 2657)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall positive social support</td>
<td>12.07 ± 3.43</td>
<td>12.94 ± 3.14</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Positive social support from spouse</td>
<td>3.95 ± 1.75</td>
<td>4.53 ± 1.75</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Positive social support from family members</td>
<td>4.40 ± 1.44</td>
<td>4.93 ± 1.75</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Positive social support from friends</td>
<td>3.66 ± 1.54</td>
<td>3.61 ± 1.48</td>
<td>.7</td>
</tr>
<tr>
<td>Overall negative social support</td>
<td>7.46 ± 2.02</td>
<td>6.44 ± 1.14</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Negative social support from spouse</td>
<td>2.83 ± 1.14</td>
<td>2.31 ± 0.71</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Negative social support from family members</td>
<td>2.51 ± 0.91</td>
<td>2.13 ± 0.45</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Negative social support from friends</td>
<td>2.14 ± 0.47</td>
<td>2.05 ± 0.30</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Values are expressed as mean ± SD. The ratings of negative aspect in overall social support were reversed.

Table 2 shows the associations between SS variables and EM in all social support were reversed. Different categories of covariates (Table 2). With every one-point increased overall PSS, people were 12% less likely to have self-reported EM (odds ratio [OR] = 0.88 [95% confidence interval [CI] = 0.85-0.91]). In contrast to PSS, overall NSS had positive relations with EM. The risk of EM raised 51% with every one-point increased overall NSS score (OR = 1.51 [95% CI = 1.41-1.61]) (Table 3, model 5).

Associations Between Variations in SS From Different Sources and Risk for EM

Having higher levels of PSS from spouse (OR = 0.70 [95% CI = 0.64-0.76]) and family members (OR = 0.73 [95% CI = 0.68-0.79]) was associated with the reduced risks of EM. However, the relationship between PSS from friends and EM was not statistically significant (Table 2, model 5). On the other hand, NSS from spouse/family members/friends was positively associated with EM. The risk for EM was 1.84 times if the level of NSS from spouse increased one point (OR = 1.84 [95% CI = 1.64-2.07]). Higher levels of NSS from family members were also linked to higher risk of self-reported EM (OR = 2.36 [95% CI = 2.03-2.75]). There is no significant relationship between PSS from friends and EM, while NSS from friends was significantly associated with EM (OR = 1.69 [95% CI = 1.32-2.17]) (Table 3, model 5). In addition, the significance of covariates varies across models. The results that higher education level and Cantonese/Taishanese language preference were associated with higher risk of EM remained consistent.

DISCUSSION

To our knowledge, this study was among the first to determine the relationships between sources and variations in SS and risk for EM among US Chinese older adults. Our findings indicated that (1) US Chinese older adults with higher levels of overall PSS, PSS from spouse, and PSS from family members were less likely to experience EM; (2) greater levels of overall NSS, NSS from spouse, and NSS from family members were associated with increased risks of EM; (3) PSS from friends and EM did not have a significant relationship, but NSS from friends and EM had the positive relation.

The findings of the potential positive effects of PSS from spouse and family members on EM in this study are consistent with previous research in other populations. A study from National Social Life, Health, and Aging Project suggested that greater levels of PSS from close relationships were related to lower reported rates of any EM, including verbal, financial, physical, and multiple types.32 Our study also reported that older adults with higher levels of PSS from spouse and family members were less vulnerable to EM than their counterparts. The positive social interactions could have modifying effects on the interpersonal strain and on the occurrence and severity of EM.15

Our findings also found that greater levels of NSS from spouse and family members were linked to increased risk of EM. In our study sample, high levels of PSS and NSS from spouse and family members were obtained simultaneously.22 Frequent contacts and interactions with spouse and other family members might generate strains and trigger EM.33 and family disharmony was a risk factor for
EM.24 Such findings are consistent with previous studies suggesting that feeling uncomfortable with someone in the family (9.1%) and having family conflicts (6.7%) at home were the top two common forms of EM among US Chinese older adults.31 Both of EM forms involved spouse and other family members. In Chinese values, making demands and criticism are generally the symbols of love and care. People believe it is the proper way for their loved ones to improve
or live better without being aware of the consequences of NSS.

Interestingly, this study showed that PSS from friends was not significantly associated with EM. In contrast, existing evidence revealed that positive friends’ support might improve older adults’ well-being.11 One possible explanation for such discrepancy is that social network members decrease with the aging process, especially for...
those who immigrate in their late life. Being of a similar age, most of older adults’ friends face similar immigration stress. It may make PSS from friends less influential. In addition, Chinese older adults tended to seek support from their family rather than friends. They were also more likely to have life satisfaction with more family-based support. Based on previous findings, it was less likely for friendship to introduce conflicts and strains due to its voluntary character compared to the relationship with spouse and children. Individuals could withdraw easily from an unsatisfying friendship. This contradicts our result that NSS had positive association with EM. In Chinese traits, people value favors. This cultural value makes them difficult to decline friends’ requests, intangibly increasing the demands for Chinese older adults. Another possible reason is that NSS from friends undermines older adults’ self-efficacy or inner strength, which makes them more vulnerable to experience EM. Future qualitative studies are needed to explore the possible explanations in the Chinese cultural context.

No results would be interpreted without the context of limitations. First, NSS could have different forms, such as “interfering in another’s affairs and discouraging the expression of feelings.” In this study, we only included criticism and demands. Second, we tested the relationships between SS variables and overall EM. Whether the study findings would differ in EM subtypes remains unclear. Third, EM was measured by a self-reported instrument, which might be subject to reporting bias. Lastly, the data were drawn from a cross-sectional study of US Chinese population. Therefore, causal relations and generalizability of the findings to other ethnic populations are uncertain.

Despite the limitations, PINE is the most extensive epidemiological research in western countries on the well-being of Chinese older adults. This study is one of the first to expand the understanding of the relationships between sources and variations in SS and risks for EM in this population. Our findings have important clinical implications. It is known that EM victims use more healthcare services, including “emergency department visit, hospitalization, nursing home placement and hospice utilization.” Therefore, understanding the relationships stated in this article is critical for physicians, nurses, and other healthcare professionals to cultivate culturally appropriate screening and assessment strategies for EM. Healthcare professionals can also integrate adequate and proper family participation into healthcare assistance/services to enhance the spousal and family positive support. In the meanwhile, it is important to provide essential educational sessions, establish safety plans, and direct social/legal services to raise the awareness of NSS and to strengthen EM protection among US Chinese older adults. New insights are provided for future studies to further explore (1) the relationships between sources and variations in SS and EM subtypes and (2) cultural explanations of friends’ support on EM.

CONCLUSIONS

This study’s findings suggest that higher levels of SS were not always associated with lower risk of EM among US Chinese older adults. Higher levels of NSS were associated with increased risk of EM. Future qualitative or longitudinal research needs to explore detailed cultural explanations and casual relationships between SS variables and EM.

ACKNOWLEDGEMENTS

We thank all Population Study of Chinese Elderly in Chicago participants for their support and research assistants of the study team who helped with data collection.

Financial Disclosure: Dr. Dong was supported by R01MD006173, R01AG042318, R34MH100443, R01NR014846, 09EJ0015, 09EJ0016, and P30AG059304.

Conflicts of Interest: The authors have no conflicts of interest to report.

Author Contributions: Study concept and design: XinQi Dong. Study conception: Shenglin Zheng, XinQi Dong. Data acquisition, analysis, and interpretation: XinQi Dong, Shenglin Zheng. Preparation, review, and final approval of manuscript: all authors.

Sponsor’s Role: None.

REFERENCES

Different Definitions of Elder Mistreatment and Mortality: A Prospective Cohort Study From 2011 to 2017

Mengting Li, PhD,* Ying Liang, PhD,† and XinQi Dong, MD, MPH‡

OBJECTIVES: To investigate the relationship between different definitions and subtypes of elder mistreatment (EM) and yearly mortality.


SETTING: Greater Chicago area.

PARTICIPANTS: Chinese Americans aged 60 and older (N=3,157).

MEASUREMENTS: Data were collected from 2011 to 2017, with mortality data collected over the subsequent 4 years. Face-to-face in-home interviews were conducted. EM was measured using a brief screening tool (10 items) and a detailed assessment (56 items) and defined using different criteria for overall and specific subtypes of EM. Mortality was ascertained during follow-up. Cox proportional hazards models were used.

RESULTS: Four hundred seventy-five (15.2%) participants reported EM. Severe and moderate EM were associated with greater risk of 1-year (hazard ratio (HR)=2.51, 95% confidence interval (CI)=1.04–6.03; HR=2.55, 95% CI=1.08–6.03), 2-year (HR=1.68, 95% CI=1.01–2.78; HR=1.69, 95% CI=1.04–2.74), 3-year (HR=1.73, 95% CI=1.17–2.55; HR=1.73, 95% CI=1.19–2.51) and 4-year (HR=1.51, 95% CI=1.08–2.10; HR=1.48, 95% CI=1.08–2.04) mortality. A broad definition of EM was associated with greater risk of 3-year and 4-year mortality. With respect to subtypes of EM, psychological mistreatment and caregiver neglect were associated with greater mortality risk, whereas the relationships between psychological mistreatment, caregiver neglect and mortality risk varied according to definitional criteria.


Key words: elder mistreatment; mortality risk; Chinese

According to a report from the National Research Council, elder mistreatment (EM) is defined as intentional actions that cause harm or create a serious risk of harm, regardless of intent, to a vulnerable older adult by a trusted person or failure by a caregiver to satisfy the older adult’s basic needs or protect the older adult from harm.1 Prior studies of EM reported to Adult Protective Services (APS) have been associated with greater mortality,2,3 but EM reported to APS drastically underestimates the scope of EM in community population settings.4 Understanding the consequences of EM in community settings will help to inform future prevention and intervention efforts.

There is no consensus on screening or operational definitions of EM. Early research pointed to differences in the level of severity of elder abuse based on density and intensity.5 It revealed the different degree of danger that an individual might be facing. Older adults enduring more-frequent mistreatment behaviors were more likely to have poor physical and mental health and chronic pain.6 Heterogeneity in defining EM has obfuscated the applicability and comparability of research findings, which may be particularly important in minority populations.7 Estimates of the prevalence of EM have varied because of inconsistent screening tools and different operational definitions of EM.8 Prior research has shown that different screening modalities and definitions of EM will yield different prevalence findings and different effects on consequences of mistreatment.9 This is also relevant to specific subtypes of
EM, which include psychological, physical, and sexual mistreatment; caregiver neglect; and Financial exploitation. Additional investigation into the consequences, such as death, associated with different screening modalities and definitions of EM will provide a nuanced understanding.

Previous research has investigated the relationship between EM (reported to APS) and mortality by examining rates of mortality across multiyear spans. This approach has the advantage of examining complex confounding influences of comorbidities with respect to mortality outcomes. Studies are needed to measure yearly mortality risk to examine different mortality risk over time. Healthcare professionals and social service agencies could use this information to determine the point of intervention necessary for health and well-being.

Furthermore, in studies on EM and mortality, representation of nonwhites has been limited. Prior studies of EM in minority populations yielded significantly different prevalence estimates from white older adults in the US, and consequences of EM in minority populations in community settings are virtually unknown. To address these gaps and advance the study of EM, this study leveraged data from an epidemiological cohort study of community-dwelling Chinese-American older adults. Specifically, this study aimed to investigate the relationship between different screening modalities and definitions of EM subtypes with respect to 1-, 2-, 3-, and 4- mortality. We hypothesized that the strictness of overall EM definitions would affect the estimation of mortality and that different subtypes of EM would yield nonuniform estimates of mortality risk over time.

METHODS

Population
Data were derived from the Population Study of Chinese Elderly (PINE), a community-engaged, population-based epidemiological study of Chinese-American adults aged 60 and older in the greater Chicago area from 2011 to 2017, with a response rate of 91.9%. Participants were self-reported as Chinese, and the baseline cohort consisted of 3,157 participants, who were interviewed every 2 years. Two types of participants were lost to follow-up in addition to those who died. One group could not be contacted. These participants changed their telephone number, did not answer the telephone, or moved. The other group were reluctant participants. They did not want to participate in the study any more, or a family member did not allow them to participate an interview. Each participant was contacted over time to determine change in vital status, and 234 participants died during the 4-year period since their baseline interview. Written informed consent was obtained from all participants, and the study was approved by the institutional review board at Rush University Medical Center in Chicago, Illinois.

Measures

**EM Screener**
To screen for EM, we used a 10-item instrument (score range 0–10) modified from the Hwalek-Sengstok Elder Abuse Screening Test (H-S/EAST) and the Vulnerability to Abuse Screening Scale (VASS). The modified scale from H-S/EAST and VASS demonstrated good reliability in this study sample, with a Cronbach alpha of 0.80. Participants were asked whether they had experienced any of the 10 EM indicators since the age of 60. Any positive response to the 10 items was considered as having experienced EM.

**Detailed Assessment for EM**
EM subtypes were assessed using a comprehensive instrument with 56 items capturing the following 5 subtypes of EM: psychological mistreatment, physical mistreatment, sexual mistreatment, caregiver neglect, and Financial exploitation. Participants were asked whether they had experienced any subtype of EM since the age of 60. Psychological mistreatment was measured using the 8-item modified Conflict Tactics Scale (CTS), including variables such as screamed or yelled at participant. Physical mistreatment was measured using the 10-item modified CTS, with variables such as kicked or shaken. An affirmative response to any of the 10 items was defined as physical mistreatment. Sexual mistreatment was measured according to the answer to the question, “Has anyone ever touched your private areas or your body when you did not want this?” An affirmative response to this question was defined as sexual mistreatment. A 20-item unmet needs assessment was used to evaluate caregiver neglect. Financial exploitation was measured using 17 items.

**Operational Definitions of EM**
Different operational definitions were applied to subtypes of EM. Five psychological mistreatment variables were constructed using different definition criteria: an affirmative response to having experienced any of the 8 psychological mistreatment items (Psych-1), affirmative responses to 2 or more items (Psych-2), affirmative responses to 3 or more items (Psych-3), affirmative responses regarding threats to send the older adult to a nursing home or to abandon or stop taking care of the older adult (Psych-4), and being insulted or threatened at least 10 or more times (Psych-5; Pillemer criteria). Because the definitions of physical and sexual mistreatment were consistent with those of prior studies, we used only 1 definition for each subtype: any affirmative response to a question about physical or sexual mistreatment. Physical and sexual mistreatment were combined in data analysis because of the small number of participants who reported physical or sexual mistreatment. Two operational definitions were used for caregiver neglect: any unmet needs and living with at least 1 other person (Neglect-1) and moderate to severe unmet needs and living with at least 1 other person (Neglect-2). We used two criteria to define Financial exploitation: an affirmative response to any of the 17 items (Financial-1) and an affirmative response to any of 14 items, excluding 3 items that may be less exploitive (felt entitled to use your money, prevented you from spending your money, tricked or pressured you into buying something) (Financial-2).

According to the different operational definitions of EM subtypes, 3 overall EM definitions were constructed: strictly defined EM (EM severe): Psych-5, physical, sexual, Neglect-2, and Financial-2; moderately defined EM...
(EM moderate): Psych-2, physical, sexual, Neglect-2, and Financial-1; and broadly defined EM (EM broad): Psych-1, physical, sexual, Neglect-1, and Financial-1.

Mortality
We obtained data on vital status of participants, including date of death, from informants and family members at regular subsequent contact. Study personnel also regularly searched local newspapers and websites for obituaries. We determined 1-, 2-, 3-, and 4-year mortality for each participant according to the date of his or her baseline interview and date of death or survival after 1, 2, 3, and 4 years.

Covariates
Demographic variables included age, sex (self-reported), years of education, and income. Cigarette smoking (ever) was assessed using a series of questions derived from the Chicago Health and Aging Project. Current regular alcohol use was measured using the Alcohol Use Disorders Identification Test. To evaluate medical comorbidities, participants were asked whether a doctor, nurse, or therapist had told them that they had: (1) heart disease, heart attack, coronary thrombosis, coronary occlusion, or myocardial infarction; stroke or brain hemorrhage; cancer, malignancy, or a tumor of any type; high cholesterol; diabetes, sugar in the urine, or high blood sugar; high blood pressure; broken or fractured hips; thyroid disease; or osteoarthritis or inflammation or problems with joints. Medical comorbidities were analyzed using a count of these 9 disease groups. All information was collected in baseline interviews.

Data Analysis
A series of Cox proportional hazards models were used to examine the association between EM and mortality. Model A was adjusted for age and sex. Education and income were added in Model B. Cigarette smoking and alcohol use were added in Model C. Medical comorbidities were added in Model D. Hazard ratios (HRs) and 95% confidence intervals (CIs) were reported. All analyses used 2-sided alternatives, with P < .05 considered significant. All statistical analyses were conducted using the PROC PHREG procedure in SAS version 9.4 (SAS Institute, Inc., Cary, NC).

RESULTS
Sample Characteristics
The baseline cohort had a mean ± standard deviation age of 72.8 ± 8.3, and 1,829 (57.9%) were female. Mean education was 8.7 ± 5.1 years. Two thousand six hundred eighty-seven (85.1%) had an annual income of less than $10,000, 927 (29.4%) had smoked in their lifetime, and 457 (14.5%) regularly consumed alcohol. Four hundred seventy-five (15.2%) reported at least 1 subtype of EM: 308 (9.8%) psychological mistreatment, 33 (1.1%) physical mistreatment, 6 (0.2%) sexual mistreatment, 331 (11.2%) caregiver neglect, 291 (9.3%) financial exploitation. There were 234 deaths (7.4%) after 4 years of follow-up (68.0%) in those with reported EM.

EM and Mortality
Table 1 shows that EM measured using a brief screening tool was not significantly associated with yearly mortality. Severe EM was associated with a significantly greater risk of 1- (HR=2.51, 95% CI=1.04–6.03), 2- (HR=1.68, 95% CI=1.01–2.78), 3- (HR=1.73, 95% CI=1.17–2.55), and 4-year (HR=1.51, 95% CI=1.08–2.10) mortality (Table 2). Moderate EM was significantly associated with greater risk of 1- (HR=2.55, 95% CI=1.08–6.03), 2- (HR=1.69, 95% CI=1.04–2.74), 3- (HR=1.73, 95% CI=1.19–2.51), and 4-year (HR=1.48, 95% CI=1.08–2.04) mortality. Broad EM was associated with greater risk of 3- (HR=1.45, 95% CI=1.04–2.04) and 4-year (HR=1.32, 95% CI=1.00–1.76) mortality.

Table 3 shows that psychological mistreatment (Psych-4) was associated with significantly greater risk of 2- (HR=3.84, 95% CI=1.21–12.17), 3- (HR=4.32, 95% CI=1.77–10.60), and 4-year (HR=3.73, 95% CI=1.65–8.44) mortality. Psychiatric mistreatment (Psych-5) was significantly associated with greater risk of 3-year mortality (HR=3.34, 95% CI=1.04–10.71). Table 4 shows that caregiver neglect (Neglect-1) was associated with significantly greater risk of 3- (HR=1.60, 95% CI=1.05–2.42) and 4-year (HR=1.47, 95% CI=1.04–2.08) mortality. Caregiver neglect (Neglect-2) was significantly associated with greater risk of 1- (HR=3.51, 95% CI=1.23–9.99), 3- (HR=2.05, 95% CI=1.23–3.41), and

Table 1. Elder Mistreatment Screen and Mortality

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>1-Year Mortality</th>
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<th>3-Year Mortality</th>
<th>4-Year Mortality</th>
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<td>0.72 (0.44–1.18)</td>
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<td>1.00 (0.92–1.09)</td>
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<td>0.99 (0.96–1.02)</td>
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<td>Income</td>
<td>1.12 (0.77–1.63)</td>
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<tr>
<td>Medical comorbidities</td>
<td>1.01 (0.76–1.35)</td>
<td>1.10 (0.95–1.27)</td>
<td>1.20 (1.08–1.34)</td>
<td>1.21 (1.11–1.32)</td>
</tr>
<tr>
<td>Elder mistreatment screen</td>
<td>0.99 (0.29–3.37)</td>
<td>1.41 (0.80–2.48)</td>
<td>0.96 (0.58–1.58)</td>
<td>1.00 (0.67–1.50)</td>
</tr>
</tbody>
</table>

p<.001; .05.
4-year (HR=1.73, 95% CI=1.11–2.71) mortality. Financial exploitation (Table 5) and physical and sexual mistreatment were not significantly associated with mortality.

**DISCUSSION**

Severe and moderate EM were significantly associated with greater risk of 1-, 2-, 3-, and 4-year mortality, and broad EM was associated with significantly greater risk of 3- and 4-year mortality. Psychological mistreatment (Psych-4, less restrictive definition of psychological mistreatment) was associated with significantly greater risk of 2-, 3-, and 4-year mortality, and psychological mistreatment (Psych-5, more restrictive definition of psychological mistreatment) was significantly associated with 3-year mortality. Caregiver neglect (Neglect-1, broad definition of caregiver neglect) was associated with significantly greater risk of 3- and 4-year mortality, and caregiver neglect (Neglect-2, restrictive definition of caregiver neglect) was associated with significantly greater risk of 1-, 3-, and 4-year mortality.

Moderate and severe EM were significantly associated with risk of mortality over time, and broad EM was associated with 3- and 4-year mortality. These results are consistent with those from the New Haven Established Populations for Epidemiologic Studies of the Elderly and the Chicago Health and Aging Project, which found that reported and confirmed EM were associated with shorter survival. Our study advances knowledge regarding the relationship between different definitions of EM subtypes with respect to 1-, 2-, 3-, and 4-year mortality. This study was among the first to demonstrate that EM is a risk factor for mortality over time. Health policies and social services were suggested to detect and intervene in EM of this vulnerable population.

Psychological mistreatment was the most prevalent subtype of EM in this study sample. The relationship between psychological mistreatment and mortality revealed that threats to send older adults to a nursing home or to abandon them were associated with greater risk of mortality than other types of psychological mistreatment (e.g., being insulted or screamed at). Chinese older adults have filial expectations that adult children will take care of them in old age and intervene in EM of this vulnerable population. APS should follow up if Chinese older adults report being threatened with being sent to a nursing home or abandoned. The health condition of older adults may explain the significant association between caregiver neglect and mortality. Neglect-1 referred to any unmet need in daily living, and the relationship between EM and mortality revealed that unmet needs in daily living are associated with the risk of mortality. The health condition of older adults may explain the significant association between caregiver neglect and mortality. Neglect-1 referred to any unmet need in daily living, and the relationship between EM and mortality revealed that unmet needs in daily living are associated with the risk of mortality.

4-year mortality was significantly associated with greater risk of 1-, 2-, 3-, and 4-year mortality. Psychological mistreatment (Psych-4, less restrictive definition of psychological mistreatment) was associated with significantly greater risk of 2-, 3-, and 4-year mortality, and psychological mistreatment (Psych-5, more restrictive definition of psychological mistreatment) was significantly associated with 3-year mortality.
associated with higher mortality than psychological mistreatment, physical mistreatment, and financial exploitation. Our findings suggest that older adults with unmet needs in daily living are at risk of dying, particularly those with moderate and severe unmet needs.

The association between physical and sexual mistreatment and mortality was not significant. In contrast, a previous study found that physical mistreatment was associated with higher mortality than verbal abuse. Another study found that in-hospital mortality was higher in individuals who had been physically mistreated than in those who had not. The small number of participants who reported physical and sexual mistreatment may explain the nonsignificant relationship in our study. Sex is a taboo topic, and open discussion of sexual issues is usually discouraged in Chinese culture, which may have made participants reluctant to report sexual mistreatment.
Our study found that financial exploitation did not significantly affect mortality risk, although earlier studies found that financial exploitation is associated with lower survival rates. Our prior study on characteristics associated with financial exploitation found that older adults who were financially exploited were more likely to have more education, higher income, and longer residence in the United States. Their high socioeconomic status may have enabled them to have better access to healthcare services and reduced their mortality risk.

Limitations
Several limitations of this study should be considered. First, we tracked this cohort for 4 years. Whether the associations between EM and mortality change after 5 years is unclear.

Table 4. Caregiver Neglect and Mortality

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>1-Year Mortality</th>
<th>2-Year Mortality</th>
<th>3-Year Mortality</th>
<th>4-Year Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neglect-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.14 (1.08–1.20) 2</td>
<td>1.15 (1.11–1.18) 3</td>
<td>1.13 (1.10–1.15) 3</td>
<td>1.13 (1.11–1.15) 3</td>
</tr>
<tr>
<td>Sex</td>
<td>0.30 (0.08–1.13)</td>
<td>0.31 (0.06–1.82)</td>
<td>0.90 (0.32–2.55)</td>
<td>0.73 (0.36–1.43)</td>
</tr>
<tr>
<td>Education</td>
<td>1.01 (0.93–1.10)</td>
<td>1.01 (0.97–1.06)</td>
<td>1.00 (0.96–1.03)</td>
<td>0.99 (0.96–1.02)</td>
</tr>
<tr>
<td>Income</td>
<td>1.08 (0.73–1.60)</td>
<td>1.10 (0.89–1.37)</td>
<td>1.07 (0.89–1.28)</td>
<td>1.05 (0.90–1.22)</td>
</tr>
<tr>
<td>Smoking</td>
<td>1.74 (0.58–5.20)</td>
<td>1.99 (1.02–3.89) 5</td>
<td>2.23 (1.32–3.79) 4</td>
<td>1.90 (1.25–2.86) 4</td>
</tr>
<tr>
<td>Alcohol</td>
<td>0.72 (0.21–2.51)</td>
<td>1.23 (0.66–2.30)</td>
<td>1.28 (0.79–2.06)</td>
<td>1.02 (0.67–1.54)</td>
</tr>
<tr>
<td>Medical comorbidities</td>
<td>1.01 (0.76–1.35)</td>
<td>1.11 (0.95–1.29)</td>
<td>1.21 (1.08–1.36) 3</td>
<td>1.20 (1.09–1.32) 3</td>
</tr>
<tr>
<td>Neglect-1</td>
<td>1.81 (0.69–4.73)</td>
<td>1.33 (0.76–2.34)</td>
<td>1.60 (1.05–2.42) 5</td>
<td>1.47 (1.04–2.08) 5</td>
</tr>
<tr>
<td>Neglect-2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.13 (1.07–1.20) 2</td>
<td>1.15 (1.11–1.18) 3</td>
<td>1.13 (1.10–1.15) 3</td>
<td>1.13 (1.11–1.15) 3</td>
</tr>
<tr>
<td>Sex</td>
<td>0.28 (0.08–1.06)</td>
<td>0.89 (0.44–1.77)</td>
<td>0.86 (0.50–1.49)</td>
<td>0.71 (0.46–1.09)</td>
</tr>
<tr>
<td>Education</td>
<td>1.01 (0.93–1.09)</td>
<td>1.01 (0.97–1.06)</td>
<td>1.00 (0.96–1.03)</td>
<td>0.99 (0.96–1.02)</td>
</tr>
<tr>
<td>Income</td>
<td>1.03 (0.67–1.59)</td>
<td>1.09 (0.87–1.36)</td>
<td>1.06 (0.88–1.27)</td>
<td>1.04 (0.89–1.21)</td>
</tr>
<tr>
<td>Smoking</td>
<td>1.51 (0.49–4.64)</td>
<td>1.90 (0.97–3.74)</td>
<td>2.12 (1.24–3.61) 4</td>
<td>1.82 (1.19–2.77) 4</td>
</tr>
<tr>
<td>Alcohol</td>
<td>0.73 (0.21–2.56)</td>
<td>1.23 (0.66–2.31)</td>
<td>1.27 (0.79–2.04)</td>
<td>1.01 (0.67–1.53)</td>
</tr>
<tr>
<td>Medical comorbidities</td>
<td>1.00 (0.76–1.33)</td>
<td>1.10 (0.95–1.28)</td>
<td>1.20 (1.07–1.35) 4</td>
<td>1.19 (1.08–1.31) 3</td>
</tr>
<tr>
<td>Neglect-2</td>
<td>3.51 (1.23–9.99) 5</td>
<td>1.82 (0.92–3.60)</td>
<td>2.05 (1.23–3.41) 4</td>
<td>1.73 (1.11–2.71) 5</td>
</tr>
</tbody>
</table>

1Any unmet needs and lives with family.
2Moderate to severe unmet needs and lives with family.
3p<.001; 4.01; 5.05.

Table 5. Financial Exploitation and Mortality

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>1-Year Mortality</th>
<th>2-Year Mortality</th>
<th>3-Year Mortality</th>
<th>4-Year Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.14 (1.08–1.20) 3</td>
<td>1.15 (1.12–1.18) 3</td>
<td>1.13 (1.11–1.15) 3</td>
<td>1.13 (1.11–1.15) 3</td>
</tr>
<tr>
<td>Sex</td>
<td>0.37 (0.11–1.22)</td>
<td>0.67 (0.36–1.23)</td>
<td>0.69 (0.42–1.13)</td>
<td>0.59 (0.39–0.87) 4</td>
</tr>
<tr>
<td>Education</td>
<td>1.00 (0.92–1.08)</td>
<td>1.00 (0.96–1.05)</td>
<td>0.99 (0.95–1.02)</td>
<td>0.98 (0.95–1.01)</td>
</tr>
<tr>
<td>Income</td>
<td>1.11 (0.76–1.60)</td>
<td>1.10 (0.89–1.36)</td>
<td>1.07 (0.90–1.27)</td>
<td>1.04 (0.90–1.21)</td>
</tr>
<tr>
<td>Smoking</td>
<td>1.79 (0.61–5.23)</td>
<td>1.52 (0.83–2.79)</td>
<td>1.84 (1.14–2.97) 5</td>
<td>1.64 (1.12–2.41) 5</td>
</tr>
<tr>
<td>Alcohol</td>
<td>0.68 (0.20–2.37)</td>
<td>1.09 (0.58–2.02)</td>
<td>1.08 (0.68–1.73)</td>
<td>0.87 (0.56–1.31)</td>
</tr>
<tr>
<td>Medical comorbidities</td>
<td>1.03 (0.78–1.36)</td>
<td>1.10 (0.95–1.27)</td>
<td>1.20 (1.08–1.34) 4</td>
<td>1.21 (1.10–1.32) 4</td>
</tr>
<tr>
<td>Financial-1</td>
<td>1.66 (0.55–5.05)</td>
<td>1.51 (0.81–2.83)</td>
<td>1.43 (0.86–2.37)</td>
<td>1.30 (0.84–2.01)</td>
</tr>
</tbody>
</table>

1Any affirmative response on financial exploitation assessment.
2Any affirmative response on financial exploitation assessment, excluding felt entitled to use your money, prevented you from spending your money, and tricked or pressured you into buying something.
3p<.001; 4.01; 5.05.
Second, EM may have been underreported in the study sample, which would bias the relationship between EM and mortality. Third, although it featured a representative sample of Chinese-American older adults in the greater Chicago area, findings may not be generalizable to Chinese older adults in other geographic areas or to other ethnic groups. Fourth, for certain subtypes and severity of EM, only a small number of participants had died after 4 years, resulting in large standard errors and wide confidence intervals. Future research should explore the relationship between different forms of elder abuse and mortality. Fifth, Type I error may exist due to multiple testing.28

CONCLUSION
There were heterogeneities between the associations between different definitions and subtypes of EM and yearly mortality. This study has important theoretical and practical implications. First, it examined the relationship between EM and mortality in a representative sample of Chinese-American older adults living in Chicago. The findings could inform interventions and interventions for minority populations with EM by understanding the mortality risk of different subtypes and different levels of severity of EM. Second, our results showed that the association between EM and mortality varied according to operational definitions and subtypes. Researchers should be aware of the definitions of EM when comparing findings from different studies. The relationship between subtypes of EM and mortality was different in the Chinese population than in prior studies of other ethnic groups. To account for these differences, it is suggested that APS take a culturally relevant approach to following up with individuals from minority groups experiencing EM. Our findings suggest a series of measures related to EM that healthcare professionals and social service agencies could use to screen for mortality risk. Third, our findings challenge those of earlier studies on the association between EM and mortality after a certain year. We found that associations varied according to year, which provided tailored information for healthcare professionals and social service agencies to create appropriate interventions for Chinese older adults experiencing different subtypes of EM.

ACKNOWLEDGMENTS
Conflict of Interest: The authors report no conflict of interest.

Author Contributions: Dr. Dong had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design; analysis and interpretation of data; drafting of manuscript; administrative, technical, or material support: Dong, Li, Liang. Acquisition of data, obtained funding: Dong. Critical revision of manuscript for important intellectual content, statistical analysis, study supervision: Dong, Liang.

Sponsor’s Role: Not applicable.

REFERENCES


22. Li M, Dong X. Association between both self-reported and directly observed physical function and depressive symptoms in a US Chinese population: Findings from the PINE study. JQI Psychol 2017;4:1–8.
Sex Differences in the Prevalence and Incidence of Cognitive Impairment: Does Immigration Matter?

Fengyan Tang, PhD,* Iris Chi, DSW,† and XinQi Dong, MD‡

OBJECTIVES: We aimed to examine the associations between immigration-related factors and prevalent and incident cognitive impairment (CI) and whether the associations varied by sex among US Chinese older adults.

DESIGN: Two-wave prospective study.

SETTING: The greater Chicago area.

PARTICIPANTS: Community-dwelling adults aged 60 and older who self-identified as Chinese, who were interviewed at two time points during 2011-2013 (N = 3157) and 2013-2015 (N = 2713).

MEASUREMENTS: CI was assessed by the 30-item Chinese Mini-Mental State Examination (C-MMSE). CI prevalence was determined by the percentage of respondents whose C-MMSE score was below 18 at baseline (N = 3033), and CI incidence was determined by the percentage of the respondents whose score was 18 or above at baseline (N = 2443) but dropped below 18 at wave 2. Immigration-related factors included age at migration, immigration reasons, and acculturation.

RESULTS: The CI prevalence rate was 7.62% at baseline, and the incidence rate was 5.12% at wave 2. Women were more likely than men to have CI, consisting of 77.06% and 75.20% among persons with CI at the time points. None of the immigration-related factors were related to CI prevalence and incidence. Older age, fewer years of education, and more instrumental activities of daily living limitations were risk factors of CI in the whole, male, and female samples.

CONCLUSION: Older Chinese women were generally disadvantaged in cognition and overall health as compared with older Chinese men. Yet immigration experience does not link to CI for both men and women after equalizing the well-established effects of age and education on cognition. Future research needs to investigate whether the risk of CI in late life is related to the biological and contextual factors earlier in the life course. Decreasing sex disparities in the risk of dementia may focus on reducing educational and health disparities in the early life stage. J Am Geriatr Soc 67:S513–S518, 2019.

Key words: cognitive impairment; immigration; older Chinese immigrants; sex difference

According to the 2016 American Community Survey, Chinese people are among the fastest growing aging populations in the United States, with approximately 4 million in total and 14% of them 65 years and older. Yet the prevalence of Alzheimer’s disease and related dementias remains unknown in this population, and it is very likely that the number of Asian Americans with cognitive impairment (CI) will continue to grow. As documented in a recent landmark study about dementia risk among six racial and ethnic groups, Asian Americans have the lowest dementia incidence rates (15.2/1000) over a 14-year observation period as compared with other racial/ethnic groups; however, the lifetime risk of developing dementia is still high. More than 1 in 4 people 65 years and older is expected to be diagnosed with dementia in their lifetime.

To our knowledge, no study to date has systematically examined the prevalence and incidence of CI in Chinese Americans. Less is known about the relationship between CI and immigration-related factors including age at migration, reasons for immigration, and acculturation. A growing body of research about the US Latino immigrant populations indicated that the healthy immigrant effect may extend to cognitive functioning, but findings are inconsistent. Scant research on Asian Americans suggests complex patterns exist for a variety of health outcomes, and negative outcomes are often masked among underserved subgroups (eg, those with low...
English proficiency and experiencing acculturative stress. In addition, the health advantage, if there is any, tends to wane with length of residence in the United States that may be attributed to various reasons including acculturative stress, hazardous environments, and unhealthy coping behaviors.7-9

According to age stratification and life course theories that speak to age differences in immigrant incorporation, older immigrants are exposed to fewer opportunities to learn about the host society, thus experiencing slower acculturation than younger immigrants. The intersection of timing of lives and cultural contexts of immigration shapes aging experience including cognitive aging. Immigration-related factors such as age at migration, length of residence, and English proficiency are related to mental health among Asian Americans. Particularly, immigration in the early-middle life stage and long residence time may translate into greater acculturation and English mastery, whereas late-life immigration may bring in age-related physical and cognitive problems. Reasons for immigration may indicate whether the immigration process is stressful because stress could result from a lack of control over the decision to immigrate. If people are pressured to leave their native countries, they tend to view the immigration process as an undesirable or stressful life change. The accumulative stress associated with immigration and acculturation may undermine cognitive functioning through a physiologic mechanism; that is, compulsory immigration, unwanted life change, and struggles with incorporation may lead to allostatic load or chronic activation of the physiologic stress response that further affects cognitive capacity of memory, orientation, and the rate of cognitive decline. Studies show that acculturation is related to increased allostatic load in the Mexican population.

Immigration-related factors may serve as either protective or risk factors of cognitive decline, conditional on individual and contextual characteristics. One of the important conditioning factors is sex because women and men tend to migrate for different reasons with unique immigration experiences. Previous studies consistently showed that immigrant men are advantaged relative to immigrant women across health-related outcomes including cognitive function indicators. Hill and associates found that the healthy immigrant effect was more pronounced for men than for women among older Mexican Americans; that is, men who migrated in middle life exhibited a slower rate of cognitive decline than US-born men, whereas cognitive functioning trajectories of women did not vary according to nativity status or age at migration. Highly acculturated Latinos have the potential for risk reduction, whereas acculturation has a stronger effect on unhealthy behaviors and outcomes in women than in men, probably because the process of immigration is especially stressful for women. The stressful immigration process may further undermine cognitive functioning and contribute to health disadvantages.

Drawing on the prior research, this study examines whether immigration-related factors are associated with CI prevalence and incidence in US Chinese older adults. Although we are unable to assess whether the healthy immigrant effect exists in this population due to the lack of US-born study subjects, we aim to explore whether immigration factors including immigration at older age, involuntary immigration, and low acculturation are risk factors for CI. Given the prevailing notion that late-life migration is associated with additional stressors in the acculturation process, we hypothesized that Chinese older immigrants who migrated at older age, for involuntary reasons (eg, looking after grandchildren) and with low acculturation levels, are likely to experience CI. This study further explores whether sex difference exists in CI prevalence and incidence and whether the immigration-related factors are associated with CI in men and women. We hypothesized that the negative associations between immigration risk factors and CI are more pronounced for women.

METHODS

Study sample

We used data retrieved from two waves of the Population Study of Chinese Elderly (PINE), the largest population-based epidemiological study of US Chinese older adults aged 60 and above in the greater Chicago area. Baseline surveys were conducted between 2011 and 2013 with a total of 3157 respondents, and the second wave was collected between 2013 and 2015 with a total of 2713 respondents, that is, 86% of the baseline sample. The whole sample consisted of foreign-born immigrants because age at migration ranged from about 0.76 to 88 years old (Table 1), indicating that everyone was born out of the United States.

Measures

CI was determined by the 30-item Chinese Mini-Mental State Examination (C-MMSE), based on the MMSE, which is a widely used assessment of overall cognitive status in epidemiological studies. As suggested in the literature, the optimal cutoff scores for dementia screening vary by education levels in Chinese older populations, with 16 to 17 for the illiterate. Similarly, Black and colleagues used MMSE scores below 18 and between 18 and 23 to reflect severe CI and mild CI, respectively, in older Mexican Americans. Accordingly, we used a score of 18 as the cutoff point to provide a conservative estimate of CI prevalence and incidence in the PINE sample. CI prevalence was determined by the percentage of respondents whose C-MMSE score was below 18 at baseline (N = 3033), and incidence was determined by the percentage of the respondents whose score was 18 or above at baseline (N = 2443) but dropped below 18 at wave 2.

Immigration-related factors included age at migration, reasons for immigration, and acculturation. Age at migration was calculated by subtracting the respondent’s age by the years living in the United States at baseline. Migration reasons were measured by three variables: (1) family reunification with spouse, children, or other family members; (2) involuntary immigration due to the needs for taking care of grandchildren, looking for jobs, avoidance of family conflict, financial problems, or national disaster back in home country; and (3) seeking a better life after retirement, better medical care, chances of finding a romantic partner, better living standards, or safety. Each category was binary coded (0 = no, 1 = yes). Acculturation was assessed by 12 items asking about respondents’ preference for speaking a given language in different settings, in media use, and preferred ethnicity of those with whom they interact, with responses...
Table 1. Sex differences in cognitive impairment, health, immigration experience, and demographics at baseline

<table>
<thead>
<tr>
<th>Variables</th>
<th>Women (n = 1822, 57.97%)</th>
<th>Men (n = 1321, 42.03%)</th>
<th>Bivariate analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI prevalence (0-1)</td>
<td>178 (77.06)</td>
<td>53 (22.94)</td>
<td>χ²(1)=39.75 &lt;.001</td>
</tr>
<tr>
<td>CI incidence (0-1)</td>
<td>94 (75.20)</td>
<td>31 (24.80)</td>
<td>χ²(1)=19.08 &lt;.001</td>
</tr>
<tr>
<td>Immigration reunification (0-1)</td>
<td>1354 (59.60)</td>
<td>918 (40.40)</td>
<td>χ²(1)=8.89 .003</td>
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<tr>
<td>Involuntary immigration (0-1)</td>
<td>866 (59.32)</td>
<td>594 (40.68)</td>
<td>χ²(1)=2.02 .15</td>
</tr>
<tr>
<td>Immigration for better life (0-1)</td>
<td>789 (52.04)</td>
<td>727 (47.96)</td>
<td>χ²(1)=42.20 &lt;.001</td>
</tr>
<tr>
<td>Married (0-1)</td>
<td>47.32</td>
<td>52.68</td>
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</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean rank</th>
<th>Mean rank</th>
<th>Kruskal-Wallis test</th>
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<tbody>
<tr>
<td>Medical condition (0-7)</td>
<td>1667</td>
<td>1437</td>
<td>H (1) = 51.17 &lt;.001</td>
</tr>
<tr>
<td>ADL (0-24)</td>
<td>1590</td>
<td>1540</td>
<td>H (1) = 10.72 .001</td>
</tr>
<tr>
<td>IADL (0-36)</td>
<td>1613</td>
<td>1401</td>
<td>H (1) = 49.83 &lt;.001</td>
</tr>
<tr>
<td>Depressive symptoms (0-27)</td>
<td>1650</td>
<td>1441</td>
<td>H (1) = 45.04 &lt;.001</td>
</tr>
<tr>
<td>Acculturation (12-60)</td>
<td>1533</td>
<td>1623</td>
<td>H (1) = 7.93 .005</td>
</tr>
<tr>
<td>Income (1-10)</td>
<td>1587</td>
<td>1505</td>
<td>H (1) = 7.68 .006</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M ± SD</th>
<th>M ± SD</th>
<th>t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, 59-105 y</td>
<td>72.85 ± 6.58</td>
<td>72.74 ± 7.90</td>
</tr>
<tr>
<td>Years in United States, 0.1-65</td>
<td>20.17 ± 12.46</td>
<td>19.23 ± 12.98</td>
</tr>
<tr>
<td>Age at migration, y, 0.7-88</td>
<td>52.62 ± 12.09</td>
<td>53.52 ± 12.82</td>
</tr>
<tr>
<td>Education, y, 0-26</td>
<td>7.83 ± 5.06</td>
<td>9.91 ± 4.78</td>
</tr>
</tbody>
</table>

Given on a 5-point Likert scale. The scale was validated among Chinese older immigrant populations. The total acculturation score ranged from 12 to 60, a higher score indicating a higher level of acculturation (Cronbach’s α = .92).

Control variables included sex (1 = female), education (range 0-26), income (range 1-10), marital status (1 = married), medical conditions (range 0-7), activities of daily living [ADLs] (range 0-24; Cronbach’s α = .92), instrumental activities of daily living (IADLs) (range 0-36; Cronbach’s α = .90), and depressive symptoms (range 0-27; Cronbach’s α = .82). Previous studies showed that depression, chronic conditions, and disability were associated with cognitive decline. Due to the high correlation between years living in the United States and age at migration (r = .75), we did not include the former in the final analyses.

Analysis

We examined sex differences in CI prevalence and incidence, immigration-related factors, health status, and demographic variables using χ² tests for categorical variables, t tests for continuous variables, and Kruskal-Wallis tests for ordinal or skewed continuous variables. We then used binary logistic regression models examining the associations between CI (ie, prevalence at baseline and incidence at wave 2) and immigration-related factors after controlling for baseline health and demographic variables. Because sex is a strong correlate of different types of mental disorder and cognitive functioning, we conducted analyses in the whole, male, and female samples, respectively. In the whole sample, sex was a significant variable, yet it is still unclear how the associations between immigration experience and CI varied by sex. Thus the separate analyses in the male and female samples provided a clear picture.

RESULTS

Sex differences in cognitive impairment

Sex differences were observed, with women more likely than men to have CI. At baseline, 231 (7.62%) of 3033 respondents were scored below 18 in the C-MMSE assessment, indicative of CI prevalence. Among them, 53 (22.94%) were men and 178 (77.06%) were women [χ²(1, N = 3033) = 39.75; p < .001] (Table 1). Among the respondents whose C-MMSE scores were 18 or above (n = 2443) at baseline, 125 respondents dropped scores below 18 (5.12%) at the second wave, indicative of CI incidence. Among them, 31 (24.80%) were men; 94 (75.20%) were females [χ²(1, N = 2443) = 19.08; p < .001].

Table 1 also presents sex differences in demographics, health status, and immigration-related factors. Compared with men, women had fewer years in education, a bit higher rank in income levels, and were less likely to be married. They were generally in worse health status, with more diagnosed medical conditions, ADL and IADL limitations, and depressive symptoms. In addition, women were more likely to immigrate for family reunion or involuntary reasons, with lower levels of acculturation.

Predictors of cognitive impairment prevalence and incidence

Table 2 presents the binary logistic regression results of the factors related to CI prevalence at baseline in the whole, female, and male samples. Women were 70% more likely than men, in terms of odds, to have CI at baseline (odds ratio [OR] = 1.70; p = .02). In the total, female, and male samples, education and IADL limitations were significantly...
related to the odds of having CI, respectively. A 1-year increase in schooling was associated with 25% decreased odds of CI in the total sample (OR = 0.75; \( p < .001 \)), 26% decreased odds (OR = 0.74; \( p < .001 \)) in women, and 22% decreased odds in men (OR = 0.78; \( p < .001 \)). One more limitation in IADL was associated with 13% (OR = 1.13; \( p < .001 \)) in the total sample, 10% (OR = 1.10; \( p < .001 \)) in women, and 18% increased odds (OR = 1.1; \( p < .001 \)) in men, respectively. Lower education levels and more IADL limitations were risk factors. It is noted that age was not related to CI among men, but it was a significant predictor among women and the total samples, respectively.

### Table 2. Logistic regression of factors related to cognitive impairment prevalence at baseline

<table>
<thead>
<tr>
<th></th>
<th>Total (n = 2356)</th>
<th>Women (n = 1328)</th>
<th>Men (n = 1028)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>( P )-value</td>
<td>OR (95% CI)</td>
</tr>
<tr>
<td>Female</td>
<td>1.70 (1.10-2.61)</td>
<td>.02</td>
<td>1.07 (1.04-1.11)</td>
</tr>
<tr>
<td>Age</td>
<td>1.06 (1.03-1.08)</td>
<td>&lt;.001</td>
<td>0.74 (0.70-0.79)</td>
</tr>
<tr>
<td>Education</td>
<td>0.75 (0.71-0.79)</td>
<td>&lt;.001</td>
<td>0.79 (0.54-1.15)</td>
</tr>
<tr>
<td>Married</td>
<td>1.16 (0.77-1.75)</td>
<td>.48</td>
<td>1.27 (0.80-2.02)</td>
</tr>
<tr>
<td>Medical condition</td>
<td>0.91 (0.81-1.03)</td>
<td>.16</td>
<td>0.94 (0.81-1.09)</td>
</tr>
<tr>
<td>ADL</td>
<td>1.05 (0.97-1.13)</td>
<td>.24</td>
<td>1.02 (0.94-1.12)</td>
</tr>
<tr>
<td>IADL</td>
<td>1.13 (1.10-1.17)</td>
<td>&lt;.001</td>
<td>1.10 (1.07-1.15)</td>
</tr>
<tr>
<td>Depression</td>
<td>1.02 (0.98-1.06)</td>
<td>.32</td>
<td>1.04 (1.00-1.09)</td>
</tr>
<tr>
<td>Acculturation</td>
<td>1.04 (0.99-1.10)</td>
<td>.15</td>
<td>0.99 (0.90-1.08)</td>
</tr>
<tr>
<td>Immigration reuni</td>
<td>1.25 (0.789-2.02)</td>
<td>.35</td>
<td>1.53 (0.85-2.77)</td>
</tr>
<tr>
<td>Involuntary immigration</td>
<td>0.91 (0.59-1.42)</td>
<td>.69</td>
<td>0.98 (0.58-1.68)</td>
</tr>
<tr>
<td>Immigration for better life</td>
<td>0.93 (0.60-1.43)</td>
<td>.75</td>
<td>1.12 (0.68-1.85)</td>
</tr>
<tr>
<td>Age at migration</td>
<td>1.02 (1.00-1.44)</td>
<td>.10</td>
<td>1.01 (0.99-1.04)</td>
</tr>
</tbody>
</table>

### Table 3. Logistic regression of factors related to cognitive impairment incidence at wave 2

<table>
<thead>
<tr>
<th></th>
<th>Total (n = 2356)</th>
<th>Women (n = 1328)</th>
<th>Men (n = 1028)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>( P )-value</td>
<td>OR (95% CI)</td>
</tr>
<tr>
<td>Female</td>
<td>2.59 (1.54-4.36)</td>
<td>&lt;.001</td>
<td>1.12 (1.08-1.17)</td>
</tr>
<tr>
<td>Age</td>
<td>1.12 (1.08-1.16)</td>
<td>&lt;.001</td>
<td>0.81 (0.75-0.86)</td>
</tr>
<tr>
<td>Education</td>
<td>0.84 (0.79-0.88)</td>
<td>&lt;.001</td>
<td>0.74 (0.47-1.16)</td>
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<tr>
<td>Medical condition</td>
<td>1.51 (0.92-2.47)</td>
<td>.11</td>
<td>1.35 (0.77-1.15)</td>
</tr>
<tr>
<td>ADL</td>
<td>1.01 (0.86-1.17)</td>
<td>.94</td>
<td>0.95 (0.84-1.05)</td>
</tr>
<tr>
<td>IADL</td>
<td>1.10 (0.96-1.25)</td>
<td>.17</td>
<td>1.21 (1.02-1.44)</td>
</tr>
<tr>
<td>Depression</td>
<td>0.97 (0.92-1.03)</td>
<td>.33</td>
<td>0.99 (0.93-1.05)</td>
</tr>
<tr>
<td>Immigrant reuni</td>
<td>1.07 (1.02-1.11)</td>
<td>.003</td>
<td>1.05 (1.00-1.10)</td>
</tr>
<tr>
<td>Acculturation</td>
<td>0.92 (0.84-1.01)</td>
<td>.09</td>
<td>0.94 (0.84-1.05)</td>
</tr>
<tr>
<td>Involuntary immigration</td>
<td>1.30 (0.74-3.20)</td>
<td>.36</td>
<td>1.56 (0.78-3.13)</td>
</tr>
<tr>
<td>Immigration for better life</td>
<td>0.91 (0.54-1.53)</td>
<td>.72</td>
<td>0.89 (0.47-1.70)</td>
</tr>
<tr>
<td>Age at migration</td>
<td>0.99 (0.55-1.55)</td>
<td>.60</td>
<td>0.99 (0.98-1.01)</td>
</tr>
</tbody>
</table>

### Overall model evaluation

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Total (OR = 2356)</th>
<th>Women (OR = 1328)</th>
<th>Men (OR = 1028)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood ratio test</td>
<td>577.60 (14)</td>
<td>397.14 (13)</td>
<td>168.30 (13)</td>
</tr>
<tr>
<td>( P )-value</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Score test</td>
<td>735.30 (14)</td>
<td>441.12 (13)</td>
<td>312.98 (13)</td>
</tr>
<tr>
<td>( P )-value</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Wald test</td>
<td>322.25 (14)</td>
<td>215.45 (13)</td>
<td>100.29 (13)</td>
</tr>
<tr>
<td>( P )-value</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; OR, odds ratio.

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Abbreviations: ADL, activity of daily living; CI, confidence interval; df, degrees of freedom; IADL, instrumental activity of daily living; OR, odds ratio.
increase in age was associated with 6% (OR = 1.06; p < .001) in the total sample, and 7% (OR = 1.07; p < .001) increased odds of CI in women.

Table 3 reports the results of the factors related to CI incidence at wave 2. Compared with men, women were more than two times more likely, in terms of odds, to develop CI at 2-year follow-up (OR = 2.59; p < .001). Similar to the results of the CI prevalence model, older age, fewer years of education, and more IADL limitations were related to more risk of CI incidence in the samples across sex. In addition, one more ADL was related to 21% increased risk (OR = 1.21; p = .03) in the female sample. None of the immigration-related factors were related to CI prevalence or incidence.

DISCUSSION
Using the PINE study, the only epidemiological study that has collected cognition data in a population-based sample of US Chinese adults, we investigated the association between immigration-related factors and CI in this population. The literature is mostly focused on Mexican Americans with inconsistent findings regarding the immigration effect on cognitive functioning. Previous research also neglected whether sex differences existed in the immigration-cognition associations. Our study examined, for the first time, whether CI rates vary by age at migration, migration reasons, and acculturation levels among older Chinese women and men.

The first hypothesis about immigration-related risk factors was not supported. Findings indicated that age at migration, immigration reasons, and acculturation do not matter for CI after equalizing the well-established effects of age and education on cognition. There may be many underlying reasons. In our study, about two-thirds of respondents migrated after age 50 years, and very few came to the United States involuntarily for the reasons of family conflict, financial problems, or political asylum. Most immigrated for family reunification, which may bring in their early- and middle-life experience and family support. In addition, taking care of grandchildren was another major reason for immigration. When young adults came to the United States to pursue higher education and eventually to start a family, it was common to call on their parents to provide child care. As soon as they arrived in the United States, older adults were quick to integrate into the family network and contribute to family care and support. Active roles in family life may reverse the negative effects of immigration and acculturation stress on cognitive decline. Acculturation can be both a risk and a protective factor of various health behaviors in the US Latino populations. The acculturation effect on health behaviors and outcomes among Chinese immigrants is still unclear. Future research is needed to assess the direct and indirect effects of acculturation or cultural change on cognition-related biological and behavioral processes.

The second hypothesis was partially supported. Our study showed that women were cognitively disadvantaged as compared with men. Women were more likely than men to have CI at baseline and even more likely to develop CI within the 2-year observation period. In addition, women had worse mental and physical health conditions than men in our study sample, with more depressive symptoms, chronic conditions, and more ADL and IADL limitations. However, immigration-related factors were not associated with cognitive disadvantages across sex in older Chinese immigrants.

As shown in previous studies, CI is strongly associated with functional disability measured by basic and functional ADLs. Our study found that functional disability, especially IADLs, was predictive of CI, indicating that a bidirectional or reciprocal relationship may exist between functional disability and CI. Difficulties in performing functional and IADLs are markers of increased risk of future incident CI and vice versa.

The present study has several limitations. Results from a particular area in the United State have limited generalizability to other regions. Categorization of immigration reasons into three binary variables is somewhat arbitrary, and they were not mutually exclusive, that is, one could choose more than one reason, and we did not examine the multiple reasons for immigration because a majority (91%) reported more than one reason. Due to a small number of respondents whose C-MMSE scores were below 18 at wave 2, results of logistic regression analyses on incident CI may not be valid and should be interpreted with caution. Given the small effect size (OR < .30) and low observed power (0.11-0.46) in this study, future research needs to build on a theory-based framework with well-crafted conceptual models and well-defined measures. We did not have measures of acculturative stress that can directly influence cognitive function or health-related quality of life. Using acculturation of preferred language use, media use, and ethnic identity of social interaction may not capture the acculturative stress on cognitive functioning. Our sample may have been biased toward persons who tend to be cognitively active, and those with CI were unable to participate in the study. Lastly, the use of two waves of data limits the ability to infer causal directions.

Despite these limitations, our study implies that immigration and acculturative process may present different challenges and affect health outcomes differently across racial/ethnic groups or by nativity. Age at immigration, immigration reasons, and acculturation may not account for the variance in cognitive function among older Chinese immigrants. Future research efforts are needed to focus on the intersection of aging and immigration and the confluence on cognitive functioning, and to investigate whether the risk of CI in late life is related more to the biological and contextual factors earlier in the life course than to the immigration experience and cultural change in the later years of life. In practice, regular and careful assessment of cognitive performance of those with functional disabilities is important. And maintaining and enhancing physical functioning is strongly encouraged to prevent cognitive decline among older adults, especially among women.

In conclusion, in this large population-based epidemiological study, we found sex differences in CI prevalence and incidence with older Chinese women more cognitively disadvantaged than men. Decreasing sex disparities in the risk of dementia may therefore require increased attention and efforts to reduce educational and health disparities in the early life stage. Further, active engagement with life and maintaining physical and cognitive functioning are
interrelated to define and shape the aging process, which is perhaps more important to older Chinese immigrants who are facing linguistic and social isolation.

ACKNOWLEDGMENTS

Conflict of Interest: The authors have declared no conflicts of interest for this article.

Author Contributions: All authors contributed to study design, data analysis, interpretation of data, and preparation of the manuscript.

Sponsor’s Role: There was no sponsor for this work.

REFERENCES

Perceived Stress and Cognitive Decline in Chinese-American Older Adults

Yiwei Chen, PhD,* Ying Liang, PhD,† Wei Zhang, PhD,‡ Jennifer C. Crawford, BA,* Katie L. Sakel, MS,* and XinQi Dong, MD, MPH§

OBJECTIVES: To examine whether higher levels of perceived stress are associated with lower levels of cognitive function and faster cognitive decline in older Chinese-American adults.

DESIGN: Longitudinal.


PARTICIPANTS: PINE is the largest population-based epidemiological study of Chinese Americans aged 60 and older in the greater Chicago area. Wave 1 data were collected from 3,159 older adults during 2011 to 2013. Wave 2 data were collected from 2,713 older adults during 2013 to 2015.

MEASUREMENTS: In addition to sociodemographic and health-related variables, participants completed the Chinese Perceived Stress Scale and multiple cognitive tasks. Episodic memory was assessed using the East Boston Memory Tests, perceptual speed was assessed using the Symbol Digit Modalities Test, and working memory was assessed using the Digit Span Backwards.

RESULTS: Controlling for sociodemographic and health-related variables, mixed-effects regression models showed that higher levels of perceived stress were associated with poorer episodic memory, perceptual speed, and working memory in older Chinese-American adults but not with faster cognitive decline over an average 2-year interval.

CONCLUSION: The present study is the first population-based, longitudinal study to examine the relationships between perceived stress and cognitive decline in older Chinese-American adults. It suggests the importance of researchers, social workers, and policy makers developing programs to reduce stress and improve cognitive function in older Chinese-American adults. J Am Geriatr Soc 67:S519–S524, 2019.

Key words: minority aging; perceived stress; cognitive functions; cognitive decline

The prevalence of cognitive decline and impairment generally increases with age.1–4 It is estimated that 12.7% of adults aged 60 and older in the United States have declined cognitively over the past 12 months.5 Population-based studies have found that 17% to 34% of community-dwelling older adults are cognitively impaired.6 Cognitive decline and impairment can lead to functional limitations and loss of independence in older adults.7,8 Thus, it is important to identify risk factors that contribute to cognitive decline and impairment. Stress is usually considered to be a risk factor for cognitive decline and impairment.9 The relationship between stress and cognition has received considerable attention in recent years.10–13 A systematic literature review11 suggested that stress can affect brain and cognitive functions throughout the lifespan.

According to a transactional stress model,14 perceived stress represents the psychological perception of environmental demands exceeding individual coping resources and is a core component of the stress process, resulting in adverse cognitive and physical outcomes. Cognitive function declines with age.5 When facing environmental demands (e.g., acculturation stress), older adults who have fewer coping resources (e.g., language barriers) to manage the stress may have poorer cognitive function and faster cognitive decline. Stress can influence cognitive function in older adults through a number of biological mechanisms.15 For example, chronic stress can activate the hypothalamic–pituitary–adrenal axis and stimulate release of glucocorticoids, which in turn can lead to long-lasting structural changes in the brains of older adults and faster cognitive...
Many previous studies with human participants have examined the association between perceived stress and cognitive function, but few have examined its association with cognitive decline. A longitudinal design is necessary to study the association between perceived stress and rate of cognitive decline. Using an experimental design, the relationship between global perceived stress and cognitive decline was examined over a 2-year period in 116 older American (primarily white). That study found that higher levels of global perceived stress predicted poorer performance on tasks of attention, working memory, and speed of processing in older adults but did not predict faster cognitive decline.

Few previous studies have examined the effect of perceived stress on cognitive function and cognitive decline in older adults using population-based, longitudinal data. One of the first examined the relationship between perceived stress and cognitive decline in 6,207 black and white older adults over an average of 6.8 years of follow-up. It found that higher levels of perceived stress were associated not only with lower levels of cognitive performance, but also with faster cognitive decline. Because of the conflicting findings of the previous studies, the present study aimed to examine the relationships between perceived stress and cognitive function and decline using the Population Study of Chinese Elderly in Chicago (PINE).

Previous research revealed that older Chinese-American adults experienced higher levels of perceived stress than their white counterparts. In addition to challenges of physical aging, older immigrants face acculturation stress, including language barriers, intergenerational differences in cultural values, disrupted social relationships and community support, and limited access to health insurance and health services. Although the exact rate of cognitive impairment in older Chinese-American adults is understudied, evidence suggests that Asian Americans have similar or higher rates of impairment and dementia than older white adults. PINE is a large population-based longitudinal study of Chinese-American adults aged 60 and older in the Greater Chicago area. In the initial assessment during 2011 to 2013, approximately 74% of 3,159 Chinese older adults perceived some level of daily stress in the past month. This was in contrast to 46% of older white adults, who reported substantially lower levels of daily life stress. The current study was designed to determine whether the high levels of perceived stress of older Chinese-American adults affect their cognitive function and decline.

Comprehensive cognitive tests are seldom administered to older Chinese-American adults, perhaps because of language barriers. In PINE, a battery of cognitive tests was administered in the preferred language of Chinese older adults to assess multiple cognitive functions, including episodic memory, perceptual speed, and working memory. The present study used data from 2 waves of the PINE; Wave 1 data were collected from 3,159 older adults during 2011 to 2013, and Wave 2 data were collected from 2,713 older adults during 2013 to 2015. Based on the transactional stress model and previous research on stress and cognition, we made the hypotheses that higher levels of perceived stress would be associated with lower levels of cognitive functions in older Chinese-American adults and faster cognitive decline.

**METHODS**

**Population and Settings**

PINE is a community-engaged, population-based epidemiological study of Chinese-American adults aged 60 and older living in the greater Chicago area. It has implemented culturally and linguistically appropriate community recruitment strategies guided by a community-based participatory research approach. Trained bicultural research assistants interviewed participants according to the participants’ preference. Demographic characteristics of the PINE sample were comparable with those available from the 2010 US Census and a random street-block census of the Chinese community in Chicago. Wave 1 data were collected from 2011 to 2013. Of 3,542 eligible Chinese older adults contacted, 3,159 agreed to participate, a response rate of 91.9%. Wave 2 data were collected from 2013 to 2015 from 2,713 older adults (86% of Wave 1 sample). Of the 444 older adults who did not participate in Wave 2, 115 had died, 186 were lost to follow-up, and 143 refused to attend. We used participants with data from both waves.

**Measures**

**Perceived Stress**

The Chinese Perceived Stress Scale (PSS-10) was used to assess how often life situations were perceived as stressful in the last month. Respondents indicated answers to each question on a 5-point scale (0 = never, 4 = very often). Total scores ranged from 0 to 40, with higher scores indicating greater psychological stress. The PSS-10 demonstrated good internal consistency (α = .86).

**Cognitive Function**

A battery of cognitive tests was administered in face-to-face interviews. Three cognitive functions were assessed: episodic memory, perceptual speed, and working memory. Episodic memory was a composite of the East Boston Memory Test—Immediate Recall and the East Boston Memory Test—Delayed Recall. Perceptual speed was measured using the Symbol Digit Modalities Test, an 11-item test that required rapid perceptual comparisons of numbers and symbols in 90 seconds. Working memory was assessed using the Digit Span Backwards, which was drawn from the Wechsler Memory Scale—Revised. Raw scores of these cognitive tests were converted to z-scores using means and standard deviations of the distribution of the scores of all participants on the tests. All scores are normally distributed at both waves.

**Time**

Time was modeled as a continuous variable in years, months, and days since the initial assessment at Wave 1.
Control Variables

The following sociodemographic and health-related variables were controlled: age, sex (female = 1), marital status (married = 1), income ($10,000 or more annually), years of formal education, years living in the United States, health status (1 = good or excellent), and medical comorbidity (sum of up to 9 chronic conditions such as heart disease and stroke). The Patient Health Questionnaire was used to assess depressive symptoms. Participants indicated the frequency with which they had experienced 9 depressive symptoms in the last 2 weeks on a 4-point scale (0 = not at all, 3 = nearly every day). Because of lower endorsement and skewed distribution, depressive symptoms were dichotomized as 0 (no symptom) or 1 (any depressive symptoms).

Analysis

To test the relationships between perceived stress and cognitive function between perceived stress and rate of cognitive decline, we used mixed-effects regression models. For each cognitive function, we first ran an unadjusted model (Model 1) that included perceived stress at Wave 1, time (modeled as a continuous variable in years, months, and days since initial interview), and the interaction between perceived stress and time. The stress main effect tested the first hypothesis. The time main effect tested whether cognitive decline was significant. The interaction between stress and time tested the second hypothesis. Then we ran an adjusted model (Model 2) controlling for sociodemographic and health-related variables (age, sex, marital status, education, income, years in the United States, health status, chronic medical conditions, depressive symptoms). All analyses were performed using SAS version 9.2 (SAS Institute, Inc., Cary, NC).

RESULTS

Sample characteristics, perceived stress, and cognitive function are described in Table 1. Figure 1 illustrates cognitive decline from Wave 1 to Wave 2.

Table 2 describes results of the mixed-effects regression models on episodic memory. Supporting the first hypothesis, levels of perceived stress were significantly associated with episodic memory. In the unadjusted model (Model 1), each 1-point higher level of perceived stress was associated with a 0.015-unit lower episodic memory score ($p < .001$). In the adjusted model (Model 2), the main stress effect ($b = -0.009$) remained significant ($p < .001$) after controlling for the sociodemographic and health-related variables. The time main effect was not significant for episodic memory. The second hypothesis was tested using the interaction between stress and time. Contrary to prediction, level of perceived stress was not significantly associated with faster decline in episodic memory.

Table 3 shows the results of the mixed-effects regression models on perceptual speed. Supporting the first hypothesis, levels of perceived stress were significantly associated with initial levels of perceptual speed. In the unadjusted model (Model 1), each 1-point higher level of perceived stress was associated with a 0.022-unit lower perceptual speed score ($p < .001$). In the adjusted model (Model 2), the main stress effect ($b = -0.013$) remained significant ($p < .001$), after controlling for the sociodemographic and health-related variables, although level of perceived stress was not significantly associated with faster decline in perceptual speed.

Table 4 shows results of the mixed-effects regression models on working memory. Supporting the first hypothesis, levels of perceived stress were again significantly associated with initial levels of working memory. In the unadjusted model (Model 1), each 1-point higher level of perceived stress was associated with a 0.014-unit lower working memory score ($p < .001$). In the adjusted model (Model 2), the main stress effect ($b = -0.008$) remained significant ($p < .01$), after controlling for the sociodemographic and health-related variables. Similar to episodic memory and perceptual speed, level of perceived stress was not significantly associated with faster decline in working memory.

Patterns of covariates with different cognitive functions were also noteworthy. More education, more years living in the United States, better health status, and no depressive symptoms were significantly associated with better episodic memory; younger age, being male, higher education, and higher income were related to better perceptual speed; and younger age, being male, more education, better health status, and no depressive symptoms were associated with better working memory. Of the sociodemographic and health-related variables, age and education were consistently associated with all 3 cognitive functions.

DISCUSSION

In this population-based, longitudinal study of 2,713 older Chinese-American adults, we found that higher levels of perceived stress were related to poorer performance in all 3 cognitive functions (episodic memory, perceptual speed, working memory). More importantly, the patterns of associations were essentially the same after controlling for sociodemographic (age, sex, marital status, education, income, years of living in the United States) and health-related (self-rated health status, chronic medical conditions, and depressive symptoms) variables, but contrary to our hypothesis, level of perceived stress was not associated with faster cognitive decline over an average 2 years of follow-up. This is the first study to examine the relationships between perceived stress and cognitive decline in older Chinese-American adults.

Supporting the transactional model of stress, the present study suggests that perceived stress could profoundly influence cognitive functions in older Chinese-American adults. Levels of perceived stress are substantially higher in older Chinese-American adults than in their white counterparts. Older Chinese-American adults may experience the combination of age-related decline in physical health and immigration-related disadvantages in social support and coping resources. It is estimated that more than 80% of the U.S Chinese older adults were born in foreign countries and that 30% immigrated to the United States after the age of 60. Immigration literature has documented language and cultural barriers, disrupted social relationships and social support, lower levels of education and income, and limited access to health insurance and health services as sources of stress in Chinese immigrants.
the present study, the length of time living in the United States was positively related to episodic memory ($b = .00$, standard error $0.00$, $p < .05$), suggesting that acculturation may reduce stress and promote cognitive function in older Chinese adults. Using a population-based, longitudinal study, our results are consistent with the model and findings of previous research on stress and cognition, revealing that higher levels of perceived stress were associated with poorer performance on multiple cognitive tasks in immigrant older adults.

Contrary to previous study findings, the present study did not find that higher levels of perceived stress predicted faster cognitive decline. This may be due to the difference in the average intervals of follow up. The previous study had an average interval of 6.8 years, whereas PINE had an average interval of only 2 years. The average performance of episodic memory declined only slightly 0.02 units over time. Perceptual speed declined 0.05 units and working memory 0.11 units between the 2 waves. Higher levels of stress may not make any long-lasting structural changes in the brain of older adults and faster cognitive decline in such short period of time. Longer duration and multiple waves of data may provide better estimates of rates of cognitive decline in older adults.

It is also possible that cognitive decline is a continuous process, but the stress measure in the present study was a transient measure that assessed how often life situations were perceived as stressful in the last month. Although it has been argued that it is likely that the measure reflected chronic stress levels, transient and chronic measures are not the same. A recent study of the effects of transient and chronic loneliness on cognitive function in older adults found that chronic loneliness had more pronounced negative effects on the brain health of older adults than transient loneliness. Future studies may use transient and chronic measures to assess stress.

**Limitations**

The findings of the present study should be interpreted with caution. Although PINE has a longitudinal design, we are able to analyze only 2 waves of data, with an average interval of 2 years. Thus, we could not thoroughly examine the longitudinal relationships between change in perceived stress and change in cognitive function. Future research should use more waves of data to better estimate the longitudinal relationship between perceived stress and cognitive decline. Second, the cognitive battery used in PINE did not capture a full range of cognitive function. More cognitive tests, such as those reflecting crystalized intelligence (e.g., vocabulary), may allow more comprehensive understanding of change in different types of cognitive function.

In addition, clinical assessment of older adults’ cognitive impairment is lacking in PINE. Thus, we do not know whether cognitive decline was faster for those older adults diagnosed with cognitive impairment. Future studies might use some established measures of cognitive impairment, such as the Trail-Making Test. Finally, this population-based study was conducted in the greater Chicago area. Although it has been shown that the PINE sample was representative of US Chinese population in the 2010 US Census, caution should be taken in generalizing the

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**Table 1. Sample Characteristics, Perceived Stress, and Cognitive Functions**

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>M±SD(N%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>2713</td>
<td>72.63±8.15</td>
</tr>
<tr>
<td>Sex: (Female)</td>
<td>2713</td>
<td>1584(58.39%)</td>
</tr>
<tr>
<td>Education</td>
<td>2700</td>
<td>8.65±5.05</td>
</tr>
<tr>
<td>Years Lived in the US</td>
<td>2701</td>
<td>19.68±12.52</td>
</tr>
<tr>
<td>Income: (More than $10,000)</td>
<td>2682</td>
<td>2302 (85.83%)</td>
</tr>
<tr>
<td>Marital Status: (Married)</td>
<td>2712</td>
<td>1922 (70.87%)</td>
</tr>
<tr>
<td>Depressive Symptoms: (Any)</td>
<td>2700</td>
<td>1473 (54.56%)</td>
</tr>
<tr>
<td>Health Status: (Good/Very Good)</td>
<td>2713</td>
<td>1051 (38.75%)</td>
</tr>
<tr>
<td>Medical Comorbidity</td>
<td>2713</td>
<td>2.07±1.45</td>
</tr>
<tr>
<td>Perceived Stress</td>
<td>2687</td>
<td>10.03±6.54</td>
</tr>
<tr>
<td>Time Between Wave 1 and Wave 2</td>
<td>2713</td>
<td>1.92±0.30</td>
</tr>
<tr>
<td>Cognitive Functions (Wave 1)</td>
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<td></td>
</tr>
<tr>
<td>Episodic Memory</td>
<td>2677</td>
<td>-0.03±0.97</td>
</tr>
<tr>
<td>Working Memory</td>
<td>2677</td>
<td>0.00±0.99</td>
</tr>
<tr>
<td>Perceptual Speed</td>
<td>2171</td>
<td>-0.05±0.91</td>
</tr>
<tr>
<td>Cognitive Functions (Wave 2)</td>
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<tr>
<td>Episodic Memory</td>
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<td>-0.05±0.98</td>
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<tr>
<td>Working Memory</td>
<td>2676</td>
<td>-0.11±1.00</td>
</tr>
<tr>
<td>Perceptual Speed</td>
<td>2631</td>
<td>-0.10±1.06</td>
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---

**Figure 1.** Cognitive decline from Wave 1 to Wave 2. [Color figure can be viewed at wileyonlinelibrary.com]
### Table 2. Mixed-Effects Regression Models on Episodic Memory

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1</th>
<th></th>
<th>p-value</th>
<th>Model 2</th>
<th></th>
<th>p-value</th>
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<td>b</td>
<td>SE</td>
<td></td>
<td>b</td>
<td>SE</td>
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</tr>
<tr>
<td>Intercept</td>
<td>-0.11</td>
<td>0.14</td>
<td>0.45</td>
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<td>0.12</td>
<td>0.90</td>
</tr>
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<td>0.003</td>
<td>&lt; 0.001</td>
<td>-0.009</td>
<td>0.003</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Time Between Wave 1 and Wave 2</td>
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<td>0.07</td>
<td>0.09</td>
<td>-0.01</td>
<td>0.06</td>
<td>0.88</td>
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<tr>
<td>Stress x Time</td>
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<td>0.01</td>
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<td>0.71</td>
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<td>Age</td>
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<td>&lt; 0.001</td>
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<tr>
<td>Gender</td>
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<tr>
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<tr>
<td>Education</td>
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<td>&lt; 0.001</td>
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<tr>
<td>Income</td>
<td>0.08</td>
<td>0.04</td>
<td>0.04</td>
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<tr>
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<tr>
<td>Perceived Health Status</td>
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<td>0.01</td>
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<td>0.13</td>
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<tr>
<td>Depressive Symptoms</td>
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### Table 3. Mixed-Effects Regression Models on Perceptual Speed

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<th>p-value</th>
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<td>SE</td>
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<td>0.14</td>
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<td>0.12</td>
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<td>0.01</td>
<td>0.84</td>
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<td>Income</td>
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### Table 4. Mixed-Effects Regression Models on Working Memory

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<td>0.34</td>
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<td>&lt; 0.001</td>
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<td>-0.01</td>
<td>0.06</td>
<td>0.88</td>
</tr>
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</tr>
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<td>0.09</td>
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<tr>
<td>Medical Comorbidity</td>
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<td>0.03</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Depressive Symptoms</td>
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<td>0.03</td>
<td>0.01</td>
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</table>
results of the present study to older Chinese adults living in other regions of the United States.

CONCLUSION

Despite these limitations, the present study is the first population-based, longitudinal study to examine the relationships between perceived stress and cognitive function and decline in older Chinese-American adults. Higher levels of perceived stress predicted poorer performance in multiple cognitive functions but were not associated with faster cognitive decline over 2 years. These findings have broad implications for researchers, social workers, and policy makers. Sources of higher levels of stress need to be identified in older Chinese-American adults and compared with those of older white adults. Social workers can also use the sociodemographic and health-related variables to profile the high-risk groups of older Chinese-American adults. Inventions designed to reduce stress can be used to improve cognitive function in older Chinese-American adults.

ACKNOWLEDGMENTS

Conflict of Interest: The authors declare no potential conflict of interest with respect to the research, authorship, or publication of this article.

Author Contributions: All authors: study design, data analysis, interpretation of data, manuscript preparation.

Sponsor’s Role: The preparation of the paper was supported by the General Program of the National Natural Science Foundation of China (71874076, 71473117) and the National Natural Science Fund for Distinguished Young Scholars (71622013).

REFERENCES

OBJECTIVES: To examine whether and how early-life experiences such as years of schooling affect late-life cognitive function through a pathway of activity engagement.

DESIGN: Prospective.

SETTING: We used data from 2 waves of the Population Study of Chinese Elderly in Chicago (PINE).

PARTICIPANTS: PINE is the largest population-based epidemiological study of Chinese-American adults aged 60 and older in the greater Chicago area. Wave 1 data were collected for 2 years, from July 2011 to June 2013, and Wave 2 data were collected from 2013 to 2015; total sample size was 2,713.

MEASUREMENTS: Education was measured in years of schooling. Activity engagement was assessed using 15 items grouped into two clusters: cognitive activity and social activity. Cognitive function was evaluated using five instruments to assess general mental status (Chinese Mini-Mental State Examination (C-MMSE)), episodic memory, perceptual speed, working memory, global cognition score.

RESULTS: Adjusting for sociodemographic and health-related control variables, education measured at Wave 1 was associated with better global cognition (β = 0.025, p < .001), C-MMSE (β = .037, p < .001), episodic memory (β = .026, p < .001), Symbol Digit Modalities Test perceptual speed (β = .036, p < .001), and Digit Span Backward working memory (β = .047, p < .001) at Wave 2. Activity engagement, cognitive activity in particular, significantly mediates the effect of education on all cognitive tests, with the size of the mediating effect ranging from 16% to approximately 24%.


Key words: education; cognitive function; activity engagement; Chinese older adults

Because of advances in public health and biomedicine, Americans are living longer than ever before. Life expectancy at birth in the United States in 2015 was 79.3, 5 years longer than 3 decades before,1 but living longer is not always an unmixed blessing because it is often associated with a greater prevalence of chronic conditions, including cognitive impairment, that are largely age related.2,3 Approximately 12.7% of US adults aged 60 and older have experienced cognitive decline in the past 12 months,4 and more than 1 in 5 individuals aged 71 to 79 has cognitive impairment.6 Cognitive impairment is usually a precursor to various forms of dementia7 that contribute to disability and loss of independence,6,8–10 thus greatly undermining the quality of life of older adults. Given the increasing burden of cognitive impairment, it is imperative to examine its social antecedents to prevent and delay it in older adults. Focusing on education, one of the most powerful and robust determinants of health disparity,11,12 this study aimed to examine whether and how early-life experiences affect late-life cognition using a life course perspective.13

Having more education is positively associated with better health, longer life,12,14,15 and better cognitive performance in later life.16 Specifically, having less education is a strong risk factor for cognitive impairment and dementia,17 whereas having more education protects against faster rates of cognitive decline.18,19 That said, recent studies using longitudinal data and sophisticated statistical methods suggest...
that associations between education and decline in domains of cognitive function are complex and inconclusive.\textsuperscript{20–25} Therefore, effects of education on cognitive change over time should be interpreted with caution for different populations when diverse cognitive tests are used.

Several pathways underlying education and cognitive function have been proposed in prior research. First, as a core component of socioeconomic status that indicates human capital such as abilities, skills, and attitudes,\textsuperscript{12} education has direct effects on brain development and function through enhancing synaptic density\textsuperscript{20} and maintaining adequate and stable cerebral blood flow.\textsuperscript{26,27} which increases brain reserve capacity to protect against brain damage.\textsuperscript{27} In addition, based on the “use it or lose it” hypothesis, education may affect cognitive function indirectly by weaving disparate health linking behaviors and practices into a coherent and healthy lifestyle.\textsuperscript{12} Regular engagement in meaningful activities that fulfill sense of purpose in people’s life often promotes cognitive function because these activities often require and reinforce cognitive skills. Recent studies suggest that better educated older Chinese adults are more likely to engage in activities that are socially integrating and cognitively challenging.\textsuperscript{18,29} Engaging in activities, in turn, is considered to be an important modifiable midlife risk factor for late-life cognitive impairment\textsuperscript{30} because it enhances cognitive reserve, which promotes efficient use of brain networks, making older adults less vulnerable to age-related cognitive decline.

This study focuses on US Chinese older adults, an understudied but rapidly growing population that may be at high risk of cognitive impairment. With approximately 14% of Chinese Americans being aged 65 and older,\textsuperscript{31} this population is among the fastest growing aging racial and ethnic populations. With limited knowledge of dementia and barriers to timely diagnosis, treatment, and service access, Chinese Americans are often more vulnerable to risk of cognitive impairment.\textsuperscript{32} Using the first epidemiological survey of US Chinese older adults, this examined the relationship between Wave 1 educational attainment and activity engagement and Wave 2 cognitive function assessed using various cognitive tests gauging general mental status, perceptual speed, and memory. These aspects of cognition often have different trajectories over the life span and may thus have different associations from one another with earlier-life educational experiences.\textsuperscript{27} Based on prior theories and research, we hypothesized that having more education, typically completed early in life, would be associated with better Wave 2 cognitive function, controlling for baseline cognitive status, and that cognitive activity and social activity would partially mediate the association between baseline education and Wave 2 cognitive function. By controlling for baseline cognition, our analysis has the advantage of examining a form of cognitive change that reduces the chance of endogeneity. Findings will shed light on the long-term effect of early-life experiences on late-life cognitive performance.

**METHODS**

**Study Population**

To test the proposed hypotheses, we used data from 2 waves of the Population Study of Chinese Elderly in Chicago (PINE), the largest population-based epidemiological study of Chinese-American adults aged 60 and older in the greater Chicago area.\textsuperscript{34} PINE takes a community-based participatory research approach, and its primary purpose is to examine cultural determinants of health and well-being of Chinese-American older adults.\textsuperscript{35} Respondents of all cognitive abilities were enrolled at baseline and follow-up if they were able and willing to provide informed consent. Trained bicultural research assistants interviewed respondents in English or a Chinese dialect, including Mandarin, Cantonese, Taishanese, and Teochew, according to their preference. Wave 1 data were collected for 2 years, from July 2011 to June 2013. Of 3,542 eligible Chinese older adults contacted, 3,159 agreed to participate, a response rate of 91.9%. Wave 2 data were collected from 2013 to 2015 from a total sample size of 2,713, yielding an attrition rate of approximately 14% (115 having died, 186 were lost to follow-up, 143 refused to participate). Mean level of education for the whole sample was 8.7 ± 5.0 years (Table 1). Mean social activity score was 9.0 ± 4.8, and mean cognitive activity score was 8.4 ± 5.8. Mean age was 72.5, the average number of chronic conditions was 2, mean annual income is approaching the income level ranging from $5,000–$9,999, 58.3% were female, and 71.5% were married. We used a valid sample for each cognitive test as the dependent variable to make full use of the sample.

**Variables**

Cognitive function was measured using five instruments, assessing general mental status, episodic memory, perceptual speed, working memory, and global cognition. Based on the widely used Mini-Mental State Examination (MMSE) in epidemiological studies,\textsuperscript{36} the 30-item Chinese MMSE (C-MMSE) was used to measure general mental status. Respondents need to answer at least 26 questions to have a valid C-MMSE score. The C-MMSE has been found to have acceptable reliability and validity in older Chinese populations.\textsuperscript{37} Episodic memory was evaluated using summary scores of the East Boston Memory Test—Immediate Recall and the East Boston Memory Test—Delayed Recall of brief stories.\textsuperscript{38} Perceptual speed was gauged using the oral version of the 11-item Symbol Digit Modalities Test (SDMT), which calls for rapid perceptual comparisons of numbers and symbols for 90 seconds. Working memory was measured using Digit Span Backward (DB), drawn from the Wechsler Memory Scale—Revised.\textsuperscript{39} All 4 instruments were standardized into z-scores. A global cognitive score was calculated by averaging z-scores of the 4 tests. As summarized previously,\textsuperscript{40} this is useful because it increases statistical power by reducing random variability within tests and reduces floor and ceiling effects of particular tests. All composite measures, except for C-MMSE, were normally distributed at both waves.

The independent variable was years of education, and mediating variables were social activity and cognitive activity at Wave 1. Fifteen questions were grouped into 2 clusters: cognitive activity (including activities requiring more mental exercise and less social interaction than activities that were grouped into social activity) and social activity (including activities requiring less mental exercises and
more social interaction than activities that were grouped into cognitive activity)\(^4\) to assess frequency of engaging in these types of activities. The former comprised activities that are cognitively stimulating, including listening to the radio, reading the newspaper, reading magazines, reading books, playing games (e.g., cards, checkers, crosswords), and playing mahjong. The latter comprised activities that are socially integrated with others such as friends and relatives. For the questions, “How often do you listen to the radio; read newspapers; read magazines; read books; play games such as cards, checkers, crosswords, or other puzzles or games; play mahjong; go out to a movie, restaurant, or sporting event; visit relatives, friends, or neighbors; have people for a dinner or a party; and go on day trips or overnight trips?” a Likert scale (0 = once a year or less, 1 = several times a year, 2 = several times a month, 3 = several times a week, 4 = every day or almost every day) was used for responses. For the questions, “In the past five years, how many times have you visited a museum; attended a concert, play, or musical; visited a library; or visited a community center?” a different Likert scale (0 = never, 1 = 1–2 times, 2 = 3–9 times, 3 = 10–19 times, 4 = ≥20 times) was used. For the question, “How much time do you spend reading each day?” response categories were none (0), a few minutes (1), half an hour (2), 1 to 2 hours (3), 2 to 3 hours (4), and more than 3 hours (5). Measures of cognitive activity and social activity were summed indices, with scores for the former ranging from 0 to 33 and scores for the latter ranging from 0 to 32. The standardized alpha ranges from 0.66 to 0.75 for cognitive activity and social activity across waves.

We controlled for age, sex, marital status, income, activity of daily living (ADL) disabilities (eating, dressing, bathing, walking, transferring, grooming, incontinence, toileting), instrumental activity of daily living (IADL) disabilities (managing money, using telephone, preparing meals, doing laundry, taking medication, doing housework), and medical comorbidity (a count variable that examined the existence of heart disease; stroke or brain hemorrhage; cancer; high cholesterol; diabetes; high blood pressure; broken hip; thyroid disease; osteoarthritis, inflammation, joint problems). These sociodemographic and health-related factors are associated with cognitive function.\(^4\)\(^2\),\(^4\)

### Statistical Methods

Sample characteristics are summarized in Table 1. Associations between education and activities at Wave 1 and global cognition at Wave 2 are presented in Table 2. Model 1 included education and control variables. Cognitive activity was added to Model 2 and social activity to Model 3. Ordinary least squares (OLS) regression was used in these models. The Sobel test was used to assess the significance of mediating effects of activities. After this, domain-specific cognitive tests replaced the global cognition test. Because the C-MMSE has a skewed distribution, quantile regressions at the median were used. C-MMSE results are presented in Table 3. For episodic memory, perceptual

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent and mediating variables, mean ± SD</td>
<td></td>
</tr>
<tr>
<td>Education, years (n=2,605)</td>
<td>8.67 ± 5.02</td>
</tr>
<tr>
<td>Social activity (n=2,605)</td>
<td>9.05 ± 4.76</td>
</tr>
<tr>
<td>Cognitive activity (n=2,605)</td>
<td>8.39 ± 5.81</td>
</tr>
<tr>
<td>Dependent variables at Wave 2, mean ± SD</td>
<td></td>
</tr>
<tr>
<td>Episodic memory (n=2,581)</td>
<td>−0.04 ± 0.96</td>
</tr>
<tr>
<td>SDMT perceptual speed (n=2,531)</td>
<td>−0.06 ± 1.06</td>
</tr>
<tr>
<td>DB working memory (n=2,573)</td>
<td>−0.11 ± 1.00</td>
</tr>
<tr>
<td>C-MMSE (cognitive performance) (n=2,544)</td>
<td>−0.20 ± 1.14</td>
</tr>
<tr>
<td>Global cognition score (n=2,574)</td>
<td>−0.10 ± 0.85</td>
</tr>
<tr>
<td>Control variables at Wave 1, mean ± SD</td>
<td></td>
</tr>
<tr>
<td>Episodic memory (n=2,575)</td>
<td>−0.04 ± 0.97</td>
</tr>
<tr>
<td>SDMT perceptual speed (n=2,100)</td>
<td>−0.05 ± 0.91</td>
</tr>
<tr>
<td>DB working memory (n=2,581)</td>
<td>0</td>
</tr>
<tr>
<td>C-MMSE (cognitive performance) (n=2,537)</td>
<td>−0.00 ± 0.99</td>
</tr>
<tr>
<td>Global cognition score (n=2,571)</td>
<td>−0.02 ± 0.80</td>
</tr>
<tr>
<td>Age (n=2,605)</td>
<td>72.51 ± 8.12</td>
</tr>
<tr>
<td>Activities of daily living (n=2,605)</td>
<td>0.32 ± 1.92</td>
</tr>
<tr>
<td>Instrumental activities of daily living (n=2,605)</td>
<td>3.48 ± 5.94</td>
</tr>
<tr>
<td>Comorbidity (n=2,605)</td>
<td>2.06 ± 1.45</td>
</tr>
<tr>
<td>Annual income (n=2,605)</td>
<td>1.93 ± 1.09</td>
</tr>
<tr>
<td>Sex, % (n=2,605)</td>
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<tr>
<td>Female</td>
<td>58.3</td>
</tr>
<tr>
<td>Male</td>
<td>41.7</td>
</tr>
<tr>
<td>Married, % (n=2,605)</td>
<td>71.5</td>
</tr>
<tr>
<td>Yes</td>
<td>28.5</td>
</tr>
</tbody>
</table>

SD = standard deviation; SDMT = Symbol Digit Modalities Test; DB = Digit Span Backward; C-MMSE = Chinese Mini-Mental State Examination.
speed, and working memory, OLS regressions were applied; results are summarized in Table 4.

RESULTS

Table 2 presents a series of OLS regression models that examine the direct and indirect effects of education on global cognition through social and cognitive activity. As shown in Model 1, education (b = 0.025, P < .001) was significantly related to Wave 2 global cognition, controlling for baseline sociodemographic characteristics, health status, and global cognitive function. Inclusion of cognitive activity in Model 2 reduced the effect of education (b = 0.020, P < .001). Results from the Sobel test suggest that cognitive activity mediates close to 22% (P < .001) of the effect of education. When cognitive activity was replaced with social activity (Model 3), the Sobel test showed that it mediated approximately 7% (P < .001) of the effect of education.

Table 2. Ordinary Least Squares Regressions: Regress Global Cognition Score at Wave 2 on education, Social Activity, Cognitive Activity, and Control Variables at Wave 1 (W1): Two Waves of the Population Study of Chinese Elderly in Chicago (N = 2,543)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b (Standard Error)</td>
<td>P-Value</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (centered at 72)</td>
<td>−0.02 (0.00)</td>
<td>&lt; .001</td>
<td>−0.02 (0.00)</td>
</tr>
<tr>
<td>Female</td>
<td>−0.02 (0.02)</td>
<td>.62</td>
<td>−0.01 (0.02)</td>
</tr>
<tr>
<td>Married</td>
<td>0.02 (0.03)</td>
<td>.47</td>
<td>0.02 (0.03)</td>
</tr>
<tr>
<td>Annual income</td>
<td>0.02 (0.01)</td>
<td>.02</td>
<td>0.02 (0.01)</td>
</tr>
<tr>
<td>Activities of daily living</td>
<td>−0.01 (0.01)</td>
<td>.06</td>
<td>−0.01 (0.01)</td>
</tr>
<tr>
<td>Instrumental activities of daily living</td>
<td>−0.01 (0.00)</td>
<td>&lt; .001</td>
<td>−0.01 (0.00)</td>
</tr>
<tr>
<td>Comorbidity</td>
<td>0.02 (0.01)</td>
<td>.01</td>
<td>0.02 (0.01)</td>
</tr>
<tr>
<td>Global cognition score (W1)</td>
<td>0.59 (0.02)</td>
<td>&lt; .001</td>
<td>0.56 (0.02)</td>
</tr>
<tr>
<td>Independent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education (W1)</td>
<td>0.025 (0.00)</td>
<td>&lt; .001</td>
<td>0.020 (0.00)</td>
</tr>
<tr>
<td>Cognitive activity (W1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social activity (W1)</td>
<td>0.012 (0.00)</td>
<td>&lt; .001</td>
<td>0.012 (0.00)</td>
</tr>
<tr>
<td>Intercept</td>
<td>−0.10</td>
<td></td>
<td>−0.20</td>
</tr>
<tr>
<td>Adjusted coefficient of determination</td>
<td>0.63</td>
<td></td>
<td>0.64</td>
</tr>
</tbody>
</table>

Global cognition score is calculated by averaging z-scores for cognitive performance, episodic memory, perceptual speed, and working memory. When cognitive activity and social activity are both included in the model (not shown), the coefficient associated with education is 0.020 (P < .001), with cognitive activity is 0.011 (P < .001), and with social activity is 0.001 (P > .6).

Sobel test suggests that cognitive activity mediates 21.50% (P < .001) of the effect of education and social activity mediates 6.79% (P < .001) of the effect of education.

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Table 3. Quantile (0.50 Quantile) Regressions: Regression of Chinese Mini-Mental State Examination (C-MMSE) (Indicator of General Mental Status at Wave 2) on Education, Cognitive Activity, Social Activity, and Control Variables at Wave 1 (W1): Two Waves of the Population Study of Chinese Elderly in Chicago (N = 2,488)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b (Standard Error)</td>
<td>P-Value</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (centered at 72)</td>
<td>−0.02 (0.00)</td>
<td>&lt; .001</td>
<td>−0.02 (0.00)</td>
</tr>
<tr>
<td>Female</td>
<td>−0.07 (0.03)</td>
<td>.02</td>
<td>−0.05 (0.03)</td>
</tr>
<tr>
<td>Married</td>
<td>−0.01 (0.03)</td>
<td>.73</td>
<td>−0.02 (0.03)</td>
</tr>
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<td>Annual income</td>
<td>−0.01 (0.01)</td>
<td>.59</td>
<td>−0.02 (0.01)</td>
</tr>
<tr>
<td>Activities of daily living</td>
<td>−0.02 (0.02)</td>
<td>.38</td>
<td>−0.03 (0.02)</td>
</tr>
<tr>
<td>Instrumental activities of daily living</td>
<td>−0.02 (0.01)</td>
<td>&lt; .001</td>
<td>−0.03 (0.01)</td>
</tr>
<tr>
<td>Comorbidity</td>
<td>0.02 (0.01)</td>
<td>.02</td>
<td>0.02 (0.01)</td>
</tr>
<tr>
<td>C-MMSE (W1)</td>
<td>0.60 (0.03)</td>
<td>&lt; .001</td>
<td>0.58 (0.03)</td>
</tr>
<tr>
<td>Independent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education (W1)</td>
<td>0.037 (0.00)</td>
<td>&lt; .001</td>
<td>0.032 (0.00)</td>
</tr>
<tr>
<td>Cognitive activity</td>
<td>0.012 (0.00)</td>
<td>&lt; .001</td>
<td></td>
</tr>
<tr>
<td>Social activity</td>
<td>0.007 (0.00)</td>
<td>.02</td>
<td></td>
</tr>
</tbody>
</table>

Sobel test suggests that cognitive activity mediates 23.9% (P < .001) of the effect of education and that social activity mediates 7.7% (P < .001) of the effect of education.

When cognitive activity and social activity are both included in the model (not shown), the coefficient associated with education is 0.032 (P < .001), with cognitive activity is 0.011 (P < .001), and social activity is 0.003 (P > .2).

Table 3. Quantile (0.50 Quantile) Regressions: Regression of Chinese Mini-Mental State Examination (C-MMSE) (Indicator of General Mental Status at Wave 2) on Education, Cognitive Activity, Social Activity, and Control Variables at Wave 1 (W1): Two Waves of the Population Study of Chinese Elderly in Chicago (N = 2,488)
For episodic memory, results from Sobel tests suggest that cognitive activity mediates 23.7% ($P < .001$) of the effect of education. When cognitive activity and social activity are both included in the model (not shown), the coefficient associated with education is 0.018 ($P < .001$), with cognitive activity is 0.014 ($P < .001$), and with social activity is 0.003 ($P > .6$).

For SDMT perceptual speed, results from Sobel tests suggest that cognitive activity mediates 21.0% ($P < .001$) of the effect of education and that social activity mediates 5.9% ($P < .001$) of the effect of education. When cognitive activity and social activity are both included in the model (not shown), the coefficient associated with education is 0.030 ($P < .001$), with cognitive activity is 0.014 ($P < .001$), and with social activity is $-0.003$ ($P > .4$).

For DB working memory, results from Sobel tests suggest that cognitive activity mediates 16.0% ($P < .001$) of the effect of education and that social activity mediates 4.8% ($P < .001$) of the effect of education. When cognitive activity and social activity are both included in the model (not shown), the coefficient associated with education is 0.039 ($P < .001$), with cognitive activity is 0.014 ($P < .001$), and with social activity is 0.001 ($P > .6$).

ADL=activity of daily living; IADL=instrumental activity of daily living.

cognition score, showing that our model has considerable explanatory power.

The global cognition score was then broken down into domain-specific cognitive function, and results were summarized in Tables 3 and 4. Given that the distribution of C-MMSE is skewed, we reported results only from quantile regression at the median in Table 3, and cognitive activity was found to mediate approximately 24% ($P < .001$) of
the effect of education and social activity 8% (P < .001). When episodic memory, SDMT perceptual speed, and DB working memory were examined in Table 4, similar patterns were identified. The effects of education on these cognitive domains were even greater.

Some interesting patterns on covariates are also worth mentioning. Age and IADL disability were consistently and negatively related to all domains of cognitive function, whereas sex, marital status, and ADL disability were not. Annual income was associated with better SDMT perceptual speed and DB working memory but not general mental status (C-MMSE) or episodic memory. Comorbidity was related to better C-MMSE and episodic memory but not SDMT perceptual speed or DB working memory.

Whether global cognition score or domain-specific cognitive function was examined, the direct effect of education was substantial and significant in all models, especially for SDMT perceptual speed and DB working memory. Activity engagement, cognitive activity in particular, significantly mediates the effect of education. The PINE data largely support both proposed hypotheses.

**DISCUSSION**

With worldwide rapid population aging, this study is significant in several ways. First, we examined Chinese-American older adults, a rapidly growing population that faces unique health challenges but whose health needs mainstream society often neglects largely because of the model minority myth, which assumes that Asian Americans are problem free. Second, we focused on cognitive function, an important indicator of quality of late life, and comprehensively assessed it using a battery of cognitive tests. Third, we took a life course perspective by tracing back to early life experiences and examining their association with activity engagement, cognitive activity in particular, significantly mediates the effect of education. The PINE data largely support both proposed hypotheses.

**CONCLUSION**

Despite these limitations, this is perhaps one of the first epidemiological studies to examine the direct and indirect effects of education on multiple domains of cognitive function in Chinese-American older adults using 2 waves of data. The findings indicate that cognitive function in late life is associated with a combination of exposures to cognitive stimulation over the life course ranging from formal education in early life to activity participation in older age. To reduce future burden of cognitive impairment in older Chinese Americans, close to 90% being foreign born and 70% reporting limited English proficiency, it is essential for policy makers and practitioners to develop interventions and programs to facilitate activity engagement. Preferably, these enrichment programs should be delivered in diverse formats, contents, and languages (English, Mandarin, Cantonese) to accommodate older Chinese Americans with different educational and cognitive levels and language and dialect preferences.
ACKNOWLEDGMENTS
Conflict of Interest: The authors declare no conflicts in all areas listed in author guidelines.

Author Contributions: All authors: study design, data analysis, interpretation of data, preparation of manuscript.

Sponsor’s Role: There was no sponsor for this manuscript.

REFERENCES
Oral Health Symptoms and Cognitive Function Among US Community-Dwelling Chinese Older Adults

Darina V. Petrovsky, PhD, RN,* Bei Wu, PhD,*† Weiyu Mao, PhD, MSW, MPhil,‡ and XinQi Dong, MD, MPH§

BACKGROUND/OBJECTIVES: Limited research is available on the relationship between oral health symptoms and cognitive function among community-dwelling US Chinese older adults. The purpose of this study was to examine the associations between tooth/gum symptoms and changes in cognitive function.

DESIGN: Two-wave epidemiological study.


PARTICIPANTS: US Chinese older adults (N = 2713; mean age = 72.6 y; 58.4% women).

MEASUREMENTS: We selected self-reported oral (tooth and gum) symptoms as independent variables. To examine changes in cognitive function (wave 2: Baseline), we chose the following three domains: episodic memory (East Boston Memory Test); executive function (Symbol Digit Modalities Test); and working memory (Digit Span Backwards). In addition, we assessed global cognitive function by constructing a composite measure.

RESULTS: At baseline, 1297 participants (47.8%) reported having teeth symptoms, and 513 participants (18.9%) reported having gum symptoms. Adjusting for sociodemographic and health-related characteristics, participants who reported having teeth symptoms at baseline experienced their global cognition decrease by 0.07 units (estimate = −0.07; p = .003) and their episodic memory decrease by 0.07 units (estimate = −0.07; p = .026). Participants who reported having teeth symptoms at baseline experienced a faster rate of decline in global cognition for every additional year (estimate = 0.02; p = .047). However, this effect disappeared once we adjusted for all covariates (estimate = 0.02; p = .069). We found no significant relationship between baseline gum symptoms and change of cognitive function.


Key words: oral health; cognition; older adults; Chinese; cognitive change

Oral health is an important part of well-being and overall health in older adults. For example, poor oral health in older adults was associated with decreased quality of life, depression, and hypertension. Poor oral health was also linked to poor cognition and cognitive decline. When examining the associations between oral health measures and risk for cognitive decline or incident dementia, the methodological limitations of previous studies included inconsistencies in oral health and cognition measures as well as small samples. Although some studies reported a positive association between poor oral health and cognitive decline, others did not.

Racial and ethnic minorities are particularly vulnerable to the negative consequences of poor oral health due to lack of access to preventive dental services further exacerbated by a language barrier and low socioeconomic status. Chinese Americans comprise the largest group of Asian immigrants and one of the fastest growing minority populations in the United States. Over the past decade, the population of US community-dwelling Chinese older adults increased by 55% compared with the general growth rate of 15% among US older adults. Chinese American older adults may disproportionately experience more oral health...
Previous studies found that greater numbers of tooth loss were associated with better cognitive function and slower rate of cognitive decline and a higher risk of dementia in Chinese older adults. Previous studies did not address the relationship between oral health symptoms and specific cognitive domains. Given the role of cognitive domains in the dementia diagnosis, oral health symptoms may be associated with some, but not all cognitive domains.

The objectives of our study were to (1) examine the associations between tooth/gum symptoms and change in cognitive function in US community-dwelling Chinese older adults, and (2) examine the association between tooth/gum symptoms and change of individual cognition domains.

METHODS

Study design and data source

In this retrospective epidemiological study, we used data from the Population Study of Chinese Elderly (PINE). The New York University institutional review board designated our study as exempt from human subject review. The PINE study team collected baseline data between 2011 and 2013 using in-home interviews. Detailed description of the baseline PINE data collection is available elsewhere. The second wave of data was completed in 2015. Of 3157 baseline respondents, follow-up interviews were completed with 2713 older adults (86% of baseline participants). Compared with those who agreed to participate in wave 2, those who did not complete the wave 2 interview were older and had worse cognitive function performance.

Measures

Oral health symptoms

We selected self-reported oral health (tooth and gum) symptoms as independent variables. At the time of the interview when reviewing past medical history, the PINE study team asked the participants, “Have you had these symptoms in the past?” We defined “teeth symptoms” if the respondents selected “teeth” as their answer. We defined “gum symptoms” if the participants chose “gums” as their answer.

Cognitive function

The PINE team administered five cognitive tests at both waves during in-home interviews. Four tests measured three cognitive domains: executive function, episodic memory, and working memory. Detailed description of cognitive measures in this sample were published elsewhere. Briefly, executive function was assessed using the Symbol Digit Modalities Test (SDMT), an 11-item test measuring rapid perceptual comparisons of numbers and symbols in 90 seconds (range = 0-80). To assess episodic memory, the researchers used the composite score of the East Boston Memory Test (Immediate and Delayed Recall of brief stories [range = 0-24]). Working memory was measured by the Digit Span Backwards. In addition, to estimate global cognitive function, the researchers constructed a composite measure of global cognitive function using five tests (SDMT, East Boston Memory Test Immediate and Delayed Recall, Digit Span Backwards, and Mini-Mental State Examination). To avoid minimal floor and ceiling effects, a composite score was calculated by transforming each participant’s score on the individual cognitive test to a Z score based on the mean and standard deviation of the distribution of the scores of all respondents, and then averaging Z scores across all cognitive tests.

Covariates

The following covariates were previously shown to be associated with oral health and cognition. We included two domains of covariates in our analyses: sociodemographic and health-related factors measured at baseline. We used the following sociodemographic variables in our analyses: age (years), sex (male: 0; female: 1), marital status (not married coded as 0; married as 1), living arrangement (defined as a number of household members), language preference (English/Mandarin coded as 0; Cantonese/Taishanese coded as 1), years in the United States, years in the community, income, and years of education. Age was measured in chronological years and centered at 72. Health-related factors included the number of medical comorbidities (defined as a count of chronic conditions that a participant told he or she has by a doctor, nurse, or a therapist), smoking status (never smoked, current smoker, or former smoker), and overall social support. We measured the overall social support using the average of six responses on the Health and Retirement Study social support scale (Cronbach’s α = 0.73). Previous research findings indicated an association of social support with cognitive function in community-dwelling US Chinese older adults.

Time

We measured time as the difference between baseline and wave 2 interviews. The mean was 1.92 years (SD = 0.30) (range = 1.75-3.72 y).

Data analysis

Descriptive χ² statistics were used to compare sociodemographic and health-related characteristics between groups with and without oral health symptoms at baseline. Spearman correlation coefficients were used to examine the bivariate associations between baseline oral health symptoms and changes in three cognitive function domains. The change in cognitive function was measured by subtracting baseline cognitive Z score test scores from wave 2 responses. Mixed-effect regression models were run to examine the associations between baseline teeth/gum symptoms and the changes in global cognition, executive function, episodic memory, and working memory. Model 1 tested the main effect of oral health symptoms with adjustment for time, baseline oral health symptoms, and oral health symptoms × time. Model 2 added sociodemographic variables. Model
3 further added health-related characteristics. Given the possibility of co-occurring teeth and gum symptoms at baseline, teeth problems were controlled for in the gum model and vice versa. The analyses were completed using SAS software v.9.2 (SAS Institute Inc, Cary, NC, USA).

RESULTS

Detailed information on cognitive function changes and sociodemographic and health characteristics associated with cognitive function in the PINE sample is available elsewhere.21 Of the 2713 respondents at baseline, 1297 (47.8%) reported having teeth symptoms, and 513 (18.9%) reported having gum symptoms at baseline. At baseline, 422 (15.6%) reported having both teeth and gum symptoms. Table 1 presents baseline characteristics and their association with oral health symptoms. Compared with participants who had no teeth symptoms, participants with teeth symptoms at baseline were younger, married, lived with more household members, resided in the United States and their neighborhood for a shorter period, had less income, and were currently smoking. Compared with participants who had no gum symptoms at baseline, older adults with gum symptoms at baseline were younger, lived with more household members, resided in the United States and their neighborhood for a shorter period, had less income, and more medical conditions.

Table 2 presents the relationship between baseline teeth symptoms and change of cognitive function. Adjusting for sociodemographic and health-related characteristics, participants who reported having teeth symptoms at baseline experienced their global cognition decrease by 0.07 units (Global Cognition Model 3; estimate_{teeth symptoms} = -0.07; p = .003) and their episodic memory decrease by 0.07 units (Episodic Memory Model 3; estimate_{teeth symptoms} = -0.07; p = .026). Participants who reported having teeth symptoms at baseline experienced a faster rate of decline in global cognition for every additional year (Global Cognition Model 1; estimate_{teeth symptoms X time} = 0.02; p = .047). However, this effect disappeared once we adjusted for all covariates (Global Cognition Model 3; estimate_{teeth symptoms X time} = 0.02; p = .069). We found no significant relationship between baseline gum symptoms and change of cognitive function (Table 3).

DISCUSSION

In our study, we found that participants who reported having teeth symptoms at baseline experienced a change in their cognition. Specifically, for having baseline teeth symptoms, global cognition and episodic memory both declined. We found that sociodemographic and health-related covariates accounted for most of the relationship between baseline teeth symptoms and the rate of cognitive decline in global cognition.
### Table 2. Association between baseline teeth symptoms and changes in cognitive function, estimated from mixed-effects models

<table>
<thead>
<tr>
<th></th>
<th>Global cognition</th>
<th>Episodic memory</th>
<th>Executive function</th>
<th>Working memory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model 1a</strong></td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.01</td>
<td>0.762</td>
<td>0.133</td>
<td>0.01</td>
</tr>
<tr>
<td>Time</td>
<td>-0.05 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
</tr>
<tr>
<td>Gum symptoms</td>
<td>0.07 (0.04)</td>
<td>0.080</td>
<td>0.169</td>
<td>0.07 (0.04)</td>
</tr>
<tr>
<td><strong>Model 2b</strong></td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.01</td>
<td>0.762</td>
<td>0.133</td>
<td>0.01</td>
</tr>
<tr>
<td>Time</td>
<td>-0.05 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
</tr>
<tr>
<td>Gum symptoms</td>
<td>0.07 (0.04)</td>
<td>0.080</td>
<td>0.169</td>
<td>0.07 (0.04)</td>
</tr>
<tr>
<td><strong>Model 3c</strong></td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.01</td>
<td>0.762</td>
<td>0.133</td>
<td>0.01</td>
</tr>
<tr>
<td>Time</td>
<td>-0.05 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
</tr>
<tr>
<td>Gum symptoms</td>
<td>0.07 (0.04)</td>
<td>0.080</td>
<td>0.169</td>
<td>0.07 (0.04)</td>
</tr>
</tbody>
</table>

*Estimate (standard error [SE]).

Model 1: Test of main effect of gum symptoms at baseline with adjustment for time, and gum symptoms × time.

Model 2: Model 1 + sociodemographic characteristics.

Model 3: Model 2 + health-related characteristics.

### Table 3. Association between baseline gum symptoms and changes in cognitive function, estimated from mixed-effects models

<table>
<thead>
<tr>
<th></th>
<th>Global cognition</th>
<th>Episodic memory</th>
<th>Executive function</th>
<th>Working memory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model 1a</strong></td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.002 (0.02)</td>
<td>0.920</td>
<td>0.06</td>
<td>0.186</td>
</tr>
<tr>
<td>Time</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
</tr>
<tr>
<td>Gum symptoms</td>
<td>0.07 (0.04)</td>
<td>0.082</td>
<td>0.165</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>Model 2b</strong></td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.002 (0.02)</td>
<td>0.920</td>
<td>0.06</td>
<td>0.186</td>
</tr>
<tr>
<td>Time</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
</tr>
<tr>
<td>Gum symptoms</td>
<td>0.07 (0.04)</td>
<td>0.082</td>
<td>0.165</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>Model 3c</strong></td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.002 (0.02)</td>
<td>0.920</td>
<td>0.06</td>
<td>0.186</td>
</tr>
<tr>
<td>Time</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
<td>&lt; 0.001 (0.01)</td>
</tr>
<tr>
<td>Gum symptoms</td>
<td>0.07 (0.04)</td>
<td>0.082</td>
<td>0.165</td>
<td>0.04</td>
</tr>
</tbody>
</table>

*Estimate (standard error [SE]).

Model 1: Test of main effect of gum symptoms at baseline with adjustment for time, and gum symptoms × time.

Model 2: Model 1 + sociodemographic characteristics.

Model 3: Model 2 + health-related characteristics.
cognition. Having gum symptoms at baseline showed no significant relationship with any of the cognitive domains.

Chinese older adults face barriers that may contribute to our findings. For example, in a sample of 1288 Asian Americans living in New York City, 41.5% reported not receiving annual oral health examinations. Furthermore, factors that contributed to the lack of annual oral health examinations included poor English fluency, low educational attainment, and lack of dental insurance. Lack of English proficiency compared with English fluency was associated with a 2-fold increase of not receiving oral health examinations. Similarly, in another study of older Asian Americans, older adults with limited English fluency were 3.5 more times likely to lack dental health insurance. Furthermore, older Asian Americans who lacked dental insurance were 6.4 times less likely to use preventive dental care services.

Our study did not find an association between gum symptoms and cognitive function. Cultural factors may have partially contributed to our findings. Chinese older adults may view teeth symptoms as more acute dental problems compared with chronic gum symptoms, such as bleeding or swollen gums, making gum problems less likely to be reported. Moreover, they may rely on self-treatment (eg, vitamin C supplementation, drinking tea, or rinsing with salt water) and delay seeking dental care treatment. Periodontitis starts out symptomless; therefore, older adults are less likely to seek oral health treatments. Periodontitis, however, is a major contributor to tooth loss, tooth migration, and ultimately, masticatory dysfunction.

In our study, we found significant associations between baseline teeth symptoms and change in episodic memory. Deficits in episodic memory (ie, ability to retain new information) are most common in older adults with mild cognitive impairment making them more likely to progress to Alzheimer’s disease dementia. Furthermore, changes in episodic memory are often reported in older adults several years before the onset of dementia. Therefore, in a short follow-up period we are more likely to capture changes in the episodic memory, compared to other cognitive domains (ie, executive function, working memory).

Our study has several limitations. First, the average follow-up time of less than 2 years may not be long enough to detect cognitive changes in our sample. Second, we used self-reported general oral health symptoms as predictors for changes in cognitive function. We were not able to examine potential associations between a more precise objective measure of poor oral health (ie, toothaches, tooth decay, bleeding, or swollen gums) and cognitive function. Subjective self-reported oral health symptoms may not correlate highly with the direct clinical evaluations; thus we cannot ascertain the effect of tooth loss and periodontal disease on cognition. Third, we were not able to ascertain the timing of oral health symptoms. Fourth, due to 14% sample attrition and the fact that those who did not complete the wave 2 interview were older and had worse cognitive function performance, our findings may be more pertinent to older adults with better cognitive function. Additionally, we were not able to include factors related to the use of preventive oral health services, such as dental health insurance. Asian older adults who do not have dental insurance or lack English proficiency are less likely to receive oral health care. This study, however, was the first step toward gaining a better understanding of the relationship between oral health symptoms and changes in cognitive function in a large US Chinese older adult population.

Despite these limitations, this study has important policy and practice implications. Our findings point to the importance of assessing oral health symptoms in this population. Developing policy measures aimed at ameliorating health and improving cognition in this high-risk fast-growing population in the United States would need to include oral health preventive and dental care services. Medical and dental care providers can identify problematic oral health symptoms as risk factors of cognitive decline. Outreach programs that target older adults to improve the awareness of these problems can then be developed. Dental care community outreach programs should focus their information on practical ways to prevent oral health problems and provide information on accessible treatment options.

Our study has important implications for future research. Future studies should include objective oral health assessments when examining the association between oral health symptoms and cognitive function in this population. Second, studies with a longer follow-up period may be needed to observe more clinically meaningful changes in cognition. Additionally, future studies should consider how the timing of oral health symptoms is related to changes across multiple cognitive domains.

ACKNOWLEDGMENTS

Conflict of Interest: None.

Author Contributions: Study concept and design, data analysis, interpretation of data, revision of the manuscript for important content, final approval of version to be published: all authors. First manuscript draft: Petrovsky.

Sponsor’s Role: NIH/NIDCR 1 U01 DE027512-01 (PI: Bei Wu).

REFERENCES


Depressive Symptoms and Onset of Functional Disability Over 2 Years: A Prospective Cohort Study

Dexia Kong, PhD, MSW, MBE,* Phyllis Solomon, PhD,† and XinQi Dong, MD, MPH*

OBJECTIVES: This prospective cohort study examined the relationship between depressive symptoms and onset of functional disability over 2 years among US Chinese older adults, a rapidly growing minority older adult population.

DESIGN AND SETTING: This study used survey data from 2713 Chinese older adults who completed both baseline (2011-2013) and follow-up (2013-2015) interviews of the Population Study of Chinese Elderly in Chicago. Depressive symptoms were assessed at baseline by the nine-item Patient Health Questionnaire. Functional disability was measured by three validated scales, Katz Index of Independence in Activities of Daily Living (ADLs), the Lawton Instrumental Activities of Daily Living (IADLs) scale, and the Rosow and Breslau mobility scale. Multivariate logistic regression was conducted to examine the relationship between baseline depressive symptoms and the development of functional disability (ADLs, IADLs, mobility) at 2-year follow-up while adjusting for covariates.

RESULTS: Of the 2713 participants, 5.2% experienced ADL disability onset, 35.6% experienced IADL disability onset, and 23.3% experienced mobility disability onset over 2 years. After adjusting for covariates, the odds of ADL disability onset (odds ratio [OR] = 1.06; 95% confidence interval [CI] = 1.02-1.11), IADL disability onset (OR = 1.05; 95% CI = 1.01-1.09), and mobility disability onset (OR = 1.05; 95% CI = 1.01-1.09) were consistently higher in US Chinese older adults with higher levels of depressive symptoms than their less-depressed counterparts. Other significant risk factors included older age and more chronic physical conditions.


Key words: depressive symptoms; disability; longitudinal; minority aging

Functional disability in later life represents a significant public health concern given substantial social, health, and financial ramifications.1,2 Disability in this article refers to difficulty or inability to perform daily activities necessary for independent living, specifically difficulty in performing activities of daily living (ADLs; ie, bathing and feeding), instrumental ADLs (IADLs; ie, preparing meals and managing money), and mobility tasks (ie, walk up/down stairs).3,4 Studies have shown that disability worsens over time from inception.5 It is, therefore, optimal to emphasize screening risk factors and to develop intervention strategies targeted to prevent onset of disability proactively. Understanding risk factors for onset of disability in old age represents a fundamental step in focusing screening and, subsequently, devising such preventive interventions.

Multiple longitudinal studies have established negative effects of depressive symptoms on functional disability in the general US older adult population.6,7 In a cohort of 3809 community-dwelling adults aged 65 years and older followed for 6 years, the likelihood of developing disability increased by 14% to 17% for each additional depressive symptom at baseline.8 Another study reported that older adults with persistent depressive symptoms were over five times more likely to develop functional disability over 4 years than their non-depressive counterparts.9 A population-based cohort study documented deleterious effects of depressive symptoms on disability emerged as early as 1-year follow-up and continued to increase over time.10 Notwithstanding discrepancies in reported odds ratios (ORs) and relative risk statistics due to methodological differences (ie, varying measures and follow-
up durations), existing studies indicated a significant relationship between depressive symptoms and subsequent onset of disability in the general aging population.

While such empirical evidence has been accumulating in the general older adult population, a review of the literature revealed that older ethnic minority populations are disproportionately underrepresented in existing studies, although disability prevalence and trajectories are known to differ by socioeconomic status and ethnicity. Specifically, older Asian Americans accounted for less than 10% of samples in prior studies and no population-based longitudinal data are available on this population. As a result, understanding of disability trajectories and associated risk factors remain particularly limited among older Asian Americans. However, developing targeted preventive interventions calls for an improved understanding of unique risk factors of disability in this vulnerable subgroup of US older adults. It is thus critical to investigate whether existing knowledge is applicable to this rapidly growing subgroup of older adults.

To bridge the knowledge gap, the purpose of this prospective cohort study was to investigate the relationship between depressive symptoms and onset of disability in a population-based study of US Chinese older adults. It was hypothesized that, compared to their less-depressed peers, US Chinese older adults with higher levels of depressive symptoms at baseline will have a greater likelihood to develop functional disability over 2 years. A focus on Chinese older adults in the present study is warranted for two reasons. First, Chinese older adults, with an estimated population of 366,760 in 2010, represent one of the largest and fastest-growing older minority population in the United States. Second, examining the relationship between depressive symptoms and disability is of particular relevance to US Chinese older adults because prevalence of both conditions has been reported to be high in this community, with approximately 50% and 54% of this population experiencing various levels of functional disability and depressive symptoms, respectively. Study findings could potentially facilitate the development of targeted prevention strategies (ie, enhanced screening of depressive symptoms) to reduce disability in US Chinese older adults.

**METHODS**

**Sample and Setting**

Data were obtained from the Population Study of Chinese Elderly in Chicago (PINE), a prospective cohort study of community-dwelling Chinese older adults aged 60 years and older in the greater Chicago, IL, area. The purpose of PINE was to examine physical and psychological well-being of US Chinese older adults. A total of 3157 Chinese older adults completed baseline interviews between July 2011 and June 2013. Of baseline participants, 115 (3.6%) died and 329 (10.4%) were lost to follow-up during the 2-year period. Consequently, follow-up interviews were conducted with 2713 participants, yielding a follow-up rate of 85.9%. Design and implementation information of PINE have been published elsewhere. The present study used data from 2713 participants who completed both the baseline and follow-up interviews. The average time between baseline and follow-up interviews was 1.92 years. Face-to-face interviews were conducted by trained bicultural and multilingual research assistants in participants’ preferred language or Chinese dialects (English, Mandarin, Cantonese, or Taishanese). All participants signed informed consent forms. Study protocol was approved by the institutional review board of Rush University Medical Center.

**Measures**

**Dependent Variables**

Functional disability was measured using three validated instruments, modified Katz Index of Independence in ADLs, Lawton IADLs scale, and Rosow and Breslau mobility scale.

The modified ADL index asked participants whether they needed help with eight basic self-care activities, including feeding, dressing, bathing, walking, transferring, grooming, incontinence, and toileting. Participants rated the extent to which they needed help for each task on a four-point scale ranging from 0 = none to 3 = most of the time. Total scores ranged from 0 to 24, with higher score indicating greater levels of disability (Cronbach’s α = .92). For the IADL scale, participants were asked to rate the extent to which they needed assistance with 12 activities that are cognitively and functionally more complex than those in ADL, including managing money, using a telephone, preparing meals, doing laundry, taking medication, doing housework, maintaining routine health, attending to special health needs, shopping, traveling, getting outside of home, and being alone. Total scores ranged from 0 to 36, with higher score indicating higher level of disability (Cronbach’s α = .90). Mobility scale assessed whether participants needed help in performing three mobility tasks: heavy work around the house, walk up/down stairs to the second floor, and walk a half mile. Participants responded yes/no to each item. Final score is a sum of responses to the three items, ranging from 0 to 3. A higher score indicates a greater level of functional disability (Cronbach’s α = .80).

Previous studies suggested that ADL disability represents the most advanced form of functional disability because such disability prevents older adults from performing basic self-care tasks to live independently. IADL and mobility disabilities are generally considered as less severe. The present study examined onset of disability in three domains (ADL, IADL, and mobility tasks) to capture effects of depressive symptoms on disability of varying severity. The onset of functional disability was defined as reporting no difficulty in completing any tasks in three domains (ADL, IADL, and mobility tasks) at baseline but needing help in completing one or more tasks in these three domains at follow-up interview. The three dependent variables assessing onset of disability (ADL, IADL, and mobility) were coded dichotomously (yes/no) for analyses purposes.

**Independent Variable**

Depressive symptoms were assessed by the nine-item version of the Patient Health Questionnaire. Participants...
were asked to rate the extent to which they experienced nine symptoms on a four-point scale ranging from 0=not at all to 3=nearly every day. The nine items included little interest or pleasure in doing things, feeling down, sleep problems, poor appetite or overeating, feeling bad about self, trouble concentrating on things, restless, and thoughts better off dead, which corresponded with diagnostic criteria for depressive disorders in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). Total scores ranged from 0 to 27, with higher score indicating higher levels of depressive symptoms (Cronbach’s α = .82).  

**Covariates**

Baseline variables that have been found to predict disability in a recent systematic review were included as covariates. Covariates were age (in years), sex (male/female), education (in years), marital status (married/not married), household size (number of household members beside self), currently smoking (yes/no), and body mass index (BMI; calculated by weight in kilograms divided by height in meters squared). In the present study, a BMI score of 18.5 kg/m² or below was defined as underweight, 18.5 to 24.9 kg/m² was defined as normal weight, 25.0 to 29.9 kg/m² was defined as overweight, and 30.0 kg/m² or above was defined as obese. Income was operationalized as annual income from all sources in 10 categories, ranging from 1 = $0 to $4999 to 10 = $75 000 and above. Acculturation was measured by a 12-item scale adapted from the Short Acculturation Scale for Hispanics. The scale assessed participants’ preference of speaking English vs Chinese in various settings: using Chinese vs English media, and having Chinese vs American social contacts on a five-point scale ranging from 1 = only Chinese to 5 = only English/American. Higher scores indicated higher acculturation levels (Cronbach’s α = .88). Number of chronic conditions was ascertained by summing the presence of nine chronic medical diagnoses (ie, heart disease, stroke, cancer, high cholesterol, diabetes, high blood pressure, hip fracture, thyroid, and osteoarthritis). Global cognitive function was a composite score based on five well-validated individual cognition tests, including Chinese Mini-Mental State Examination, East Boston Memory Test (EBMT)-Immediate Recall, EBMT-Delayed Recall, Digit Span Backwards test, and Symbol Digit Modalities Test. Global cognitive function score was constructed by (1) transforming scores on each instrument to a z score; and (2) averaging the four z scores. This approach assured measurement error and flooring/ceiling effects in individual tests were minimized.  

**Data Analysis**

Univariate statistics were used to describe prevalence of disability at baseline and follow-up and onset of disability over 2 years. Descriptive statistics were calculated to summarize sample characteristics at both baseline and follow-up. χ², Wilcoxon, or t-tests were used to compare characteristics between those with or without onset of functional disability in three domains, depending on which statistic was appropriate to the data. Three multivariable logistic regression models were conducted to examine the relationship between baseline depressive symptoms and onset of functional disability across three domains (ADL, IADL, and mobility disability), controlling for time and relevant baseline covariates. Time was entered in all models to account for its potential influence. All analyses were conducted using SAS Version 9.2 (SAS Institute Inc, Cary, NC).  

**RESULTS**

Table 1 summarizes prevalence rates of ADL, IADL, and mobility disability onset. A relatively small percent of US Chinese older adults experienced onset of ADL disability (5.2%). Over one third (35.6%) experienced onset of IADL, and 23.3% experienced onset of mobility disability. Table 2 presents sample characteristics based on onset of disability in the three domains. Overall, US Chinese older adults with ADL disability onset were more likely to be older, not married, nonsmokers, and obese. Additionally, they had fewer household members, and more chronic conditions and depressive symptoms on average. US Chinese older adults with IADL disability onset were more likely to be older, female, and not married. On average, they had lower income, fewer household members, and more chronic conditions. Finally, US Chinese older adults with mobility disability onset were more likely to be older, female, not married, and nonsmokers. They had lower education, fewer household members, more chronic conditions and depressive symptoms, and lower cognitive function.

Table 3 shows relationships between baseline depressive symptoms and onset of disability in three domains. Baseline depressive symptoms predicted onset of disability across all three domains over 2 years, even when controlling for all covariates. Specifically, odds of ADL disability onset (OR = 1.06; 95% confidence interval [CI] = 1.02-1.11), IADL disability onset (OR = 1.05; 95% CI = 1.01-1.09), and mobility disability onset (OR = 1.05; 95% CI = 1.01-1.09) were consistently higher in US Chinese older adults with higher levels of depressive symptoms than their less-depressed counterparts. Furthermore, US Chinese older adults who were older and had more chronic conditions were more likely to develop disability across all three domains. Lastly, higher education (OR = 1.08; 95% CI = 1.03-1.13) and lower cognitive function (OR = 0.63; 95% CI = 0.46-0.86) predicted onset of ADL disability; lower income (OR = 0.85; 95% CI = 0.75-0.96), lower levels of acculturation (OR = 0.96; 95% CI = 0.93-0.99), and obesity (OR = 3.06; 95% CI = 1.31-7.17) predicted onset of IADL disability; and female predicted onset of both IADL and mobility disability.

**Table 1. Onset of Functional Disability Over 2 Years in US Chinese Older Adults**

<table>
<thead>
<tr>
<th>Functional Disability Domains</th>
<th>Baseline, No. (%)</th>
<th>2-Y Follow-Up, No. (%)</th>
<th>Incident Physical Disability, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADL (N = 2711)</td>
<td>192 (7.1)</td>
<td>225 (8.3)</td>
<td>130 (5.2)</td>
</tr>
<tr>
<td>IADL (N = 2634)</td>
<td>1333 (50.6)</td>
<td>1413 (52.2)</td>
<td>463 (35.6)</td>
</tr>
<tr>
<td>Mobility (N = 2701)</td>
<td>1035 (38.3)</td>
<td>1138 (42.1)</td>
<td>387 (23)</td>
</tr>
</tbody>
</table>

Abbreviations: ADL, activity of daily living; IADL, instrumental ADL.
Table 2. Sample Characteristics by Onset of Disability Categories at 2-Year Follow-Up

<table>
<thead>
<tr>
<th>Variables</th>
<th>Onset of ADL Disability</th>
<th></th>
<th>Onset of IADL Disability</th>
<th></th>
<th>Onset of Mobility Disability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (N = 130, 5.2%)</td>
<td>No (N = 2388, 94.8%)</td>
<td>P Value</td>
<td>Yes (N = 463, 35.6%)</td>
<td>No (N = 838, 64.4%)</td>
<td>P Value</td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>78.6 (7.5)</td>
<td>71.6 (7.6)</td>
<td>&lt;.0001</td>
<td>71.5 (6.9)</td>
<td>67.8 (6.1)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Sex, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>46 (4.3)</td>
<td>1,017 (95.7)</td>
<td>.1054</td>
<td>200 (32.1)</td>
<td>423 (67.9)</td>
<td>.0118</td>
</tr>
<tr>
<td>Female</td>
<td>84 (5.8)</td>
<td>1,371 (94.2)</td>
<td>.1054</td>
<td>263 (38.8)</td>
<td>415 (61.2)</td>
<td>.0118</td>
</tr>
<tr>
<td>Marital status, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>71 (3.9)</td>
<td>1,750 (96.1)</td>
<td>&lt;.0001</td>
<td>354 (27.2)</td>
<td>689 (66.1)</td>
<td>.0111</td>
</tr>
<tr>
<td>Not married</td>
<td>59 (8.5)</td>
<td>636 (91.5)</td>
<td>&lt;.0001</td>
<td>109 (42.4)</td>
<td>148 (57.6)</td>
<td>.0111</td>
</tr>
<tr>
<td>Education, mean (SD), y</td>
<td>8.5 (5.5)</td>
<td>8.8 (5.0)</td>
<td>.4469</td>
<td>9.2 (5.3)</td>
<td>9.2 (4.5)</td>
<td>.9722</td>
</tr>
<tr>
<td>Income, mean (SD) USD</td>
<td>1.8 (0.7)</td>
<td>1.9 (1.1)</td>
<td>.4440</td>
<td>1.8 (1.0)</td>
<td>2.1 (1.4)</td>
<td>.0003</td>
</tr>
<tr>
<td>Household size, mean (SD), No.</td>
<td>1.4 (1.6)</td>
<td>1.9 (1.9)</td>
<td>.0322</td>
<td>1.9 (1.8)</td>
<td>2.2 (2.0)</td>
<td>.0001</td>
</tr>
<tr>
<td>Acculturation, mean (SD) No.</td>
<td>14.6 (3.6)</td>
<td>15.2 (4.7)</td>
<td>.2193</td>
<td>15.2 (4.2)</td>
<td>15.8 (5.2)</td>
<td>.1532</td>
</tr>
<tr>
<td>Currently smoking, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>4 (1.4)</td>
<td>279 (98.6)</td>
<td>.2193</td>
<td>50 (29.1)</td>
<td>122 (70.9)</td>
<td>.5532</td>
</tr>
<tr>
<td>No</td>
<td>126 (5.6)</td>
<td>2,108 (94.4)</td>
<td>.0025</td>
<td>413 (36.6)</td>
<td>716 (63.4)</td>
<td>.0053</td>
</tr>
<tr>
<td>BMI, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>15 (8.5)</td>
<td>162 (91.5)</td>
<td>.0322</td>
<td>27 (32.9)</td>
<td>55 (67.1)</td>
<td>.0001</td>
</tr>
<tr>
<td>Normal weight</td>
<td>69 (4.2)</td>
<td>1,571 (95.8)</td>
<td>.0001</td>
<td>315 (35.2)</td>
<td>579 (64.8)</td>
<td>.0003</td>
</tr>
<tr>
<td>Overweight</td>
<td>32 (5.4)</td>
<td>561 (94.6)</td>
<td>.0003</td>
<td>102 (34.7)</td>
<td>192 (65.3)</td>
<td>.0003</td>
</tr>
<tr>
<td>Obese</td>
<td>7 (9.7)</td>
<td>65 (90.3)</td>
<td>.0160</td>
<td>15 (60.0)</td>
<td>10 (40.0)</td>
<td>.0750</td>
</tr>
<tr>
<td>No. of chronic conditions, mean (SD)</td>
<td>2.6 (1.5)</td>
<td>2.0 (1.4)</td>
<td>&lt;.0001</td>
<td>2.0 (1.3)</td>
<td>1.6 (1.3)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Cognitive function, mean (SD) No.</td>
<td>-0.4 (0.9)</td>
<td>0.1 (0.8)</td>
<td>&lt;.0001</td>
<td>0.2 (0.7)</td>
<td>0.3 (0.6)</td>
<td>.0196</td>
</tr>
<tr>
<td>Depressive symptoms, mean (SD), No.</td>
<td>4.2 (6.1)</td>
<td>2.3 (3.7)</td>
<td>&lt;.0001</td>
<td>2.0 (3.4)</td>
<td>1.5 (2.8)</td>
<td>.5656</td>
</tr>
</tbody>
</table>

Abbreviations: ADL, activity of daily living; BMI, body mass index; IADL, instrumental ADL.
disability (OR = 1.66; 95% CI = 1.24-2.24) and mobility disability (OR = 1.54; 95% CI = 1.14-2.09).

**DISCUSSION**

To our knowledge, this is the first population-based longitudinal study examining the prospective relationship between depressive symptoms and onset of functional disability among US Chinese older adults. Findings indicate that depressive symptoms predict subsequent onset of ADL, IADL, and mobility disabilities over 2 years among US Chinese older adults. The adjusted OR found in this study is comparable to those reported in the general US aging population (ranged from 1.14 to 5.47), despite methodological differences. Nevertheless, the findings extend knowledge by establishing the relationship between depressive symptoms and disability onset in an underrepresented minority aging population.

There are several potential mechanisms underlying the relationship between depressive symptoms and development of functional disability. First, prolonged presence of certain somatic depressive symptoms, particularly fatigue and pain, may contribute to enhanced decline of physical functioning over time. Moreover, older adults with depressive symptoms are more likely to experience amplified symptom burden and complications of chronic medical conditions, both of which may increase risks for disability. Furthermore, older adults with depressive symptoms are less likely to adhere to treatment regimens, which consequently may be linked to onset of progression of medical conditions resulting in impairment that leads to disability. According to a recent meta-analytic review, medical patients who were depressed were three times more likely to be noncompliant with various treatment regimens than those not depressed. Adverse outcomes of depressive symptoms, such as social withdrawal, lack of energy/interest, and declining sense of self-efficacy, might diminish older adults’ motivation to attempt physical activities, leading to overreporting of disability. This explanation resonates with findings from previous studies that suggest disability can be attributed to both individuals’ impaired physical capacity and reduced willingness to engage in daily activities. Furthermore, given the Chinese culture, influences the expression of depression more somatically, this orientation may have a heightened effect on functional disability.

Another potential explanation is that biological changes associated with depressive symptoms, such as elevated cortisol levels and insulin resistance, may increase disability risks. Furthermore, several longitudinal studies indicated that there exists a bidirectional relationship between depressive symptoms and disability. In other words, the two conditions may reinforce each other over time to exert greater negative influence on physical functioning. Although testing the reciprocal relationship is beyond the scope of the present study, such possibility should be explored in diverse aging populations.

Taken together, study findings highlight the importance of depressive symptoms in onset of disability among Chinese older adults. However, it has been well established that depressive symptoms are often underrecognized and untreated in this population. Further, US Chinese older adults with depressive symptoms are more likely to report somatic symptoms, such as insomnia and fatigue. As a result, they tend to seek care from primary care providers. Consequently, brief screening instruments capturing somatic presentations of depressive symptoms that can easily be employed routinely by primary care providers should be instituted for use among US Chinese older adults. Enhanced screening and treatment of depressive symptoms may ultimately reduce disability in this population.

**Table 3. Multivariate Associations Between Baseline Characteristics and Onset of Functional Disability at 2 Years**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Onset of ADL Disability</th>
<th>Onset of IADL Disability</th>
<th>Onset of Mobility Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (intervals)</td>
<td>1.44 (0.74-2.79)</td>
<td>0.51 (0.33-0.79)**</td>
<td>1.10 (0.73-1.66)</td>
</tr>
<tr>
<td>Age</td>
<td>1.10 (1.07-1.14)***</td>
<td>1.09 (1.07-1.12)***</td>
<td>1.11 (1.09-1.13)***</td>
</tr>
<tr>
<td>Female sex</td>
<td>1.26 (0.78-2.04)</td>
<td>1.66 (1.24-2.24)***</td>
<td>1.54 (1.14-2.09)**</td>
</tr>
<tr>
<td>Education</td>
<td>1.08 (1.03-1.13)**</td>
<td>1.02 (0.99-1.06)</td>
<td>0.98 (0.95-1.02)</td>
</tr>
<tr>
<td>Income</td>
<td>0.87 (0.65-1.16)</td>
<td>0.85 (0.75-0.96)**</td>
<td>0.87 (0.76-1.00)</td>
</tr>
<tr>
<td>Marital status (married)</td>
<td>0.94 (0.59-1.51)</td>
<td>1.09 (0.78-1.51)</td>
<td>0.79 (0.58-1.08)</td>
</tr>
<tr>
<td>Household size</td>
<td>0.99 (0.88-1.12)</td>
<td>0.97 (0.91-1.04)</td>
<td>1.06 (0.99-1.13)</td>
</tr>
<tr>
<td>Acculturation</td>
<td>0.96 (0.90-1.02)</td>
<td>0.96 (0.93-0.99)*</td>
<td>1.00 (0.97-1.03)</td>
</tr>
<tr>
<td>Currently smoking</td>
<td>0.46 (0.16-1.35)</td>
<td>1.01 (0.67-1.54)</td>
<td>0.78 (0.49-1.24)</td>
</tr>
<tr>
<td>BMI (underweight)</td>
<td>1.52 (0.77-3.02)</td>
<td>0.81 (0.48-1.36)</td>
<td>0.78 (0.46-1.33)</td>
</tr>
<tr>
<td>BMI (overweight)</td>
<td>1.12 (0.70-1.80)</td>
<td>0.98 (0.72-1.32)</td>
<td>1.25 (0.93-1.68)</td>
</tr>
<tr>
<td>BMI (obesity)</td>
<td>1.87 (0.73-4.79)</td>
<td>3.06 (1.31-7.17)**</td>
<td>0.71 (0.28-1.83)</td>
</tr>
<tr>
<td>No. of chronic conditions</td>
<td>1.16 (1.01-1.33)**</td>
<td>1.12 (1.02-1.24)*</td>
<td>1.20 (1.09-1.32)**</td>
</tr>
<tr>
<td>Cognitive function</td>
<td>0.63 (0.46-0.86)**</td>
<td>0.96 (0.75-1.22)</td>
<td>0.93 (0.74-1.16)</td>
</tr>
<tr>
<td>Depressive symptoms</td>
<td>1.06 (1.02-1.11)**</td>
<td>1.05 (1.01-1.09)*</td>
<td>1.05 (1.01-1.09)**</td>
</tr>
</tbody>
</table>

Abbreviations: ADL, activity of daily living; BMI, body mass index; IADL, instrumental ADL; *p<0.05, **p<0.01, ***p<0.001.

aData are given as odds ratio (95% confidence interval).
LIMITATIONS

Several limitations of the present study need to be acknowledged. Since data from the present study were collected in the greater Chicago area, it is unclear whether study findings may be relevant to other ethnic minority populations or Chinese older adults in other locations. Also, the present study used two waves of data to examine the longitudinal relationship between depression and functional disability onset. The short duration of about 2 years limits the ability to determine whether the findings differ in longer time frames.44 Third, depressive symptoms and disability were measured by self-report instruments, which may reflect recall bias. It is unknown whether study findings would vary if depressive symptoms and disability were clinically assessed. Furthermore, the possibility that disability may lead to subsequent onset of depressive symptoms was not considered in the present analyses. Finally, since the current analyses focused exclusively on functional disability, it is unknown whether depressive symptoms affect other disability dimensions in US Chinese older adults.

IMPLICATIONS

Study findings have significant clinical and policy implications. Compared to other risk factors of functional disability, such as old age and medical comorbidity, depressive symptoms are more amenable to psychosocial interventions.40 Consequently, culturally relevant depression screening and subsequent treatment interventions may have the potential to reduce functional disability in US Chinese older adults. Findings underscore the pressing need to develop culturally appropriate interventions to address depressive symptoms in this population. Randomized controlled trials are essential to examine whether enhanced screening and treatment of depressive symptoms do reduce disability in diverse populations.

DIRECTION FOR FUTURE RESEARCH

Future studies should explore longitudinally the relationship between depressive symptoms and onset of disability in specific ADL or IADL tasks to determine whether such a relationship varies over time by specific activities.43 Additionally, the relationships between depressive symptoms and disabilities in other dimensions (ie, work disability, social functioning) and the number of disabilities in various domains should be evaluated in future research. Rigorous randomized clinical trials need to be conducted to determine the effectiveness of targeted depression screening followed by interventions to prevent functional disability in diverse populations. Future studies of longer durations have the potential to validate present findings. Moreover, the relationship between depressive symptoms and onset of disability requires further investigation with other ethnic minority aging populations. Future studies using advanced statistical techniques, such as cross-lagged path analysis, to elucidate the causal mechanisms underlying the longitudinal relationship between depressive symptoms and onset of disability and the potential reciprocal relationship between the two conditions need to be undertaken.5,40

CONCLUSION

Study findings extend existing literature by demonstrating that depressive symptoms among a rapidly growing ethnic minority aging population are significant risk factors for development of functional disability over 2 years. Such findings suggest that culturally sensitive screening followed by developing culturally relevant intervention programs addressing depressive symptoms may have the potential to reduce functional disability in US Chinese older adults.

ACKNOWLEDGMENT

Financial Disclosure: Dr. Dong is supported by R01MD 006173, R01AG042318, R34MH100443, R01NR014846, 09EJ0015, 09EJ0016, and P30AG059304.

Conflicts of Interest: The authors have no conflicts of interest to report.

Author Contributions: All authors contributed to the conception, design, drafting, and revision of the article.

Sponsor’s Role: None.

REFERENCES

Comorbid Depressive Symptoms and Chronic Medical Conditions Among US Chinese Older Adults

Dexia Kong, PhD, MSW, MBE,* Phyllis Solomon, PhD,† and XinQi Dong, MD, MPH*

OBJECTIVES: The prevalence and health consequences of comorbid depressive symptoms (DSs) and chronic medical conditions (CMCs) among older ethnic minority populations remain poorly understood. To bridge this gap, the present cross-sectional study examined the prevalence of comorbid DS-CMC and the association between such comorbidity and health services use among US Chinese older adults.

DESIGN AND SETTING: Data were from the Population Study of Chinese Elderly in Chicago (N = 3157). The relationship between comorbid DS-CMC and health service use (ie, emergency department [ED] visits and hospitalizations) was investigated by stratifying the sample into four groups: (1) neither DSs nor CMCs (ie, heart disease, stroke, cancer, high cholesterol, diabetes, high blood pressure, hip fraction, thyroid, and osteoarthritis); (2) DSs only; (3) CMCs only; and (4) comorbid DS-CMC. Multivariate negative binomial regression models were conducted to determine the relationship between comorbid DS-CMC and health service use.

RESULTS: Participants were 73 years old on average. The prevalence of comorbid DSs ranged between 0.7% and 4.6% across various CMCs. The odds of DSs were at least twice as high among US Chinese older adults with CMCs than those without the various conditions. Compared with US Chinese older adults with neither DSs nor CMCs, those with comorbid DS-CMC had more ED visits (rate ratio [RR] = 3.32; 95% confidence interval [CI] = 2.03-5.42) and hospitalizations (RR = 3.12; 95% CI = 1.95-4.97).

CONCLUSION: Recognition and treatment of comorbid DS-CMC warrant increased policy and clinical attention. The findings underscore the potential need to develop effective services targeting DSs among US Chinese older adults with CMCs.

Key words: comorbidity; depressive symptoms; chronic medical conditions; health services use; minority aging

INTRODUCTION

Nearly half of community-dwelling US adults live with at least one chronic medical condition (CMC), such as hypertension, diabetes, cancer, and stroke, and more than 25% experience multiple chronic conditions.1 Furthermore, it is well established that depression often co-occurs with CMCs, particularly diabetes, cancer, heart disease, stroke, and arthritis.2–6 Multiple studies have documented that comorbid depression is associated with a sixfold higher likelihood of functional disability,7 a 70% increase in overall medical costs,8 and a 2.4-fold increase in mortality than those without depression.9

Notwithstanding fiscal ramifications and heightened risks for adverse health outcomes, there is a paucity of knowledge regarding such comorbidity among older ethnic minority populations. According to previous US research, among older Medicare beneficiaries with diabetes, comorbid depression was associated with increased length of stay and costs for inpatient care.10 Other studies revealed that older adults with certain CMCs, such as asthma, digestive disorders, arthritis, and heart failure, were more likely to experience depression.11,12 Furthermore, prior research indicates that individual CMCs associated with depression vary for different ethnic populations.13 For instance, kidney, vision, and circulation problems were associated with depression among older African American adults, whereas other CMCs (ie, diabetes, heart disease, hypertension, and arthritis) were not significant.14 For older Mexican Americans, significant predictors of depression included diabetes, arthritis, cancer, incontinence, kidney disease, and ulcers.13 Another study reported that among six common CMCs (high blood pressure, heart disease, stroke, diabetes, arthritis, and osteoporosis), only arthritis was associated with depressive symptoms (DSs) among Chinese older adults in Hong Kong.15 Considering the ethnic differences

From the *Institute for Health, Health Care Policy and Aging Research, Rutgers University, New Brunswick, New Jersey; and the †School of Social Policy and Practice, University of Pennsylvania, Philadelphia, Pennsylvania.

Address correspondence to XinQi Dong, MD, MPH, Institute for Health, Health Care Policy and Aging Research, Rutgers University, 112 Paterson St, New Brunswick, NJ 08901 (E-mail: xdong@ifh.rutgers.edu).

DOI: 10.1111/jgs.15669

JAGS 67:S545–S550, 2019
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and increasing diversity among the aging US population, an improved understanding of this specific comorbidity in ethnic minority populations is critical.

To bridge this significant knowledge gap, this population-based cross-sectional study examined prevalence rates and associated health services use of comorbidity of DSs and CMCs in US Chinese older adults. A focus on Chinese older adults is important for two reasons. First, Chinese older adults are one of the largest and fastest growing older minority populations in the United States. It was estimated in 2010 that there were 366,761 Chinese older adults, a population that has been growing at a rate far exceeding that of the general US older adult population. Second, CMCs and DSs are prevalent in US Chinese older adults. According to previous research, more than 84% of US Chinese older adults had one or more CMCs and more than 60% had two or more conditions. Furthermore, multiple studies reported that US Chinese older adults experience DSs at a higher rate than that of the general US older adult population. However, the prevalence of comorbid DS-CMC and negative health consequences remains poorly understood in this fast-growing population.

Specifically, the aims of the study were to do the following: (1) examine the prevalence and odds of DSs across common CMCs among US Chinese older adults; and (2) determine the relationship between comorbid DS-CMC and health services use (ie, emergency department [ED] visits and hospitalizations). On the basis of empirical evidence from other populations, it was hypothesized that (1) the prevalence and odds of DSs would be different across common CMCs; and (2) the DS-CMC comorbidity would be associated with a higher likelihood of health services use in terms of ED visits and hospitalizations than either condition considered alone.

METHODS

Study Setting and Sample

Analyses used baseline data from the Population Study of Chinese Elderly in Chicago (PINE) collected between July 2011 and June 2013. The PINE is a longitudinal, representative, population-based study of Chinese older adults in the greater Chicago area. The purpose of PINE was to examine health status and psychological and social well-being of Chinese older adults. Eligible participants were (1) self-identified as Chinese; (2) 60 years or older; and (3) community-dwelling residents in the greater Chicago area. Detailed information on design and implementation of PINE has been described elsewhere.

Eligible participants were identified in collaboration with more than 20 community-based organizations serving Chinese families in the region. Of 3,542 eligible Chinese older adults who were approached, a sample of 3,159 participated, yielding a response rate of 91.9%. In-home interviews were conducted by trained bicultural and multilingual research assistants in participants’ preferred language or dialects, including English, Mandarin, Cantonese, Toishanese, and Teochew. Participants signed informed consent forms, and the institutional review board of Rush University Medical Center approved the protocol.

Measures

Dependent Variables

Dependent variables included number of ED visits and hospitalizations. ED visit was assessed by asking, “How many times have you visited an emergency room in the past two years?” Hospitalization was determined by questioning, “How many times have you been hospitalized in the past two years?”

Independent Variable

The independent variable was comorbid DS-CMC. Participants were stratified into four mutually exclusive groups based on presence of CMCs and/or DSs: (1) neither DSs nor CMCs; (2) DSs in absence of CMCs; (3) CMCs in absence of DSs; and (4) comorbid DS-CMC.

CMCs were assessed by asking participants whether they had ever been informed by a physician, nurse, or therapist that they had any of nine specific chronic conditions, including heart disease, stroke, cancer, high cholesterol, diabetes, high blood pressure, hip fracture, thyroid, and osteoarthritis. Participants who reported yes to any one of the nine conditions were categorized as having a CMC.

The presence of DS was assessed using the nine-item version of the Patient Health Questionnaire (PHQ-9). The scale is one of the most widely used self-report measure of depression in community-based studies. It consists of nine items, including loss of interest in doing things, feeling down, sleep problems, feeling tired or having little energy, poor appetite or overeating, feeling bad about self, trouble concentrating on things, feeling restless, and thoughts of better off dead. Participants rated the extent to which they endorsed each item on a four-point Likert scale ranging from 0 (not at all) to 3 (nearly every day). The final score is the sum of scores of all scale items, ranging from 0 to 27. The Chinese version of PHQ-9 has demonstrated good psychometric properties in Chinese populations, with Cronbach’s α ranging from 0.86 to 0.91 in different studies. In the present study, a cutoff point of 10 was used to identify participants with DSs. A recent meta-analysis reported the cutoff point of 10 had a pooled sensitivity of 0.78 and a specificity of 0.87 in identifying major depression in various settings. The Cronbach’s α in the present study was 0.82.

To be classified as having a comorbidity of DSs, participants indicated at least one CMC and a PHQ-9 score of 10 or greater. Dummy variables representing three groups were entered simultaneously into regression models, with neither DS nor CMC group used as the reference category.

Covariates

Andersen’s Behavioral Model of Health Services Use, a widely used theoretical framework for examining use of health services among diverse populations, guided the selection of covariates in analyses. The model specifies that health service use is a function of an individual’s predispositions to use health services (predisposing factors [eg, age, sex, marital status, and education]), ability to mobilize resources to obtain such services (enabling factors [eg, health insurance coverage, living arrangement, and social
support), and need for the services (need factors [eg, self-reported health, functional limitations, and medical diagnoses]). Because more than 85% of US Chinese older adults are foreign-born immigrants, acculturation (ie, degree of cultural assimilation to the dominant culture) was included as an enabling factor.

Predisposing factors included age (in years), sex (female/male), marital status (married/not married), and education (in years).

Enabling factors included acculturation, household size, health insurance coverage (yes/no), and income. Acculturation was measured by a validated scale with excellent psychometric properties. The multidimensional scale assessed participants’ preferences of speaking English vs Chinese in various settings (five items), using Chinese vs English media (three items), and having Chinese vs American social contacts (four items). Participants responded on a 5-point scale with 1 (only Chinese), 2 (more Chinese than English/American), 3 (both equally), 4 (more English/American than Chinese), and 5 (only English/American). Higher scores indicated greater levels of acculturation. Cronbach’s α in the present study was 0.88. Household size was measured by asking participants the number of people in their households besides themselves. Income was annual personal income from all sources reported by participants on a 10-point scale ranging from 1 ($0–$4,999) to 10 ($75,000 and above).

Need factors included self-reported health, which was assessed by a single-item question, “In general, how would you rate your health?” on a 4-point scale ranging from 1 (poor) to 4 (very good).

Data Analysis

Descriptive statistics were used to summarize sample characteristics. Characteristics of participants were compared across the four comorbid medical and/or DS categories using χ² statistics (categorical variables) and analysis of variance/Kruskal-Wallis tests (continuous variables). To address objective 1, prevalence of DSs was calculated for each category of CMC and per total number of these categories; and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to examine the odds of having comorbid DSs for each individual CMC. For objective 2, multivariate negative binomial regression analyses were conducted to assess the relationship between comorbid DS-CMC and use of health services (ie, ED visits and hospitalizations), controlling for the covariates. Missing data were addressed by listwise deletion in all models. All statistical analyses were conducted using SAS Version 9.2 (SAS Institute Inc, Cary, NC).

RESULTS

Table 1 compares sample characteristics of participants across the four comorbid DS and/or CMC categories. Approximately 14% did not have any CMCs nor DSs, 66% had at least one CMC but no DSs, 2.1% had DSs but no CMCs, and 18% had comorbid DS-CMC. Overall, those who reported comorbid DS-CMC were more likely to be older, female, married, and insured. They also tended to have fewer people in the household, lower income, and poorer self-reported health.

Table 2 presents prevalence rates and adjusted odds (adjusted for age, sex, marital status, and education) of DSs across specific CMCs and different CMC frequency groups. DSs were more prevalent among US Chinese older adults with high blood pressure (4.6%), arthritis (4.3%), and high cholesterol (4.3%), followed by those with diabetes (2.7%) and heart disease (2.0%), with less than 1% for the remaining four CMCs (ie, stroke, cancer, hip fracture, and thyroid disease). Moreover, US Chinese older adults with heart disease (OR = 1.99; 95% CI = 1.46-2.72), stroke (OR = 1.80; 95% CI = 1.14-2.84), cancer (OR = 2.13; 95% CI = 1.64-2.77) was increased, compared with no CMCs.

Table 1. Sample Characteristics Across Categories of Chronic Medical Conditions and/or Depressive Symptoms

<table>
<thead>
<tr>
<th>Variables</th>
<th>Neither Chronic Medical Condition Nor Depressive Symptoms (n = 428, 13.8%)</th>
<th>Chronic Medical Condition Alone (n = 2071, 66.9%)</th>
<th>Depressive Symptoms Alone (n = 87, 2.1%)</th>
<th>Chronic Medical Condition and Depressive Symptoms (n = 571, 18.2%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD), y</td>
<td>69.5 (8.1)</td>
<td>73.1 (8.1)</td>
<td>74.0 (8.4)</td>
<td>75.5 (8.7)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Sex, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>271 (57.9)</td>
<td>969 (40.2)</td>
<td>9 (33.3)</td>
<td>68 (29.7)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>197 (42.1)</td>
<td>1444 (59.8)</td>
<td>18 (66.7)</td>
<td>161 (70.3)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Marital status, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>387 (83.2)</td>
<td>1681 (69.8)</td>
<td>19 (70.4)</td>
<td>135 (59.0)</td>
<td></td>
</tr>
<tr>
<td>Not married</td>
<td>78 (16.8)</td>
<td>729 (30.2)</td>
<td>8 (29.6)</td>
<td>94 (41.0)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Education, mean (SD), y</td>
<td>8.6 (4.7)</td>
<td>8.8 (5.1)</td>
<td>7.0 (5.6)</td>
<td>8.3 (5.4)</td>
<td>.1115</td>
</tr>
<tr>
<td>Household size, mean (SD), No.</td>
<td>14.8 (4.4)</td>
<td>15.4 (5.2)</td>
<td>15.2 (5.3)</td>
<td>15.0 (5.0)</td>
<td>.4317</td>
</tr>
<tr>
<td>Health insurance, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>261 (56.1)</td>
<td>1904 (79.1)</td>
<td>17 (63.0)</td>
<td>192 (83.8)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>204 (43.9)</td>
<td>503 (20.9)</td>
<td>10 (37.0)</td>
<td>37 (16.2)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Income (USD), mean (SD)</td>
<td>1.9 (1.2)</td>
<td>2.0 (1.2)</td>
<td>1.5 (0.6)</td>
<td>1.8 (0.7)</td>
<td>.0073</td>
</tr>
<tr>
<td>Self-reported health, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>26 (5.6)</td>
<td>408 (16.9)</td>
<td>12 (44.4)</td>
<td>147 (64.2)</td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td>138 (29.5)</td>
<td>1102 (45.7)</td>
<td>9 (33.3)</td>
<td>66 (28.8)</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>256 (54.7)</td>
<td>816 (33.6)</td>
<td>6 (22.2)</td>
<td>13 (5.7)</td>
<td></td>
</tr>
<tr>
<td>Very good</td>
<td>48 (10.3)</td>
<td>87 (3.6)</td>
<td>0 (0)</td>
<td>3 (1.3)</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>
Table 2. Prevalence and Adjusted OR of Depressive Symptoms Across Chronic Medical Conditions

<table>
<thead>
<tr>
<th>Chronic Medical Condition</th>
<th>Depressive Symptom Prevalence by the Specific Chronic Medical Conditions (in Ranked Order)</th>
<th>Adjusted OR of depressive symptoms (95% CI)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>High blood pressure (n = 1723)</td>
<td>145 (4.6%)</td>
<td>0.91 (0.70-1.20)</td>
</tr>
<tr>
<td>High cholesterol (n = 1512)</td>
<td>133 (4.3%)</td>
<td>1.11 (0.85-1.44)</td>
</tr>
<tr>
<td>Arthritis (n = 1222)</td>
<td>135 (4.3%)</td>
<td>1.60 (1.23-2.08)***</td>
</tr>
<tr>
<td>Diabetes (n = 697)</td>
<td>83 (2.7%)</td>
<td>1.70 (1.28-2.25)***</td>
</tr>
<tr>
<td>Heart disease (n = 475)</td>
<td>64 (2.0%)</td>
<td>1.99 (1.46-2.72)***</td>
</tr>
<tr>
<td>Stroke (n = 179)</td>
<td>24 (0.8%)</td>
<td>1.80 (1.14-2.84)*</td>
</tr>
<tr>
<td>Cancer (n = 165)</td>
<td>22 (0.7%)</td>
<td>2.13 (1.35-3.38)***</td>
</tr>
<tr>
<td>Hip fracture (n = 222)</td>
<td>23 (0.7%)</td>
<td>1.17 (0.74-1.85)</td>
</tr>
<tr>
<td>Thyroid disease (n = 268)</td>
<td>22 (0.7%)</td>
<td>0.91 (0.57-1.44)</td>
</tr>
<tr>
<td>Any chronic medical condition (n = 2642)</td>
<td>229 (7.3%)</td>
<td>1.34 (0.88-2.06)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of chronic medical conditions</th>
<th>27 (0.9%)</th>
<th>Reference group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (n = 725)</td>
<td>46 (1.5%)</td>
<td>1.08 (0.66-1.78)</td>
</tr>
<tr>
<td>2 (n = 774)</td>
<td>56 (1.8%)</td>
<td>1.11 (0.68-1.81)</td>
</tr>
<tr>
<td>≥3 (n = 1143)</td>
<td>127 (4.1%)</td>
<td>1.70 (1.09-2.67)*</td>
</tr>
</tbody>
</table>

*aAdjusted ORs are the odds of experiencing depressive symptoms vs not experiencing depressive symptoms in the presence of each chronic medical condition, adjusting for age, sex, marital status, and education.

Abbreviations: CI, confidence interval; OR, odds ratio.

*P < 0.05, **P < 0.01, ***P < 0.001.

CI = 1.35-3.38), diabetes (OR = 1.70; 95% CI = 1.28-2.25), and arthritis (OR = 1.60; 95% CI = 1.23-2.08) had higher odds of DSs than those without one of these five specific CMCs. Compared with Chinese older adults without CMCs, those with more than three CMCs had two times higher odds of DSs (OR = 1.7; 95% CI = 1.09-2.67).

Table 3 shows the associations between comorbidity of DS and/or CMC categories and health services use using multivariate negative binomial regression analyses. Compared with US Chinese older adults with neither DSs nor CMCs, those with comorbid DS-CMC had two times higher odds of DSs than those without such conditions. In addition, comorbid DS-CMC is associated with a greater likelihood of health services use than when either condition is considered individually. Specifically, the likelihood of ED visits and hospitalization were higher for those with comorbid DS-CMC than those with DSs or CMCs only.

The overall prevalence of DSs among US Chinese older adults with CMCs ranged from 0.7% to 7.3%, which is comparable to that reported in the US community-dwelling older adult population (0.8%-19%). Further comparison with extant research is hampered by variations in specific CMCs and populations used in previous studies. Similar to studies in other US aging populations, study findings further indicate that the presence of certain CMCs, including heart disease, stroke, cancer, diabetes, and arthritis, increases the odds of DSs among US Chinese older adults by approximately twofold. In contrast, two prior investigations suggested that only arthritis and back/neck problems were significantly associated with DSs among Chinese older adults in Boston and Hong Kong. Another study reported that stroke, arthritis, diabetes, and cancer were not related to DSs in non-Hispanic white older adults. Differences in

Table 3. Multivariate Negative Binomial Regression Between Comorbid Depressive Symptoms–Chronic Medical Physical Conditions and Health Services Use*

<table>
<thead>
<tr>
<th>Variables</th>
<th>ED visits</th>
<th>Hospitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neither chronic medical conditions nor depressive symptoms (reference group)</td>
<td>2.49 (0.84-7.33)</td>
<td>1.51 (0.50-4.60)</td>
</tr>
<tr>
<td>Depressive symptoms only</td>
<td>2.52 (1.68-3.76)***</td>
<td>2.03 (1.40-2.96)***</td>
</tr>
<tr>
<td>Chronic medical conditions only</td>
<td>3.32 (2.03-5.42)***</td>
<td>3.12 (1.95-4.97)***</td>
</tr>
</tbody>
</table>

*Data are given as the rate ratio (95% confidence interval). Data are adjusted for age, sex, marital status, education, acculturation, household size, health insurance, income, and self-reported health.

Abbreviation: ED, emergency department.

*P < 0.05, **P < 0.01, ***P < 0.001.
designs, subject characteristics, and measurements may partially explain the discrepancies. Nevertheless, these findings indicate that comorbidity of DSs among US Chinese older adults with CMCs warrants clinical and research attention.7,36

Comparable with previous research of the general US population,21,36,37 study findings suggest that Chinese older adults with comorbid DS-CMCs are more likely to have ED visits and hospitalization than those with either DSs or CMCs alone. Such findings are consistent with the broader evidence regarding the negative health-related outcomes associated with comorbid mental health conditions, such as functional disability,20,37 poor health-related quality of life,38 and worsened medical prognosis and mortality.6,9 There are several possible explanations for these relationships. First, depression has been reported to be an independent risk factor for the onset and deterioration of certain CMCs, such as heart disease, diabetes, and cancer.8 Elevated cortisol levels and inflammation associated with depression may physiologically cause earlier onset of CMCs.6 Moreover, comorbid depression has been found to heighten symptom severity and burden and enhance risks of advanced medical complications in patients with CMCs.35 In addition, nonadherence to treatment regimens and compromised self-care capacities connected to depression, such as physical inactivity, smoking, and unhealthy eating, are most commonly reported behavioral mechanisms through which depression increases the incidence and deterioration of CMCs.40,41

A recent systematic review concluded that CMCs can be a risk factor for development and worsening of depression.42 Specifically, declined physical functions and symptoms (eg, pain) associated with the progression of CMCs can exacerbate or precipitate depression.41 Multiple studies suggest that the relationship between depression and CMCs may be bidirectional and the two conditions may reinforce each other to exert greater negative impacts on health outcomes over time than when each is considered individually.3,43 The reciprocal relationship between depression and CMCs can lead to higher risks of mortality, disability, and acute complications, thereby increasing use of health services.44,45

The study findings indicate that addressing DSs among US Chinese older adults with CMCs is a significant public health need. However, US Chinese older adults with DSs are more likely to report somatic symptoms (ie, insomnia and fatigue) than affect.46 As a result, they tend to seek care from primary care providers rather than professional mental health services.45 Therefore, collaborative or integrative care models, in which mental health professionals and primary care providers work as partners to address DSs, while holistically serving the patient, represent a culturally relevant approach in the treatment of comorbid DSs among this population.48

STRENGTHS AND LIMITATIONS

Several limitations should be considered in interpreting study findings. First, results may not be generalizable to Chinese older adults in other geographical areas or to other ethnic minority populations. Second, DSs and CMCs were self-reported, which may be subjected to reporting bias. For instance, participants may forget to report existing diagnoses or confuse physician’s diagnoses with subclinical symptoms. Nevertheless, previous studies suggest that self-reported presence of CMCs is reasonably reliable.49 Third, DSs may be underrecognized and underreported because of culturally informed perceptions and stigma associated with mental illness in Chinese populations.50 Moreover, DSs were measured by a self-reported scale, which was not validated by psychiatric diagnostic instruments. Therefore, it remains unclear whether these findings are applicable to clinical diagnoses of depression. Fourth, because CMCs were measured by the total number of CMCs, it is unknown whether the findings would differ for individual CMCs. In addition, the cross-sectional design precludes the ability to make causal inferences regarding the relationship between comorbid DS-CMC and use of health services. Fifth, severity and duration of CMCs and DSs, which may influence health services use, were not examined.37 Last, the number of ED visits and hospitalizations is subject to recall bias considering the recall period of 2 years.

IMPLICATIONS

Notwithstanding the limitations, the study findings have significant clinical and policy implications. First, there is a pressing need to raise awareness among healthcare providers serving US Chinese older adults of the rates of comorbid DS-CMC in this population and the associated negative health consequences. Second, findings underscore the importance of routine screening of DSs among US Chinese older adults with common CMCs. Last, providing care to US Chinese older adults with comorbid DS-CMC requires an integrated approach, in which mental health professionals and primary care providers work collaboratively to address the multifaceted care needs.

DIRECTIONS FOR FUTURE RESEARCH

Although the study focus was on comorbid DS-CMC, much research on the interrelationship and temporal order between DSs and specific CMCs is needed because existing evidence has been inconsistent. Integrated mental health and medical care programs with established evidence for the general population require adaptation and evaluation for their applicability to US Chinese older adults.48 Future studies need to use medical chart review or clinical tests to obtain more reliable medical diagnoses and to use psychiatrically sound structured psychiatric diagnostic interviews to measure depression. Rigorous pragmatic randomized controlled trials need to be conducted to examine whether screening and treatment of DSs influence health services use in diverse populations. Last, future studies should isolate health outcomes of coexisting DSs and specific CMCs.

CONCLUSION

Comorbid DSs among US Chinese older adults with CMCs are a public health issue with significant clinical implications. Comorbid DS-CMC is associated with a greater likelihood of health services use, specifically ED visits and hospitalizations, among this rapidly growing ethnic minority population. Enhanced recognition and treatment of DSs...
warrant attention from both policymakers and healthcare professionals serving US Chinese older adults with CMCs. Effective services targeting DSs among US Chinese older adults with CMCs have the potential to improve care outcomes.

ACKNOWLEDGMENT

Conflicts Of Interest: The authors have no conflicts of interest to report.

Author Contributions: All authors contributed to the conception, design, drafting, and revision of the article.

Sponsor’s Role: None.

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Perceived Stress, Social Support, and Dry Mouth Among US Older Chinese Adults

Weiyu Mao, PhD,* Yiwei Chen, PhD,† Bei Wu, PhD,‡ Shaoqing Ge, MPH,§ Wei Yang, PhD, MD,¶ Iris Chi, DSW,∥ and XinQi Dong, MD**

OBJECTIVES: Dry mouth is a common condition among older adults that negatively influences oral health, general health, and quality of life. The role of psychosocial factors in oral health conditions and diseases remains largely unknown. We conducted a study to examine the relationship between perceived stress and dry mouth among US older Chinese adults and further investigated the potential moderating role of social support and social strain from different sources in the relationship.

DESIGN: Cross-sectional analysis.


PARTICIPANTS: Individuals 60 years or older (N = 3157).

MEASUREMENTS: Perceived stress was measured by the 10-item Chinese Perceived Stress Scale to evaluate the degree to which life situations were perceived as stressful during the preceding month on a 5-point scale, ranging from 0 ("never") to 4 ("very often"). Dry mouth was a binary self-reported outcome variable (1 = "dry mouth"). Social support was measured by the Health and Retirement Study’s social support and strain scale from sources including spouse, other family members, and friends with a 3-point response set, ranging from 0 ("hardly ever") to 2 ("often"). Sociodemographics and disease processes were assessed as covariates.

RESULTS: Having higher levels of perceived stress was significantly associated with a higher likelihood of reporting dry mouth (odds ratio = 1.03; 95% confidence interval = 1.02-1.04). The effect of perceived stress on dry mouth may vary by levels of family and friend support.

CONCLUSION: Perceived stress may influence dry mouth either directly or indirectly. To prevent or reduce dry mouth, in addition to disease processes, interventions need to consider psychosocial factors in dry mouth, especially perceived stress and social support, in this growing population.


Key words: stress; oral health; social support; social strain; older Chinese immigrants

Dry mouth is a common condition, ranging from 17% to 29% among older adults.1,2 Saliva protects the teeth and the tissues of the mouth and is critical in maintaining oral health and function.1 Dry mouth is used to describe the subjective sensation or evaluation of oral dryness.1 Dry mouth can have negative effects on oral health, general health, and quality of life among older adults.3,4 Individuals with dry mouth can have trouble swallowing, chewing, and speaking; report symptoms of burning, altered taste, aspiration, and sensation; and experience poor oral health outcomes including dental caries, gingivitis, and difficulty in dental treatment.5

Perceived stress could potentially influence dry mouth in later life. Older adults are susceptible to stress because they face higher risk of loss of functions, mobility, and independence; loss of significant others; and limited income and social support compared with general populations.6 Perceived stress is a reaction to events or problems that initiate a physiologic response (fight or flight) in the body and is an important
indication of mental and physical health. More perceived stress was associated with self-reported dry mouth in a mixed-age sample (including older adults) in Sweden and in clinical settings in the Netherlands.

Older immigrants are particularly vulnerable to stress due to interrupted or lost social ties and acculturation challenges after immigration to a new country. However, the role of psychosocial factors in oral health and diseases remains largely unknown. Older Chinese immigrants tend to have poorer oral health outcomes and use fewer dental services compared with their host country counterparts. Older Chinese immigrants in Calgary ranked dental problems as their third most common health problem after arthritis and hypertension. Older adults who migrated from China comprise the fourth largest immigrant group in the United States. The increasing oral health disease burdens among older Chinese immigrants point to the need for investigations of psychosocial factors in light of the current emphasis on physical diseases and health behaviors in oral health. Whether and how perceived stress influences dry mouth in this population warrants further exploration.

Stress could influence health through direct or indirect pathways. Social support could affect health for individuals under stress (the buffering model) or irrespective of stress (the main-effect model). Many close relationships are characterized by helpful and upsetting traits, propelling scholars to examine both positive and negative aspects of social support. Social support typically embodies the supportive or positive aspect, whereas social strain describes negative exchanges between individuals including conflict, criticism, and rejection. Scholars also need to investigate different types and sources of support and strain.

Social support and social strain could have main effects on dry mouth in later life. Individuals with stronger social support have better health compared with those who do not, irrespective of stress exposure. No research has explored the direct relationship between social support, social strain, and dry mouth in later life. We extrapolated findings from the few studies on social support and other oral health outcomes. Low social support was associated with fewer functioning teeth and more anterior open tooth spaces among older Chinese immigrants, expands the investigation of different sources of social support and strain and dry mouth in this population, and unveils the potential pathways linking perceived stress and dry mouth in this context. We addressed three research questions: (1) What is the relationship between perceived stress and dry mouth among US older Chinese adults? (2) What is the main effect of different sources of social support and strain on dry mouth? (3) Do different sources of social support and strain moderate the relationship between perceived stress and dry mouth and, if so, to what extent?

METHODS

Population and Setting

This study used baseline data from the Population Study of Chinese Elderly in Chicago (PINE), the largest population-based, community-engaged study of its kind. The PINE study aimed to understand the relationship between key psychosocial and cultural determinants, health, and well-being among community-dwelling US older Chinese adults. We included 3157 older Chinese adults in the greater Chicago area in the analyses.

Measures

Dry Mouth

At the time of the interview when reviewing past medical history, participants were asked whether they experienced any problems with dry mouth in the past (1 = “dry mouth,” 0 = “no such condition”). This is a common measure to assess dry mouth. Subjective assessments of oral dryness were shown to be a robust indicator or measure of dry mouth in various studies. Self-reported information on oral dryness is important to consider in promoting health and quality of life among older adults.

Perceived Stress

We used the 10-item Chinese Perceived Stress Scale, with a Cronbach α of .86 in our sample, to evaluate the degree to which participants perceived life situations as stressful during the preceding month on a 5-point scale, ranging from 0 (“never”) to 4 (“very often”). A total score after reverse coding of positive items was calculated. Higher scores indicated greater psychological stress, with a theoretical range of 0 to 40.

Social Support

Social support was measured by the Health and Retirement Study’s social support scale, with Cronbach α of .73 in our sample. Participants were asked how often they could “open up to” or “rely on” their spouse, other family members, and friends for help (0 = “hardly ever,” 1 = “some of the time,” 2 = “often”). A total score for each source was created. Higher values indicated higher levels of social support, with a theoretical range of 0 to 4.
**Social Strain**

Social strain was measured by the Health and Retirement Study's social strain scale, with Cronbach α of .63 in our sample.22 Participants were asked to report how often they experienced “too many demands” or being “criticized” by their spouse, other family members, and friends (0 = “hardly ever,” 1 = “some of the time”, 2 = “often”). Higher values indicated higher levels of social strain. A total score for each source was created, with a theoretical range of 0 to 4.

**Covariates**

We controlled for age (years), sex (1 = female, 0 = male), education (years), marital status (1 = married, 0 = not married), annual income (1 = >$10 000/year, 0 = ≤$10 000/year), years in the United States, diabetes (1 = having such condition, 0 = no such condition), and heart disease (1 = having such condition, 0 = no such condition).

**Data Analysis**

We used descriptive analyses for sample characteristics, conducted bivariate correlations to check multicollinearity, and checked group differences by dry mouth (t tests and χ² tests). To answer our research questions, we carried out stepwise logistic regression models by source of social support and strain. Model 1 contained covariates and perceived stress; model 2 added social support and strain from each source; and model 3 further added interaction terms including “perceived stress × social support” and “perceived stress × social strain” from each source. We used listwise deletion for missing data, which was far less than 5% of the sample. We generated outputs using statistical software SAS, v.9.4 (SAS Institute, Inc., Cary, NC).

**RESULTS**

In our sample, 25.5% of respondents reported dry mouth. 22.3% older adults reported having diabetes, and 15.1% reported having heart disease. The average score for perceived stress was 10.1 (range = 0-39; standard deviation [SD] = 6.6). For social support (range = 0-4), the average score was 2.3 (SD = 1.8) for spousal support, 2.8 (SD = 1.3) for family support, and 1.6 (SD = 1.5) for friend support. For social strain (range = 0-4), the average score was 0.4 (SD = 0.8) for spousal strain, 0.2 (SD = 0.6) for family strain, and 0.1 (SD = 0.3) for friend strain. Older adults who reported dry mouth tended to be female with medical conditions and have lower income, shorter length of stay, more years of education, and more stress.

The logistic regression models demonstrated the relationship between perceived stress and dry mouth and further examined the moderating role of social support and strain by source. In model 1 (Tables 1–3), more perceived stress was significantly associated with higher odds of dry mouth, adjusted for covariates (odds ratio [OR] = 1.03; 95% confidence interval [CI] = 1.02-1.04). In subsequent models (Table 1), each 1-unit increase in perceived stress remained significantly correlated with higher odds of dry mouth (OR = 1.03; 95% CI = 1.01-1.05), accounting for covariates, spousal support or strain, and interactions. Table 2 demonstrates that each 1-unit increase in perceived stress was significantly correlated with higher odds of dry mouth (OR = 1.03; 95% CI = 1.02-1.04), accounting for covariates and family support or strain. When including interactions of “stress × family support” and “stress × family strain,” the significant effect of perceived stress disappeared. The interaction between stress and family support became significant (OR = 1.01; 95% CI = 1.00-1.02).

Table 3 shows that each 1-unit increase in perceived stress was significantly correlated with higher odds of dry mouth (OR = 1.02; 95% CI = 1.01-1.04), accounting for covariates and friend support or strain. Higher levels of friend support were significantly correlated with lower odds of dry mouth (OR = .94; 95% CI = 0.88-1.00). After adding interactions of “stress × friend support” and “stress × friend strain,” the significant effect of perceived stress disappeared. The significant effect of friend support remained (OR = 0.94;
DISCUSSION

Our findings indicate that perceived stress was associated with dry mouth either directly or indirectly among US older Chinese adults, given sources of social support and strain. Specifically, more perceived stress was directly associated with higher odds of dry mouth, accounting for the effects of spousal support and strain. This is consistent with previous mixed-sample studies.8,9 Social support and strain from a spouse did not attenuate the relationship between perceived stress and dry mouth, which is not unusual. A nonsignificant association between quality of marital relationships and subjective health ratings among older adults was reported, along with a significant association with psychological well-being.18 Spousal

Table 2. Logistic Regression Models for Dry Mouth by Family Support and Strain (N = 3157)

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n = 3071)</td>
<td>(n = 3064)</td>
<td>(n = 3064)</td>
</tr>
<tr>
<td><strong>OR (95% CI)</strong></td>
<td><strong>OR (95% CI)</strong></td>
<td><strong>OR (95% CI)</strong></td>
</tr>
<tr>
<td>Age</td>
<td>1.00 (.99-1.01)</td>
<td>1.00 (.99-1.02)</td>
</tr>
<tr>
<td>Female</td>
<td>1.40 (1.17-1.69)***</td>
<td>1.42 (1.18-1.71)***</td>
</tr>
<tr>
<td>Married</td>
<td>.99 (.80-1.21)</td>
<td>.99 (.80-1.22)</td>
</tr>
<tr>
<td>Education</td>
<td>1.03 (1.01-1.04)**</td>
<td>1.03 (1.01-1.04)**</td>
</tr>
<tr>
<td>Annual income (&gt; $10,000)</td>
<td>.93 (1.72-1.21)</td>
<td>.94 (.73-1.22)</td>
</tr>
<tr>
<td>Years in United States</td>
<td>1.38 (1.14-1.68)**</td>
<td>1.39 (1.14-1.68)**</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1.77 (1.42-2.19)***</td>
<td>1.78 (1.43-2.21)***</td>
</tr>
<tr>
<td>Heart disease</td>
<td>1.03 (1.02-1.04)***</td>
<td>1.03 (1.02-1.04)***</td>
</tr>
<tr>
<td>Family support</td>
<td>.98 (.91-1.05)</td>
<td>.96 (.89-1.03)</td>
</tr>
<tr>
<td>Family strain</td>
<td>.95 (.82-1.10)</td>
<td>1.00 (.84-1.17)</td>
</tr>
<tr>
<td>Perceived stress × family support</td>
<td>1.01 (.99-1.00)*</td>
<td></td>
</tr>
<tr>
<td>Perceived stress × family strain</td>
<td>.99 (.97-1.01)</td>
<td></td>
</tr>
</tbody>
</table>

| Pseudo R² | .06 | .06 | .06 |

**Abbreviations:** CI, confidence interval; OR, odds ratio.

* p < .05.

** p < .01.

*** p < .001.

Note. Missing value was less than 5% of the total sample. Listwise deletion was used.

Table 3. Logistic Regression Models for Dry Mouth by Friend Support and Strain (N = 3,157)

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n = 3071)</td>
<td>(n = 3046)</td>
<td>(n = 3046)</td>
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<td><strong>OR (95% CI)</strong></td>
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</tr>
<tr>
<td>Age</td>
<td>1.00 (.99-1.01)</td>
<td>1.00 (.99-1.01)</td>
</tr>
<tr>
<td>Female</td>
<td>1.40 (1.17-1.69)***</td>
<td>1.44 (1.19-1.73)***</td>
</tr>
<tr>
<td>Married</td>
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<td>Education</td>
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<td>1.03 (1.01-1.05)**</td>
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<tr>
<td>Annual income (&gt; $10,000)</td>
<td>.93 (.72-1.21)</td>
<td>.94 (.73-1.22)</td>
</tr>
<tr>
<td>Years in United States</td>
<td>1.38 (1.14-1.68)***</td>
<td>1.37 (1.13-1.66)***</td>
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<tr>
<td>Diabetes</td>
<td>1.77 (1.42-2.19)***</td>
<td>1.77 (1.42-2.20)***</td>
</tr>
<tr>
<td>Heart disease</td>
<td>1.03 (1.02-1.04)***</td>
<td>1.03 (1.02-1.04)***</td>
</tr>
<tr>
<td>Friend support</td>
<td>.94 (.88-1.00)*</td>
<td>.94 (.88-1.00)*</td>
</tr>
<tr>
<td>Friend strain</td>
<td>1.05 (1.81-1.35)</td>
<td>1.11 (1.84-1.46)</td>
</tr>
<tr>
<td>Perceived stress × friend support</td>
<td>1.01 (1.00-1.02)*</td>
<td></td>
</tr>
<tr>
<td>Perceived stress × friend strain</td>
<td>.98 (.94-1.01)</td>
<td></td>
</tr>
</tbody>
</table>

| Pseudo R² | .06 | .06 | .06 |

**Abbreviations:** CI, confidence interval; OR, odds ratio.

* p < .05.

** p < .01.

*** p < .001.

Note. Missing value was less than 5% of the total sample. Listwise deletion was used.

95% CI (0.88-1.00). The interaction between stress and friend support became significant (OR = 1.01; 95% CI = 1.00-1.02).

We plotted the relationship between perceived stress and estimated probabilities of dry mouth by level of support to illustrate significant interactions. In Figure 1, the relationship between perceived stress and dry mouth varied by level of family support. Individuals with high family support had the steepest slope, followed by those with medium and low family support. In Figure 2, the relationship between perceived stress and dry mouth followed a similar pattern. The relationship between perceived stress and dry mouth was the strongest among participants with high family or friend support.
support and strain may be less likely to affect physical health outcomes. We suspect that older adults are likely to be in long-term marriages and have normalized spousal support and strain that may not influence dry mouth independently.

Older Chinese immigrants tend to heavily rely on children and other family members for support and care.28 Friends become more important after immigration to the United States, compared with their counterparts in China.28 Friend support was suggested to be protective against dry mouth in this study. Besides that, the study did not find strong associations between family support, friend support, and dry mouth; instead, perceived stress was positively related with a higher likelihood of reporting dry mouth among US older Chinese adults. Despite this, there is some evidence of significant group differences by level of family or friend support in the relationship between perceived stress and dry mouth. The relationship between perceived stress and the odds of having dry mouth was the strongest among older adults with high family or friend support despite the absence of a strong, direct association between such support and dry mouth.

We speculate that family and friend support could potentially impact perceived stress; while perceived stress is related to dry mouth symptom, family or friend support could thus indirectly affect the perceived dry mouth symptoms. We speculate that too much social support might have negative consequences on oral health, as seen in social overload from traditional social networks resulting in negative psychological and behavioral consequences.29 We also speculate that the type of support might make the difference between more stress and less. For instance, when too much unsolicited emotional support or advice is offered or perceived, it might create more stress than it relieved. It might also be possible that extended talk and rumination with family and friends could increase perceived stress and indirectly increase dry mouth.30

We acknowledge that having diabetes or heart disease was significantly associated with a relatively high likelihood of reporting dry mouth, accounting for perceived stress, social support, and social strain in this population. We speculate that poor health may lead to stress and dry mouth. Poor health may require medication intakes, resulting in increased risks of dry mouth. We also speculate that individuals with higher levels of education might be more likely to be aware of having certain oral health symptoms including dry mouth. Individuals with lower levels of education might consider dry mouth as a normal part of aging and may not report this symptom.

Findings should be interpreted with caution. Due to the cross-sectional nature of the data, we cannot rule out an inverse relationship between perceived stress and dry mouth. Generalizability of findings to other contexts might be limited given the sampling of older Chinese immigrants in one geographic region. Potential confounding factors including medications and oral health behaviors were not collected. The strength of significant ORs and the explained variance in dry mouth were relatively low.

Despite these limitations, this study is the first to examine the relationship between perceived stress and dry mouth and further investigate the role of social support and strain from different sources among US older Chinese adults. This study demonstrates the importance of examining immigrant oral health outcomes in later life, understanding this specific type of oral health outcome among older ethnic minority immigrants in a specific cultural group, and examining social support and social strain from different sources. It has theoretical and practical significance regarding how perceived stress may influence dry mouth in this context. Future studies should investigate the dynamic relationship between perceived stress and dry mouth over time within this population.

This study has implications for the medical and dental community. This study highlights the interconnections among perceived stress, social support, and dry mouth among older Chinese immigrants and the importance of considering psychosocial determinants of oral health symptoms and problems in later life with respect to treatment and health promotion efforts. We need to raise awareness among dental and healthcare providers of the potential role that perceived stress could play in promoting optimal oral health and improving quality of life in this growing population. Intervention strategies could start with the assessment of perceived stress in dental examinations and pay attention to social support of the patients when there is no other reason to cause.

![Figure 1](image1.png)

**Figure 1.** Line chart of estimated probabilities of dry mouth by perceived stress and family support, accounting for other covariates.

![Figure 2](image2.png)

**Figure 2.** Line chart of estimated probabilities of dry mouth by perceived stress and friend support, accounting for other covariates.
the stress and dry mouth in this vulnerable population. We could build community-based partnerships and design culturally and linguistically appropriate educational programs to disseminate information on dry mouth and its debilitating nature, with critical consideration of perceived stress, disease processes, and social support in this population.

ACKNOWLEDGMENTS

Financial Disclosure: None.

Conflict of Interest: None.

Author Contributions: Conception and design of the study, data analysis and interpretation, preparation of the manuscript, critical review of the manuscript, and final approval of the manuscript: Mao. Conception and design of the study, data analysis and interpretation, critical review of the manuscript, and final approval of the manuscript: Chen. Design of the study, data analysis and interpretation, critical review of the manuscript, and final approval of the manuscript: Wu. Provision of the first draft of the sample and measures, critical review of the manuscript, and final approval of the manuscript: Ge. Data analysis and interpretation, critical review of the manuscript, and final approval of the manuscript: Yang and Chi. Critical review of the manuscript and final approval of the manuscript: Dong.

Sponsor’s Role: University of Nevada, Reno, Research and Innovation New Scholarly Endeavor Grant.

REFERENCES

The Impact of Intergenerational Relationship on Health and Well-Being of Older Chinese Americans

Daniel W.L. Lai, PhD,* Vincent W.P. Lee, PhD,* Jia Li, PhD,* and XinQi Dong, MD, MPH†

BACKGROUND/OBJECTIVES: Among older adults, intergenerational support can help to improve well-being. This study examines the correlation between intergenerational relationships and the subjective well-being among older Chinese immigrants in the United States.

DESIGN: Hierarchical multiple regression analyses were applied to test the association between intergenerational relationships and self-rated well-being. The mediating effects of sense of control and the moderation effects of support from friends were also tested.

SAMPLE: A cross-sectional sample of 2717 older Chinese immigrants, aged 60 years and older, with children and grandchildren was drawn from the Population Study of Chinese Elderly.

MEASUREMENTS: Study measures included four items concerning intergenerational relationships: the Pearlin Mastery Scale, two items on seeking support from friends, and single items measuring self-rated health status and quality of life.

RESULTS: Only the feeling of closeness with children was positively linked with subjective well-being, while coresidence and frequency of talking were not. Support from friends moderated the association with self-rated health status, while sense of control partially mediated the association between feeling of closeness and both self-rated health status and quality of life.


Key words: health status; intergenerational relationships; quality of life; sense of control; social support

Families are sources of affective bonds, shared responsibilities, such as caregiving, and intergenerational transfers of knowledge and wealth. Studies report positive correlations between intergenerational or familial support and subjective well-being and mental health among older adults. For older adults, children are important sources of instrumental support, caregiving, and affective bonds. In western industrialized contexts, older adults typically live independently without heavy reliance on family. In Asian cultures, filial piety is an important traditional value, based on expectations that children will care for their parents. This has long shaped family structure and relationships, and daily life and well-being, for older Chinese adults. However, demographic, economic, and societal changes affect intergenerational values or norms. Across Asia, the incidence of living alone or only with a spouse had increased and frequent interactions between adult children and older parents can lead to conflictual relations.

In the United States, studies show that older Asian immigrants are less likely to maintain a “traditional” lifestyle (ie, coresiding with children), due to changes in cultural and socioeconomic circumstances. Although parent-child relationships (eg, respect from children) remain important, Asian immigrants, including many older Chinese who are also immigrants, have adjusted their filial expectations and value independence. Previous studies also highlight the importance of peer networks, partner relationships, and emotional support for older immigrants’ quality of life, including among older Chinese immigrants. The changing role of coresidence and familial support among Chinese and other Asian immigrants in relation to perceived quality of life was reported. This suggests that older immigrants in the United States and other western countries may be more likely to renegotiate the notion of filial piety and intergenerational support.

This study examines the link between intergenerational relationships and subjective well-being among older Chinese in a western society (ie, the United States). Few studies have
explored how emotional aspects of intergenerational relationships, such as emotional attachments and feelings of closeness, might contribute to subjective well-being among older Chinese immigrants, or how these might change in the context of migration. Previous studies focus mainly on differences between “West” and “East” when examining questions of familial care, coresidence, and independent aging, so this study aims to understand which aspects of intergenerational relationships would be associated with well-being of the older Chinese immigrants: Is coresidence important to them, or do they simply need a feeling of closeness with their families? This is the first research gap addressed by this study.

Sense of control is widely discussed in previous studies as being associated with improved self-rated physical and psychological health, and as mediating the link between competence and depression, and between caregiving and care recipients’ well-being. Older Chinese immigrants experience adaptation to new sociocultural settings that are different than their countries of origin in terms of language, employment opportunities, family structure, and so on, and these processes may affect and be affected by sense of control. However, studies on sense of control have not considered implications for intergenerational relationships and subjective well-being (such as the links between intergenerational relationships and sense of control), and studies on sense of control among older Chinese immigrants are scant. This is the second key research gap addressed by this study.

Studying the effects of intergenerational relationships on older adults’ sense of control and, in turn, on health status and quality of life can inform a deeper understanding of the links between intergenerational relationships and well-being. This research aims to expand existing literature on associations between dimensions of intergenerational relationships, sense of control, and self-rated well-being. It will also enrich discourses of how traditional intergenerational support has been transformed and renegotiated in the context of migration.

RESEARCH DESIGN

Research Questions

To address these gaps in existing research, this study aimed to answer the following questions:

1. Given the traditional virtues of filial piety and intergenerational cohesiveness that have been embedded in traditional Chinese culture for centuries, do stronger intergenerational relationships promote higher self-rated health status and quality of life among older Chinese immigrants in the United States?
2. Does subjective sense of control mediate the association between intergenerational relationships, support from friends, and their self-rated health status and quality of life?
3. Does support from friends moderate the association between intergenerational relationships and their self-rated health status and quality of life?

Analytical Framework

An analytical framework based on previous research studies has been proposed. Traditionally, in Chinese culture, intergenerational support associated with the concept of filial piety has been highly valued by older adults. Thus, stronger intergenerational relationships would be associated with a higher sense of control. Sense of control would also mediate effects on self-rated health status and quality of life, a relationship supported by other scholars. This current study also examined the effect of support from friends (specifically, its moderating effects on intergenerational relationships and self-rated health and quality of life). Direct relationships between support from friends and self-rated health status and quality of life were also assessed.

Based on previous research findings, it was hypothesized that: (1) Stronger intergenerational relationships would correlate with better self-rated health and quality of life. (2) Sense of control would mediate the association between intergenerational relationships, support from friends, and self-rated health status and quality of life. (3) Support from friends would moderate intergenerational relationships and self-rated health status and quality of life.

METHODS

Sample

This study involved secondary analysis of data from the Population Study of Chinese Elderly (PINE), a population-based study conducted between 2011 and 2013 in the greater Chicago, IL, area in the United States. The PINE survey involved interviews with a total of 3137 participants, aged 60 years and older, who self-identified as ethnic Chinese. Data collected in 2011 were used for this current study. After selecting only respondents with offspring, including children, children-in-law, and grandchildren (N = 2838), removing cases with missing values (122 cases), and data cleaning, a total of 2717 cases were retained for further regression, mediation, and moderation analyses.

Measures

The dependent variables in the study were self-rated health and quality of life. These were assessed by two separate questions, with self-rated health assessed based on the question “In general, would you say your health is?” and quality of life assessed on the question “The quality of my life is?” Both self-rated health status and quality of life were measured along a four-point scale, ranging from “poor” (1) to “very good” (4). As predicting variables, four intergenerational variables were examined in this study, covering aspects of living together, frequency of talking, feeling of closeness, and trust in health decisions. Each was measured by a single-item question: (1) “Does this person live in the same household as you?” (2) “How frequently do you talk to this person?” (3) “How close do you feel is your relationship with this person?” and (4) “Suppose you had a health problem that you were concerned about, or need to make an important decision about your own medical treatment, how likely would you talk with this person about it?” These questions could refer to the respondent’s offspring and other members of their junior generations, including children, grandchildren, children-in-law, and stepchildren. The answers for each of these questions were recoded, with higher scores indicating a closer or stronger intergenerational relationship. To measure support from friends, two questions from the PINE data set were used, each measured by a three-point scale, ranging from “hardly ever or never” (1) to “often” (3): (1) “How
often can you open up to your friends if you need to talk about your worries?” and (2) “How often can you rely on them for help if you have a problem?” The two variables were combined as one aggregated variable to measure overall support level from friends. The two items reported a high reliability score (Cronbach’s $\alpha = .82$).

Sense of control was measured by the validated Chinese version of the seven-item Pearlin Self-Mastery Scale. Respondents were asked how strongly they agreed or disagreed with each of the following statements: (1) “I have little control over things that happen to me.” (2) “There is really no way I can solve some of the problems I have.” (3) “There is little I can do to change many of the important things in my life.” (4) “I often feel helpless in dealing with the problems of life.” (5) “Sometimes I feel that I’m being pushed around in life.” (6) “What happens to me in the future mostly depends on me.” (7) “I can do about anything I really set my mind to do.” The answers to these questions were aggregated, with higher total scores indicating a stronger sense of control. Finally, a number of control variables related to respondents’ demographic characteristics and socioeconomic status were also included in the study, including age, education, income category, number of living children, household size, and number of years of residence in the United States. Age was calculated based on date of birth and the date of the interview. Education level was measured by years of completed education, and income was measured by sequential categories of income. The number of living children, household size, and years of residence in the United States are used as continuous variables in the regression analyses.

Data Analyses

The method of linear multiple regression analysis has been adopted in this research. Initial analyses were conducted to test hypothesis 1. Several steps of multiple regression were involved in testing the mediating effect of sense of control (hypothesis 2), including comparing the models before and after adding the sense of control variable. The three-step mediation method of Baron and Kenny was used to test the mediating effect. The correlations between the predicting variables and the mediator were first tested; then, the same tests were conducted between predicting variables and dependent variables; and, finally, all predicting variables and the mediator were added to the analytical model. Hypothesis 3 was tested by adding the interaction terms to the regression models to check whether support from friends moderated associations between intergenerational relationships and dependent variables. Four interaction terms were computed by multiplying the “support from friends” variable by the intergenerational variables.

RESULTS

Table 1 presents the descriptive analyses of the studied variables. Respondents’ ratings of self-rated health condition and quality of life were not high, as none of the mean scores exceeded three of four.

Initial regression analyses tested the relationships between intergenerational variables, support from friends, and self-rated well-being (Tables 2 and 3), without inserting the mediating variable and interaction terms after controlling for sociodemographic variables. Feelings of closeness were positively associated with self-rated health and quality of life after controlling for demographic and socioeconomic factors. The frequency of seeking support from friends was also correlated with both self-rated health status and quality of life.

In response to the second research question, mediation of respondents’ sense of control has been tested. After adding sense of control and interaction terms to the model, feelings of...
closeness were partially mediated, as indicated by their lower coefficients than in the original model (Tables 2 and 3). The magnitude of the partial mediation of sense of control for feeling of closeness in the model of self-rated health status was nearly 54%; and it was 33% for the model of self-rated quality of life. These findings imply that partial mediation of sense of control did not fully mediate correlations between feelings of closeness and subjective well-being. Support from friends partially moderated the correlations between intergenerational relationships and self-rated health status, as the interaction terms of feelings of closeness and living together were significant factors in the regression model. The third hypothesis was, thus, partially supported (Figures 1 and 2).

The first two hypotheses were partially supported, as not all intergenerational variables were significant factors and sense of control did not fully mediate correlations between feelings of closeness and subjective well-being. Support from friends partially moderated the correlations between intergenerational relationships and self-rated health status, as the interaction terms of feelings of closeness and living together were significant factors in the regression model. The third hypothesis was, thus, partially supported (Figures 1 and 2).

DISCUSSION AND CONCLUSION

Of the four intergenerational variables examined, only a feeling of closeness with children was associated with positive self-rated health status and quality of life among older Chinese immigrants. Sense of control partially mediated the impact of feelings of closeness on self-rated health and quality of life. Findings concerning feelings of closeness echo previous reports that intergenerational coresidence is not a prerequisite for better well-being among older adults. Strong family relationships involving emotional ties with children living at a distance can
be equally as beneficial as coresidence.9,27 While some scholars emphasize cultural traditions of coresidence associated with filial piety in traditional Chinese and other East Asian cultural contexts,2,9,11 for older Chinese immigrants, the realization of filial piety may be renegotiated through processes of acculturation to "western" social values as well as economic realities (eg, employment) facing adult children.11–14,28

Although key traditional virtues associated with filial piety, such as intergenerational coresidence and frequent face-to-face communication, may continue to influence older parent-child relationships in Chinese immigrant families, there are changes occurring under the influence of the US social atmosphere, including values of individuality instead of collectivity and living independently in western society. Parental perceptions of children as respectful could contribute to better relationships in later life, compared to coresidence.17 Even in mainland China, some older parents prefer living on their own so as to avoid conflicts with their adult children and children-in-law.11 Although the available data do not enable definite conclusions about why sense of closeness is more important than coresidence and frequent communication with children, we can hypothesize that avoidance of conflict with offspring might be one of the factors behind the significance of sense of closeness in this study.

The mediating effect of an older adult’s sense of control between intergenerational cohesiveness and his/her self-rated well-being could also help to further explain our results. Sense of control may provide older adults with a sense of dignity, as they do not need to rely on frequent physical or material support from their children. They could prioritize receiving emotional support, which could be associated with feelings of closeness. The significant relationship between intergenerational closeness

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**Figure 1.** Analyses of the impact of intergenerational cohesiveness, the mediating effect of sense of control, and the moderating effect of support from friends on self-rated health status. *P < .05, ***P < .001.
and sense of control further substantiates the beneficial effects of sense of control on health and quality of life among older Chinese adults, as noted in previous research.\textsuperscript{20–22} Stronger feelings of closeness with one’s children, which can reflect feelings of happiness and sources of support, could provide self-confidence, happiness, and a sense of security for older Chinese adults in the United States, leading to a stronger sense of control. Our results also show that positive support from friends does moderate feelings of closeness with family members and self-rated health status. Positive support from friends by these older immigrants is also positively correlated to self-rated quality of life, echoing previous research on the positive impact of social networks and support from friends on the well-being of older immigrants.\textsuperscript{14–17}

These findings can inform directions for practice with older Chinese immigrants and their family members. In terms of clinical practice, these findings suggest that healthcare professionals should be sensitive to the significance of emotional ties when assessing health and subjective wellness among older Chinese adults. Health-related diagnoses should also consider the impact of intergenerational closeness and sense of control. Interventions focusing on negative emotional symptoms or related mental health issues affecting older Chinese adults in community or long-term care settings could also capitalize on the importance of intergenerational relationships and emotional ties. Through psychosocial programs, professionals could support older people to promote strong cohesion and connections with their children, even if they do not live together or have frequent face-to-face interactions. For example, professionals could help to connect older adults and family members living abroad, to facilitate regular mutual interactions. They could also help to decorate accommodations with family photographs to enhance psychological and physical well-being and sense of closeness. More practically, professionals providing social and recreational support services could facilitate the use of new communication technologies to maintain feelings of closeness with family members, including children and grandchildren, to enhance quality of life.\textsuperscript{29,30} Improved sense of control, developed through the successful uptake of skills in handling modern technologies, would also be beneficial to older adults’ health and quality of life.

Last, some limitations should be acknowledged. First, the questions regarding intergenerational relationships answered by older respondents are only related to one family member from a younger generation who is important to them. However, it is difficult to discern who the focal family member was, or the criteria on which respondents described this person when they answered the questions. Second, as mentioned earlier, the available data do not allow for an examination of why an older adult chose to live with his/her adult children and other family members.
members or not (such as avoiding conflicts or gaining sense of control, as stated in previous literature). Third, the available data do not enable an examination of how respondents define “sense of closeness” with the family members. The adaptation to the individualistic social atmosphere of the United States, avoidance of conflicts, and pursuance of a higher sense of control could be possible factors, but we cannot prove these arguments from our data. Further discussions might inform a more comprehensive understanding of older adults’ preferences for living with family members or on their own and subjective meanings of sense of closeness and other forms of emotional attachment with family members.

ACKNOWLEDGMENTS

Conflict of Interest: The authors have no conflicts of interest to report.

Author Contributions: Lai contributed to the development of the conceptual framework, data analysis methods, the interpretation of major findings, and the writing and revision of the manuscript. Lee contributed to the collection of previous research findings, the organization of the literature review, the conception of research ideas, data analysis, and the drafting and writing of the manuscript. Li contributed to the conception of research ideas and interpretation of research findings. Dong contributed to the interpretation of research findings and suggestions for improvements to the manuscript.

Sponsor’s Role: Not applicable.

REFERENCES

Sense of Filial Obligation and Caregiving Burdens Among Chinese Immigrants in the United States

Man Guo, PhD,* Sohyun Kim, RN, MSN,† and XinQi Dong, MD, MPH‡

BACKGROUND/OBJECTIVES: Focusing on Chinese immigrants, this study examined (1) whether filial obligation, the core social norm in the Chinese culture, is related to caregiving burdens; and (2) whether level of acculturation of the caregivers moderates the above relationships.

DESIGN: Cross-sectional.

SETTING: Chicago, Illinois.

PARTICIPANTS: A purposive sample of 393 Chinese adult immigrants who were primary caregivers of parents aged 60 years or older.

MEASURES: Sense of filial obligation was captured by felt responsibility toward parents in six domains (respect, make happy, care, greet, obey, and provide financial support). Caregiving burdens were measured by the Caregiver Burden Inventory. Acculturation was measured by 12 questions about respondents’ language preference in different settings and ethnicity of individuals they interact with.

RESULTS: A stronger sense of filial obligation was significantly associated with lower levels of developmental (β = −.15), emotional (β = −.18), social (β = −.20), and physical (β = −.10) burdens. For subjective burdens (developmental, social burdens), such a protective effect of filial obligation was stronger among caregivers with lower acculturation levels. For more objective burdens (time-dependent, physical burdens), stronger filial obligation was actually associated with greater burdens among caregivers with higher acculturation levels.

CONCLUSION: Programs focusing on celebrating the cultural heritage of immigrants and improving the relationship between the parents and children may be helpful to reduce caregiving burdens. Intervention programs that help Chinese immigrant caregivers to find the most appropriate way to balance traditional and new social norms are important to provide successful care to aging Chinese immigrants. J Am Geriatr Soc 67:S564–S570, 2019.

Key words: cultural context; ethnic minority; filial piety; caregiving burden; Chinese

The well-being of the 4.6 million older immigrants in the United States is closely related to their families, who are often the major, if not the sole, source of support for these older adults.1 An important aspect of such support is through caregiving. As older immigrants often have limited access to both entitlement programs and formal healthcare systems,2 knowledge about caregiving behavior and experience of immigrant families is crucial to better support the rapidly increasing aging immigrant populations in the United States.

Caregiving experience is shaped by sociocultural contexts, only within which caregiving has personal meaning and social significance.3 Existing literature has documented racial differences in caregiver attributes, their objective stressors, coping process, social resources, and physical and psychological well-being.4,5 Despite the rich information obtained from these studies, our knowledge about how cultural influence of values and norms shapes one’s caregiving experience is limited in several important ways. First, comparisons of ethnic groups make up the majority of the existing studies.5 By using race as an independent variable, influence of other cultural-related variables is often repressed and difficult to interpret. Relatedly, there is a lack of clear definition of culture, leading to a poor understanding of the mechanisms through which unique cultural beliefs of certain racial/ethnic groups shape diverse caregiving experience.3,5 Lastly, immigration is barely a part of the conceptualization of cultural diversity in caregiving, a notable gap in the geriatric literature given the increasing population mobility around the world. As immigrants’ acculturation process often centers around the ongoing negotiations between one’s own culture of origin and the new culture in the receiving society,6 level of acculturation...
is a particularly pertinent concept to understand the diversity in immigrants’ caregiving experience.

To address these limitations, scholars have called for more in-depth research that focuses on single ethnic groups and specific cultural values to understand the cultural contexts of caregiving. Responding to these calls, this study focused on Chinese immigrants in the United States to examine (1) whether a sense of filial obligation, a core cultural norm of the Chinese population, is associated with caregiving burden; and (2) whether the acculturation level of caregivers confounds the above relationship.

Chinese Americans as Caregivers

Asian Americans are one of the fastest-growing minority groups in the United States, but they are least studied in their caregiving experience compared to other racial groups. Among Asian Americans, Chinese are the largest subgroup, accounting for 24% of the Asian American populations. In 2015, 63% of the Chinese Americans were foreign born and 34% had lived in the United States for less than 10 years. The relatively recent immigration experience of Chinese Americans makes the cultural context of caregiving particularly pertinent to this population.

Chinese American’s cultural belief of filial obligation, the sense of responsibility to respect and care for aging parents, is the most predominant cultural value relating to their caregiving experience. Chinese American families rely mostly on adult children and other family members as their primary source of support for aging adults. A systematic review of dementia caregiving of Chinese Americans reported that the sense of obligation not only motivates the caregiving behaviors of adult children in the first place, but also influences caregivers’ appraisal and coping. In some cases, this cultural value leads to a pervasive belief among Chinese Americans that it is unacceptable to say no to family caregiving responsibilities.

However, this traditional cultural norm is reshaped upon immigration and acculturation. Qualitative studies have revealed its evolving and fluid nature, documenting a continuum of traditional, modified (eg, paid care), to nontraditional caregiving behaviors (eg, placing parents in senior housing) among Chinese Americans. Whether and to what extent this cultural tradition affects caregiving experience of contemporary Chinese American immigrants has not been formally tested using large-scale quantitative data.

Filial Obligation and Caregiving Experience: Mixed Findings

There are mixed findings regarding how filial obligation, and similar concepts such as familism, affects caregiving outcomes. Several studies on caregiving burden reported that maintaining high levels of filial belief was associated with lower caregiving burdens in Chinese, Hispanic, Korean, and Arab caregivers. In contrast, research on white caregivers reported the opposite findings. Studies on Korean and Mexican Americans further indicated lack of associations between filial obligation and caregiving burden.

Mixed results were also reported regarding caregivers’ well-being in relation to their filial beliefs. While two studies found that sense of filial obligation was associated with better physical and mental health of Chinese Canadian caregivers, others reported that filial beliefs were associated with elevated levels of depression, anxiety, and emotional distress among a variety of populations, including Chinese, Hispanic, African American, and white caregivers. The positive influence of filial obligations on caregiving may occur via clearer expectation about the caregiving role and duty, greater psychological endurance, self-efficacy, positive coping and appraisal, and reduced negative effects of stressors. The mechanisms linking filial obligation and poorer caregiving outcomes include increased care involvement, avoidant coping, maladaptive thinking, beliefs of not meeting the needs of the parents, and difficulties in keeping traditional family practice in the host society. The inconsistent findings again indicate a need to further study the influence of filial obligation on immigrants’ caregiving experience.

Acculturation and Caregiving

Immigrants are a diverse population with a different degree of acculturation, which is a fluid process between culture of origin and culture in the host society. There is insufficient and equivocal knowledge regarding how acculturation shapes immigrants’ caregiving experience. Mixed results were reported that less acculturated caregivers had fewer depressive symptoms than more acculturated caregivers, or the opposite, or lack of association between acculturation and caregiving burden or depression.

One would also expect that acculturation further confounds the relationship between immigrants’ filial obligation and their caregiving experience. Less acculturated caregivers may be more “responsive” to the cultural tradition of parental care as they internalize this cultural norm to a greater extent and have fewer conflicting role demands and “acculturation gap” with care recipients. This speculation has not been formally tested, leaving a gap in the literature regarding sources of diverse caregiving experience among immigrant populations. It is important to distinguish objective burden (relating to care recipients’ symptoms or disrupted lives resulting from caregiving) from subjective burden (relating to emotional reaction to caregiving) in such investigations, as the cultural motives and normative expectations for caregiving tend to have a greater impact on subjective instead of objective caregiving burden.

Research Questions

While the majority of the studies on Chinese caregivers have used qualitative designs and were conducted mainly in China, this study used a large data set of Chinese immigrants in the United States to investigate: (1) whether sense of filial obligation is associated with caregiving burden; and (2) whether caregivers’ level of acculturation moderates the above associations?

METHODS

Sample

Data were derived from the PIETY study, which aims to understand the caregiving behaviors and well-being of
Chinese immigrants in Chicago. Relying on referrals from community agencies, 548 Chinese immigrants in the greater Chicago areas who were aged 21 years or older and who have a parent aged 60 years or older were recruited between 2012 and 2014. Face-to-face interviews were carried out in respondents’ homes, in the language preferred by the respondents. The working sample consists of 393 participants who self-reported as the primary caregiver of the father, the mother, or both parents in the family.

Measures
Filial obligation. The respondents reported how much they think children should provide six types of filial care to their aging parents: (1) respect, (2) care, (3) greeting, (4) bring pleasure, (5) obedience, and (6) financial support \(1 = \text{very little}, 2 = \text{rather little}, 3 = \text{average}, 4 = \text{rather a lot}, 5 = \text{very much}\). Sum scores were calculated, ranging from 6 to 30, with a higher score indicating a stronger sense of filial obligation \(\alpha = .85\).

Caregiving burden included five types measured by the Caregiver Burden Inventory: (1) time-dependent burden \(\text{ie, feelings of restriction on time}\), (2) developmental burden \(\text{ie, feelings of being “off-time” in development comparing to peers}\), (3) physical burden \(\text{ie, feelings of physical fatigue}\), (4) social burden \(\text{ie, feelings of role conflict}\), and (5) emotional burden \(\text{eg, negative feelings toward care receivers}\). All but the physical burden (four items) have five items, with all the items assessed on a Likert scale, ranging from 0 = never to 4 = always. Sum scores were created for each subscale \(\alpha \text{ ranged from } .78 \text{ to } .88\), with a higher score indicating greater burden.

Level of acculturation was measured by 12 questions about respondents’ language preference in different settings and ethnicity of individuals they interact with (ranging from \(1 = \text{only Chinese to } 5 = \text{only English/Americans}\)). The sum scores ranged from 12 to 60, with a higher score indicating a higher level of acculturation \(\alpha = .92\). Acculturation level was further recoded into three groups: low \(\text{ie, only spoke Chinese and had friends who were all Chinese, moderate (ie, spoke Chinese more than English and had mostly Chinese friends, and high level (spoke equally or more English than Chinese, and had equal or more American than Chinese friends). In this study, 69.72%, 21.88%, and 8.40% of the respondents were categorized as having high, moderate, and low level of acculturation, respectively. We further combined the last two groups given the small size of the last group.}

Control variables included age (in years), sex (women = 1), marital status \(\text{married} = 1\), education (in years), personal annual income (ranging from 1 = $0-$49999 to 10 = $45,000 or more), living arrangement \(1 = \text{living with parents}\), and number of siblings. Caregiving input was measured by weekly hours providing assistance with activities of daily living (ADLs) and instrumental ADLs (IADLs), and the length of time providing each type of care.

Data Analysis
We first present descriptive information of sample characteristics. To address the first research question, negative binomial regressions were carried out to test the associations between filial obligations and the five types of caregiving burden, controlling for the other covariates. To address the second research question, we created interaction terms between filial obligation and level of acculturation and added them into the regression models. We performed the analysis in three steps, with all the control variables (model 1), the two study variables (filial obligation, acculturation) (model 2), and interaction terms (model 3) entered sequentially.

RESULTS
Table 1 describes sample characteristics. The mean age of the participants was about 47 years. Over half of the participants were female, and nearly four-fifths were married. On average, participants had high school education and relatively low levels of acculturation \(\text{mean} = 21.6\) on a scale ranging from 12 to 53. Almost half of the participants lived with their parents, and the mean number of sibling was 2.35. Regarding caregiving input, 15.9% of the participants reported helping parents with ADLs for at least 1 or more hours per week, and 64.5% helped parents with IADLs. About 16% of the respondents provided care to their parents with ADLs for 1 or more years, and 64.1% of them provided care with IADLs for 1 or more years. Overall, the respondents had high levels of filial obligation \(\text{mean} = 26.23\) of a possible 30. They also reported relatively low levels of caregiving burden across all the domains.

Table 2 reports standardized beta coefficients of negative binomial regressions. The results showed that a greater sense of filial obligation was associated with significantly lower...
Table 2. Negative Binomial Regressions on Caregiving Burden of PIETY Primary Caregivers

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<tr>
<td>IADL caregiving hoursa</td>
<td>1-5</td>
<td>.83**</td>
<td>.89***</td>
<td>.89***</td>
<td>−.57</td>
</tr>
<tr>
<td></td>
<td>&gt;5</td>
<td>1.16***</td>
<td>1.23***</td>
<td>1.21***</td>
<td>−.40</td>
</tr>
<tr>
<td>ADL caregiving yearsb</td>
<td>≥1</td>
<td>−.01</td>
<td>.13</td>
<td>.07</td>
<td>−.63</td>
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<tr>
<td></td>
<td>&gt;5</td>
<td>.05</td>
<td>.01</td>
<td>.04</td>
<td>.78</td>
</tr>
<tr>
<td>IADL caregiving yearsb</td>
<td>1-5</td>
<td>.12</td>
<td>.05</td>
<td>.06</td>
<td>.74</td>
</tr>
<tr>
<td>Acculturation</td>
<td>.33**</td>
<td>.33**</td>
<td>.38</td>
<td>.40</td>
<td>.51*</td>
</tr>
<tr>
<td>Filial obligation</td>
<td>−.01</td>
<td>−.10*</td>
<td>−.15***</td>
<td>−.40***</td>
<td>−.18***</td>
</tr>
<tr>
<td>Filial obligation × acculturation</td>
<td>.06*</td>
<td>.18*</td>
<td>.11</td>
<td>.20*</td>
<td>.27**</td>
</tr>
</tbody>
</table>

Abbreviations: ADL = activity of daily living; IADL = instrumental ADL.

*aReference group was 0.

*bReference group was less than a year.

*P < .05, **P < .01, ***P < .001.
levels of developmental ($\beta = -0.15$), emotional ($\beta = -0.18$), social ($\beta = -0.20$), and physical ($\beta = -0.10$) burdens (model 2). Other variables that were associated with greater caregiving burdens included older age (time-dependent burden), higher education (all but time-dependent burden), fewer siblings (emotional burden), more hours helping with IADLs (time-dependent burden), and higher acculturation levels (time-dependent and emotional burden). Overall, the results were consistent across different models, indicating that the associations were robust regardless of control variables.

Results from the moderation effect models further showed that acculturation level moderated the associations between filial obligation and four types of caregiving burden (time dependent, developmental, physical, and social), but in different ways. As Figure 1 illustrates, for time-dependent and physical burdens that are mainly affected by caregiving involvement and physical demands of caregiving, a stronger filial obligation was associated with greater burden among caregivers with a high acculturation level, but less burdens among caregivers with low acculturation. In contrast, for developmental and social burdens that are mainly reflective of caregiver satisfaction, greater filial obligation was associated with a lower burden among both groups, and such associations were overall stronger among caregivers with a low acculturation level.

DISCUSSION

Using a large sample of Chinese immigrants in the United States, the present study examined whether Chinese caregivers’ sense of filial obligation is associated with their caregiving burdens and whether their acculturation level confounds such relationships. There are two key findings from this study. First, the results showed that Chinese caregivers with a greater sense of filial obligations had overall less caregiving burdens. Similar findings were reported in two quantitative studies on Chinese Canadian caregivers. For these caregivers who are confronted with different family norms, the sense of filial obligation may represent the ethnic identity and traditional values that many of them strive to maintain. Embracing or adhering to this traditional norm may provide these immigrants a clear expectation and sense of acceptance about their caregiving responsibilities. In contrast, Chinese caregivers with a lower level of filial obligation may have adopted American family norms of individualism and self-reliance to a greater extent and thus were likely “puzzled or...conflicted by both new and old filial practices” in their caregiving, possibly leading to greater caregiving burdens. In the study, time-dependent burden (ie, feelings of restriction on time) was not associated with filial obligation, likely due to the relatively low caregiving input of the respondents (Table 1).

The second finding of our study is that the acculturation level of the caregivers moderated the associations between filial obligation and their caregiving burden, which may in part explain the mixed findings on these associations.
reported in the prior research. We found that for developmental and social burdens that are reflective of caregivers’ subjective appraisal of caregiving experience and caregiving satisfaction, the potential benefit of filial obligation in reducing caregiving burden is stronger among individuals with a lower level of acculturation than those with a higher level of acculturation. The finding is consistent with those of previous research. We speculate that for caregivers with a lower level of acculturation, sense of filial obligation is internalized to a greater extent and as the things that they “ought to do,” thus, their caregiving experience is more “responsive” to this cultural tradition of parental care. The stronger identification they have with the traditional filial value, the greater self-affirmation or feeling of reward they may experience, whether perceived as praise or social recognition, consequently leading to elevated caregiving experience in the subjective domain. In contrast, immigrant caregivers with a high level of acculturation might be less “responsive” to such cultural expectation, reflected by the relatively flat line indicating the association between sense of filial obligation and subjective caregiving burden among this subgroup.

The moderating effect of acculturation functioned in a different way for time-dependent and physical burdens, which are more objective burdens closely related to caregiving involvement and physical demands of the caregiving. For more acculturated caregivers, a greater sense of filial obligation was actually associated with greater time-dependent and physical burdens, whereas filial obligation was associated with lower levels of these burdens among less acculturated caregivers. It is likely that more acculturated caregivers performed the task mainly out of necessity (eg, no one else was available) or social demand (to satisfy an external demand or social pressure), whereas less acculturated caregivers did so based on personal belief. In other words, there might be a sense of reluctance or lack of control among acculturated caregivers when they provided care. If that is the case, the stronger these individuals endorsed the filial obligation (ie, that they need to do), the more objective burden they may have that relates to physical health and time constraints. In contrast to highly acculturated caregivers, the potential benefit of having strong filial obligations in reducing subjective burden was much stronger for caregivers with a lower level of acculturation, again indicating that these caregivers endorse such filial obligations to a greater extent and may benefit more from fulfilling them.

Caregivers’ level of acculturation did not confound the relationship between filial obligation and emotional burden, which captured negative feelings toward care receivers. The finding may speak to the overall positive and cohesive inter-generational relations among Chinese immigrant families, regardless of the level of acculturation.

The findings need to be interpreted with cautions. Due to the limitation of secondary data analysis, current findings were contextualized in a caregiver group with minimum caregiver burden. Although the participants self-reported as primary caregivers, the overall caregiving input and burden were low, in particular for social and physical burden. It may be because the recruitment occurred in social service agencies instead of the common approach of purposive sampling of caregivers of dementia patients or patients with chronic conditions. As sense of filial obligation can be most challenged when caregiving situations are demanding and difficult, a greater variation in caregiving input and burden may better test the associations among filial obligation, acculturation, and caregiver experience. Second, the survey did not include care-recipient characteristics, such as functional ability and/or cognitive status. Instead, we used caregiving input as a proxy of care receivers’ functional health. Future studies should include direct measures of care-recipient characteristics to better assess their caregiving needs. Third, the secondary data analysis also limited our ability to assess the potential role of support from other family members that may explain the beneficial role of filial obligations on caregiver burden. Future research should include such measures to better understand the mechanism through which filial obligation protects immigrant caregivers’ well-being. Last but not least, the study was conducted in a metropolitan area with well-established Chinese communities. More studies are needed to understand caregiving experience of immigrants who live in smaller cities or rural areas with limited access to informal social networks.

Despite these limitations, this study is among the first to use a large quantitative data set and comprehensive measures of filial obligation and caregiving burden to study how a specific cultural norm, together with the acculturation process, shapes immigrants’ caregiving experience. The findings have important theoretical and practical insights for geriatricians, nurses, and other allied professionals. The findings revealed that filial obligation has a protective effect on the caregiving experience of Chinese family caregivers. Previous research also reported a weakening sense of filial obligation among immigrant families, and that many immigrant adult children reported difficulties in meeting filial expectations of their parents. Thus, community programs focusing on celebrating the cultural heritage of immigrants and promoting the sense of filial obligation toward parental care may help improve the well-being of Chinese immigrant caregivers. For Chinese immigrant caregivers, it is important to balance their perception of filial obligations and their available physical and psychological capacity for caregiving to reduce their caregiving burden. Thus, community programs focusing on celebrating the cultural heritage of immigrants and promoting the sense of filial obligation toward parental care may help improve the well-being of Chinese immigrant caregivers.

The results of this study show that for more acculturated caregivers, endorsing the traditional norm of parental care may have a negative effect on their objective burdens because of lower cultural justification for caregiving. Highly acculturated immigrant caregivers often struggle to find the best way to manage cultural expectations and new family norms in the host society. Intervention programs that help Chinese immigrant caregivers to find the most appropriate way to balance traditional and new social norms are important to provide successful care to aging Chinese immigrants. Ultimately, these programs will help to promote the well-being of both older adults and their adult children caregivers. Finally, for healthcare providers, it is important to understand the variance of acculturation levels among Chinese caregivers and its effect on caregiving burden. Consideration of acculturation factors of Chinese immigrant caregivers, including language usage, length of residence in
the United States, and ethnic communities where they are involved, would help better assess the impact of immigration on their caregiving behaviors and experience.

ACKNOWLEDGMENTS

Conflicts of Interest: The authors have no conflicts of interest to report.

Author Contributions: X. Dong had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: M. Guo, S. Kim. Acquisition of subjects and data analysis: X. Dong. Preparation of manuscript: All authors.

Sponsor’s Role: There was no sponsor for this study.

REFERENCES

Environmental Factors Associated with Chinese Older Immigrants’ Social Engagement

Daniel W.L. Lai, PhD,* Jia Li, PhD,* Vincent W.P. Lee, PhD,* and XinQi Dong, MD, MPH†

BACKGROUND/OBJECTIVES: Prior research has shown that social engagement is beneficial to older adults’ health and well-being. This study examined the association between environmental factors and social engagement of older Chinese immigrants in the United States.

SAMPLE: A cross-sectional data set of Chinese immigrants in the greater Chicago, IL, area (Population Study of Chinese Elderly; n = 3159), was used in this study.

DESIGN: Multiple regression models were used to test the associations between older adults’ engagement in cognitive and social activities and environmental factors, including financial difficulties, social support, neighborhood cohesion, neighborhood disorder, and sense of community.

MEASUREMENT: Eight questions measuring participants’ engagement in cognitive and social activities, a single-item question measuring financial difficulties, a 12-item social support measurement, an eight-item neighborhood cohesion measurement, and a six-item neighborhood disorder and sense of community scale.

RESULTS: Having fewer financial difficulties and a cohesive neighborhood is related to a higher level of engagement in both cognitive and social activities. More social support from family and friends and a sense of community are associated with higher levels of social activities engagement, but not cognitive activity engagement. Neighborhood cohesion has a stronger association with social engagement than other environmental factors and most individual-level factors. Surprisingly, neighborhood disorder is positively related to social activity engagement, which needs further examination. The associations between environmental factors and social engagement showed no significant difference between healthy and unhealthy older adults.

CONCLUSION: This study highlights the need for policies and programs to promote an active lifestyle among older immigrants by creating facilitative social and physical environments. J Am Geriatr Soc 67:S571–S576, 2019.

Key words: active aging; neighborhood cohesion; older Chinese immigrants; social engagement

Active aging is a critical component in the successful aging paradigm. Substantial research evidence demonstrates the benefits of social engagement, such as preventing disability and depression and maintaining cognitive function and subjective well-being. Similar findings have also been reported among older immigrants.

However, on moving to a new country, older immigrants face a variety of barriers that may hinder their social engagement, such as economic exclusion, language barriers, and other risk factors. According to environmental gerontology, the environment can influence older adults’ well-being by maintaining the continuity of later life, providing new opportunities and compensating losses in physical, mental, and social resources. Building an age-friendly environment and promoting person-environment fit are essential to “aging in place” and active aging of older immigrants. The objectives of the present study are (1) to examine the associations between environmental factors and social engagement among older Chinese immigrants in the United States and (2) to examine whether their health conditions will be a moderator of the associations.

Empirical studies have shown the influence of environmental factors on social engagement of older adults. However, limited studies specifically examined the group of older Chinese immigrants. Among all the environmental factors, economic exclusion, reduced social support, and neighborhood contexts are considered to play particularly critical roles in influencing older Chinese immigrants’ social engagement. First, older Asian immigrants in the United States face a higher risk of living in poverty than the general older population. A qualitative study among 24 older Chinese immigrants in Los Angeles, CA, found...
financial difficulties undermine their ability to participate in social leisure activities and develop social connections and can lead to social disengagement. Second, relating to the stigma of being alone, fear of rejection, and fear of losing preferred identities, people with little social support may be more passive in social engagement and wait for others to initiate social encounters. Older Chinese immigrants experience reduced social support due to immigration to a new country and evolving filial piety norms among adult children. Some older Asian immigrants may not utilize community centers due to the fear of being rejected. Third, neighborhood disorder, such as poorly designed infrastructure and crime, presents barriers to older adults’ participation in social or physical activities. Moreover, neighborhood cohesion and sense of community can facilitate older adults’ community and social participation. Neighborhood contexts play an important role in influencing older Chinese immigrants, as they tend to live in ethnic enclaves; and community centers are a critical space for them to attend physical and leisure activities and make friends. Based on this evidence, we hypothesized that, free of financial difficulties, a higher level of social support, neighborhood cohesion, a sense of community, and a lower level of neighborhood disorder are associated with a higher level of social engagement among Chinese older immigrants (Hypothesis 1).

While the importance of environmental factors on social engagement is recognized, the environmental gerontology also emphasizes interaction between older adults’ individual competence and environmental constraints. Health is a fundamental individual condition for social engagement. As noted by Lawton and Nahemow (1973), when people’s competence, such as “health, intelligence, ego strength, social role performance, or cultural evolution” reduces, they will become more dependent on external conditions and less competent to overcome environmental barriers. Previous empirical studies have shown the moderating role of health in the relationship between environmental factors and social engagement. A study reported that the association between perceived neighborhood problems and decrease in the quality of life is stronger among older adults with osteoarthritis than those without it. Therefore, we hypothesized that financial difficulties, social support, neighborhood cohesion, neighborhood disorder, and sense of community will be more strongly associated with social engagement among unhealthy Chinese older immigrants than their healthy counterparts (Hypothesis 2).

Older Chinese immigrants are one of the largest group of the aging population in the United States. Often stereotyped as well off and being looked after by family members, they have received insufficient attention from both academia and policy makers. The study is relevant to health and immigration policy regarding creating friendly environments to promote social engagement of aging immigrants. The conceptualization discussed above is illustrated in Figure 1.

METHODS

Study Population

The current study is based on secondary analysis of data from the Population Study of Chinese Elderly (PINE), a population-based study conducted between 2011 and 2013 in the greater Chicago, IL, area. A total of 3159 participants, aged 60 years or older and who self-identified as Chinese, participated in the study. Removing observations with missing values for each regression model, the sample size used in the regression analysis ranged from 3008 to 3092.

Measurements

Social Engagement

Social engagement was measured by the overall frequency of participation in cognitive activities and social activities. Cognitive activities include eight types of activities, such as watching TV, reading, listening to the radio, and playing Mahjong, that require more mental exercises; social activities include eight types of activities, such as going to the cinema, having dinner with friends, and going on a trip, that require more social interaction and physical strengths. The details of what specific activities were included have been reported in previous studies. The total score for social activity engagement ranged from 0 to 32, and the total score for cognitive activity engagement ranged from 0 to 33. The standardized Cronbach’s α ranged from .6 to .75.

Environmental Factors

Neighborhood disorder and cohesion was measured by a list of questions used in previous research. Each neighborhood disorder question was measured on a 4-point scale (from 0 [never] to 3 [often]) regarding the frequency of observed presence of neighborhood disorganization, such as trash, strangers, or unsafety of walking around. A higher score indicates greater neighborhood disorder. The Cronbach’s α was .80. The first three neighborhood cohesion questions (eg, “do you see neighbors and friends talking outside in the yard or in the street?”) were measured on a 4-point scale (from 0 [never] to 3 [often]), and the last three questions (eg, “how many neighbors do you know by name?”) were measured by a number indicated by the participant. The overall scores for neighborhood cohesion range from −1.08 to 2.84. The Cronbach’s α was .86. Sense of community was measured by the commonly used and validated Sense of Community Index, which has been used in previous research. The total score for this scale ranged from 12 to 60, with higher scores indicating a stronger sense of community. The Cronbach’s α for this study was .67. Social support was measured by a 12-item social support measurement that addressed participants’ perceptions of support provided by their spouse, family members, and friends. Items included negative support (being demanded and criticized) and positive support (being able to open up to talk about their worries and rely on support systems to help). Each item was rated on a 3-point scale (from 1 [hardly ever] to 3 [often]), and the negative support questions were reverse coded. A higher overall score indicated greater social support. The Cronbach’s α ranged from .64 to .72. Financial difficulties were measured by a single question, assessing participants’ difficulty in paying for food, housing, medical care, and heating. Answers ranged from 1 (very hard) to 3 (not very hard at all).

Health Condition

Self-rated overall health status was originally measured by a single-item question, with answers including 1 = very good, 2 = good, 3 = fair, and 4 = poor. The answers were further recoded to a dummy variable consisting of “good or very good” and “fair and poor.”
Sociodemographic Characteristics

Sociodemographic information in this study included age (in years), sex (female = 0), education (in years of schooling), marital status (currently married = 1), income (10 categories ranging from 1-10; the higher the score, the higher the income), length of residence in the United States (in years), length of residence in one’s current neighborhood (in years), language preferences (Cantonese and Toisanese = 1), and living arrangement (in number of cohabitants).

Data Analysis

Descriptive univariate statistics were conducted, and Spearman’s correlation was used to examine the correlation between variables. Multiple linear regression analyses were conducted while controlling for the covariates to examine the relationship between environmental factors and social engagement. Moreover, an interaction term of each factor and health condition was further added into these regression models to test the moderating effect of health condition. Unstandardized coefficient (B), standardized coefficient (β), standardized error, significance levels, and adjusted $R^2$ were reported for linear regressions. Statistical analyses were conducted using SAS, Version 9.2.

RESULTS

Sample Characteristics

General sociodemographic characteristics for PINE samples, including age, sex, education, and income, have been reported in previous studies. Table 1 shows the characteristics of the current study sample with respect to social engagement and environmental factors based on overall health status (poor/fair vs good/very good). Participants with poor/fair overall health participated in cognitive and social activities less frequently than those with good/very good self-rated overall health. They tended to have more financial difficulties, less social support, and a lower sense of community. There were no significant differences between the two groups with respect to reported neighborhood disorder and cohesion.

The details of the frequency of engagement in each type of activity of the sample have been reported in previous studies. Specifically, the most common cognitive activity that older Chinese immigrants participated in was watching TV; among social activities, 34.2% of them reported they visited the community center every day or almost every day.

The results of the Spearman’s correlation show that environmental factors, including financial difficulties, social support, sense of community, neighborhood disorder, and neighborhood cohesion, were all significantly associated with cognitive and

Table 1. Descriptive statistics of the sample

<table>
<thead>
<tr>
<th>Variables</th>
<th>Overall sample</th>
<th>Poor health</th>
<th>Good health</th>
<th>$t/\chi^2$</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M/n SD/%</td>
<td>M/n SD/%</td>
<td>M/n SD/%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social engagement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive activity</td>
<td>11.87 5.89</td>
<td>11.60 5.97</td>
<td>12.42 5.75</td>
<td>3.78</td>
<td>&lt;.0002</td>
</tr>
<tr>
<td>Financial difficulties</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very hard</td>
<td>253 8.15</td>
<td>186 5.95</td>
<td>67 2.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat hard</td>
<td>805 26.13</td>
<td>543 17.36</td>
<td>262 8.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not hard at all</td>
<td>2070 65.72</td>
<td>1175 37.56</td>
<td>895 28.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social support</td>
<td>30.17 3.131</td>
<td>29.63 3.06</td>
<td>30.75 3.33</td>
<td>9.73</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Sense of community</td>
<td>40.80 5.321</td>
<td>40.04 5.26</td>
<td>41.62 5.48</td>
<td>8.05</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Neighborhood cohesion</td>
<td>0.015 0.775</td>
<td>−0.01 0.77</td>
<td>0.02 0.78</td>
<td>1.20</td>
<td>0.23</td>
</tr>
<tr>
<td>Neighborhood disorder</td>
<td>4.00 4.028</td>
<td>4.15 4.21</td>
<td>3.87 3.92</td>
<td>1.612</td>
<td>0.204</td>
</tr>
</tbody>
</table>

Abbreviation: M/n, mean/number.
social activity engagement. The correlation between cognitive and social activities was 0.463. Having good/very good health was related to higher levels of participation in both cognitive and social activities. The full results of the Spearman’s correlation were shown in Supplementary Table S1.

Association Between Environmental Factors and Social Engagement

Table 2 presents the results of the multiple regression models. Having fewer financial difficulties and perceiving greater neighborhood cohesion were positively related to more engagement in cognitive activities. Fewer financial difficulties, neighborhood cohesion, social support, and sense of community were positively related to more engagement in social activities. Surprisingly, neighborhood disorder was positively related to social activity engagement. The correlation between cognitive and social activities was 0.463. Having good/very good health was related to higher levels of participation in both cognitive and social activities. The full results of the Spearman’s correlation were shown in Supplementary Table S1.

Interaction Between Health Status and Environmental Factors

Interactive terms between each environmental factor and health were entered into the regression models. However, none of the interactive terms have a significant association with cognitive and social activity engagement (Supplementary Table S2). In other words, the association between environmental factors and social activity engagement is not significantly different between healthy and unhealthy older adults.

DISCUSSION

Guided by the lens of environmental gerontology, this article examined the association between environmental factors and older Chinese immigrants’ social engagement, and whether the association varies by older adults’ health status. It is one of the first studies examining the environmental factors influencing social engagement of older Chinese immigrants as a specific and vulnerable aging group. The first research hypothesis was partly confirmed, but the second was not confirmed.

Financial difficulties are significantly associated with social engagement, supporting the increasing discussion about poverty as an important aspect of external environment in relation to social isolation. Research in the United States has reported that older immigrants, including Chinese, have a lower rate of participation in social security systems and retirement programs. Financial constraints may force older adults to pick up a part-time job and, therefore, reduce their time of participating in cognitive activities that mostly occur at home. Some social activities may require extra expenses, which limited the capability of the poor to engage in them.

Consistent with previous studies, neighborhood cohesion has a significant relationship with social engagement among older Chinese immigrants. Neighborhood cohesion can benefit people’s health behaviors, above and beyond the effects of individual characteristics, via the rapid dissemination of health-related information, the building of community norms for a healthy lifestyle, the collective advocacy for building a health-promoting community, and the positive psychosocial mediators, such as perceived social support, brought from close interpersonal relationships.

Importantly, the association between neighborhood cohesion and social engagement was stronger than most of older adults’ individual factors included in the study, except

Table 2. Environmental factors associating with cognitive and social activity engagement

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cognitive activity</th>
<th>Social activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Intercept</td>
<td>12.070</td>
<td>0.407</td>
</tr>
<tr>
<td>Age</td>
<td>-0.035</td>
<td>0.013</td>
</tr>
<tr>
<td>Sex (1 = female)</td>
<td>-1.561</td>
<td>0.198</td>
</tr>
<tr>
<td>Education (years)</td>
<td>0.519</td>
<td>0.023</td>
</tr>
<tr>
<td>Income</td>
<td>-0.076</td>
<td>0.086</td>
</tr>
<tr>
<td>Marital status (1 = currently married)</td>
<td>-0.417</td>
<td>0.239</td>
</tr>
<tr>
<td>Living arrangement</td>
<td>-0.124</td>
<td>0.052</td>
</tr>
<tr>
<td>Language preference (0 = Cantonese or Toisanese)</td>
<td>0.635</td>
<td>0.276</td>
</tr>
<tr>
<td>Time in the United States (years)</td>
<td>0.041</td>
<td>0.010</td>
</tr>
<tr>
<td>Time in the neighborhood (years)</td>
<td>-0.019</td>
<td>0.011</td>
</tr>
<tr>
<td>Overall health (1 = good)</td>
<td>0.325</td>
<td>0.188</td>
</tr>
<tr>
<td>Financial difficulties</td>
<td>0.503</td>
<td>0.155</td>
</tr>
<tr>
<td>Social support</td>
<td>0.039</td>
<td>0.032</td>
</tr>
<tr>
<td>Neighborhood disorder</td>
<td>0.004</td>
<td>0.023</td>
</tr>
<tr>
<td>Sense of community</td>
<td>0.024</td>
<td>0.020</td>
</tr>
<tr>
<td>Neighborhood cohesion</td>
<td>1.137</td>
<td>0.138</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.321</td>
<td></td>
</tr>
<tr>
<td>Sample size</td>
<td>2988</td>
<td></td>
</tr>
</tbody>
</table>
for education and other environmental factors, manifesting the salience of neighborhood in older Chinese immigrants’ postimmigration life. On one hand, traditional Chinese familial norms and obligations have been challenged in the US society; on the other hand, older Chinese immigrants have more challenges in acculturating into the western society. While Chinese immigrants tend to live together with other Chinese peers, the coethnic neighborhood takes a particularly important and protective role in their daily social lives.\(^5\)

The findings of this study are consistent with previous research indicating that social support from family and friends is positively related to older adults’ participation in physical exercise.\(^2\) Access to social support can lead to an increase in self-efficacy, empowerment, self-management skills, and positive emotions, which can, in turn, motivate older adults to engage in health-promoting behaviors.\(^2\) Sense of community is also positively related to more engagement in social activities, which is consistent with previous studies.\(^3\) Tang and associates used the same data set as this study and found that sense of community is related to a lower likelihood of reporting depressive symptoms.\(^2\) The present study has probably illustrated the potential mechanism for this association because social activities are evidently effective in reducing depression.

However, contrary to previous studies,\(^3\) this study’s findings indicate that neighborhood disorder is positively related to higher levels of social activity. A possibility is that most Chinese older adults live in Chinatown or other ethnic enclaves in which other Chinese people reside. This type of coethnic residence pattern, in which residents are of the same ethnic background, usually exists in working-class neighborhoods that are not well maintained.\(^3\) On the other hand, the high coethnic density could also promote a higher level of social engagement. Therefore, a coethnic residential pattern is a potential exogenous variable that influences neighborhood disorder and social engagement at the same time. Another possible explanation is that people participating in more social activities are more likely to observe or notice neighborhood disorder, compared to those spending more time in the home.

The association between environmental factors and social engagement did not vary significantly across healthy and unhealthy older adults. This is inconsistent with the notion of environmental gerontology that older adults with lower internal competence are more dependent on external environments. However, some previous studies drew a similar conclusion as ours. For instance, a study using a nationally representative sample of 6383 older adults in the United States found that neighborhood cohesion and disorder have broad impact across older adults at all levels of functional capacity.\(^8\) Tentative explanations for this study include that the activities measured in this study are not physically intense, and, therefore, those reporting fair or poor health may not need extra empowerment from the environment. In addition, the self-reported measure of health may not be as sensitive as performance-based objective measures in capturing the health problems preventing older adults’ social engagement.

The findings from this study offer some policy and practice implications. First, care policy for older people should explicitly address the affordability of social, health, and financial services to respond to the unmet needs of economically disadvantaged older adults. There is a widening gap among older populations in access to different financial resources.\(^9\) Social security, Medicare, and Medicaid policies should be improved to ensure financial security for older immigrants.\(^3\) Second, as older adults often lose family members and friends in later life, it is of particular importance to build a cohesive neighborhood environment and strengthen older immigrants’ sense of belonging to the coethnic contexts. It can facilitate naturally occurring social relations that may represent a successful approach to enhance well-being.

The study also carries clinical implications for active aging promotion. When designing programs to facilitate uptake of active lifestyle among older adults, healthcare professionals should focus beyond older adults’ individual characteristics. Professionals in health promotion settings should identify intervention points in social and community environments for the purpose of promoting social engagement. Due to the significant influence of neighborhood contexts in shaping older immigrants’ health behaviors, healthcare professionals should adopt a holistic approach in working with local communities and neighborhood stakeholders to build a cohesive healthy community atmosphere, which is a significant correlate of social engagement.

Some limitations of this study must be acknowledged. First, due to the cross-sectional nature of the data set, we cannot conclude a causal relationship. There is also a risk of reverse causality that more engagement in social activities may increase the perceived neighborhood cohesion and more observations of neighborhood disorder. Longitudinal studies should be conducted in the future to examine whether an increase or a decrease in environmental capabilities can facilitate or hinder older adults’ social engagement. Second, the findings from this study may not be generalizable to Chinese populations in other locations. Moreover, due to the nature of the secondary data set, not all dimensions of environmental factors, such as stigma and ageist attitudes, are included in this analysis.\(^8\) Further studies could include more environmental factors, as well as a closer examination on the intersection between multiple individual and environmental-level factors.

CONCLUSION

Beyond individual factors, environmental factors, especially financial difficulties and neighborhood cohesion, are associated with older Chinese immigrants’ social engagement. Health promotion should not only promote an active late-life lifestyle but also work to remove barriers to older adults’ participation in social activities. Building a cohesive community and enriching financial capacity to facilitate active aging are directions for facilitating “aging in place” while preventing the further exacerbation of social isolation and vulnerability.\(^8\)

ACKNOWLEDGMENTS

Conflict of Interest: The authors have no conflicts of interest to report.

Author Contributions: Lai contributed to the major conception and design of research ideas, directed the literature review and data analysis, and contributed to the drafting, writing, and revision of the manuscript.

Li contributed to the organization of the literature review, the conception of research ideas, data analysis, and drafting and writing of the manuscript.
Lee contributed to the concept of research ideas. Dong contributed to the interpretation of research findings and suggestions for improvements to the manuscript.

Sponsor’s Role: Not applicable.

REFERENCES


SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article.

Supplementary Table S1. Spearman’s Correlation Results
Supplementary Table S2. Linear Regressions With the Interactive Terms of Environmental Factors and Health
The Influence of Smoking Status on the Health Profiles of Older Chinese American Men

Chien-Ching Li, PhD,* Alicia K. Matthews, PhD,† XinQi Dong, MD, MPH,‡ and Melissa Simon, MD, MPH§

OBJECTIVE: To examine the influence of smoking status on the health profiles of community-dwelling older Chinese American men in the greater Chicago, IL, area.

DESIGN: This study utilized a cross-sectional study design to analyze data obtained from the larger Population Study of Chinese Elderly in Chicago (PINE).

SETTING: A population-based study conducted in Chicago.

PARTICIPANTS: Baseline data from Chinese American men who participated in PINE (N = 1492).

MEASURES: Demographic characteristics measured included age, education years, marital status, income, health insurance coverage, and smoking pack-years. Self-reported smoking status included never smoker, current smoker, and former smoker. Health profile indicators included perceived health status, past 12-month changes in health, chronic medical conditions (heart diseases, stroke, cancer, diabetes, hypertension, high cholesterol, thyroid disease, and osteoarthritis), quality of life, and depression and anxiety.

RESULTS: The mean age of the study sample was 72.5 years. Of the sample, 65% reported a smoking history, with 25.1% current smokers and 40.1% former smokers. Current smokers were younger, less educated, and uninsured. Former smokers had the poorest overall health profiles. Compared to former smokers, current smokers were less likely to have heart disease (odds ratio [OR] = 0.59; 95% confidence interval [CI] = 0.39-0.90), hypertension (OR = 0.54; 95% CI = 0.41-0.72), high cholesterol (OR = 0.74; 95% CI = 0.56-0.99), thyroid disease (OR = 0.44; 95% CI = 0.21-0.90), depression (rate ratio [RR] = 0.76; 95% CI = 0.58-0.99), and anxiety (RR = 0.72; 95% CI = 0.59-0.89), and they had fewer overall chronic medical conditions (RR = 0.79; 95% CI = 0.70-0.88) after controlling for demographic factors and smoking pack-year history. Compared to never smokers, former and current smokers reported poorer self-rated health (OR = 1.58; 95% CI = 1.11-2.26) and lower perceived quality of life (OR = 2.11; 95% CI = 1.04-4.29).

CONCLUSIONS: Consistent with prior research, smoking rates were elevated among this sample of older Chinese men. Contrary to study hypotheses, former smokers had worse overall health. Study findings suggest the need for health promotion interventions for both current and former smokers. J Am Geriatr Soc 67:S577–S583, 2019.

Key words: Chinese American; health profile; older adults; PINE; smoking

Cigarette smoking contributes to a range of chronic and debilitating illnesses, such as heart disease, stroke, cancer, and respiratory conditions, and is the most common preventable cause of death in the United States. In 2016, 15.5% of all adults in the United States were current smokers. Although smoking rates have declined significantly over the past three decades, disparities in smoking rates exist. For example, smoking rates are higher among immigrant populations whose home country has significantly higher smoking rates than the United States. Nationwide, immigrants from China constitute the second largest foreign-born group and the largest Asian group in the United States. Smoking prevalence rates among foreign-born Chinese Americans are higher compared to US-born Chinese Americans and other Asian subgroups. Among Chinese Americans, disparities in smoking prevalence rates are primarily driven by the significantly higher rates of smoking among Chinese American men compared to women (75% vs 3.2%, respectively). In addition, Chinese American populations have experienced health disparities, such as chronic diseases, cancer, and psychological distress, compared with white Americans.
previous study further showed that approximately 67% of older Chinese American men had a smoking story. Given these observed disparities, additional research is warranted on the causes and consequences of smoking in this subgroup of men. This information has important implications for developing targeted intervention efforts to reduce the negative consequences of smoking among Chinese American men and to reduce the risk of secondhand exposure among friends and family members.

Prior research has identified several risk factors associated with elevated smoking rates among Chinese American men, including level of acculturation, symptoms of anxiety and depression, low perceived risk associated with smoking, and social environmental influences, such as peer smoking and smoking norms. Although the negative consequences of smoking on health outcomes have been well documented and social environmental influences, such as peer smoking and smoking norms. Although the negative consequences of smoking on health outcomes have been well documented, there is a paucity of information on a comprehensive examination of the relationship between cigarette smoking and health conditions among older Chinese Americans. Prior research by our team has documented a relationship between cigarette smoking and lung cancer among Chinese American men due to chronic smoking, and at least one other study has documented actual higher lung cancer incidence rates in this population. However, less is known about the prevalence of smoking-related chronic health conditions beyond lung cancer among Chinese American men and how rates of these health conditions may vary based on smoking status. As such, the purposes of this study were to examine current smoking behavior among a population-based sample of older Chinese American men living in the greater Chicago, IL, area and to assess the associations between smoking status (never, former, or current) and health profiles. We hypothesized that individuals with a history of smoking (current or former) would report worse health profiles than never smokers and that this relationship would result from the worse health status of current smokers.

METHODS

Study Population and Data Sources

Data for this study were obtained from the Population Study of Chinese Elderly in Chicago (PINE). In this secondary data analysis study of participant baseline data, only males were included in the analytic sample. Female participants were excluded from this study due to low smoking prevalence rates in our sample (less than 1%), which is consistent with the extant epidemiological data on smoking prevalence rates. PINE is a community-engaged, population-based, epidemiological study of 3157 community-dwelling Chinese older adults, aged 60 years and older, living in the greater Chicago area. (For a full description of study design and implementation, see the study by Dong et al [2014]). The purpose of PINE was to collect community-level data on older Chinese adults to examine cultural determinants of health and well-being. The community-based participatory research approach was used to guide community recruitment through the collaboration between academic institutions and community-based social services agencies. Potentially eligible participants were approached through routine social services and outreach efforts serving Chinese American families. Based on available data drawn from the 2010 US Census and a random block census study conducted in Chicago’s Chinese community, PINE is representative of the aging Chinese population in the greater Chicago area with respect to key demographic attributes, including age, sex, income, education, number of children, and country of origin. The study was approved by the Institutional Review Board of Rush University Medical Center (Chicago, IL).

Measurements

Independent Variable

Smoking status (never smoker, former smoker, or current smoker) was the independent variable of the study, which was measured by two survey items: (1) “Have you ever smoked cigarettes?” and (2) “Do you currently smoke cigarettes?” We also calculated the smoking pack-years, a measure of smoking frequency and chronicity, among individuals with a smoking history. Smoking pack-years were calculated using the following equation: “pack of cigarettes smoked a day on average (1 pack = 20 cigarettes)” multiplied by “years of smoking this much.” For example, 30 pack-years = smoking 2 packs per day for 15 years.

Dependent Variables

The health profile of study participants was measured by the following: (1) self-reported health status (very good/good, fair, or poor) was measured by the question “In general, how would you rate your health?”, (2) health changes over the past year (better, same, or worse) were measured by the question “Compared to 1 year ago, how would you rate your health now?”, (3) quality of life (very good/good, fair, or poor) was measured by the question “The quality of my life is?”, (4) medical conditions: eight conditions were measured by asking participants whether they had ever been told by a physician, nurse, or therapist that they had a diagnosis of heart diseases, stroke, cancer, diabetes, hypertension, high cholesterol, thyroid disease, or osteoarthritis. Further, a composite score (range = 0-8) was created to measure a total number of medical conditions and (5) measures of depression and anxiety. Depression was measured by the Patient Health Questionnaire (PHQ-9) scale instrument. The PHQ-9 has nine questions to assess how often the participant has been bothered by depressive symptoms during the past 2 weeks (0 = not at all, 1 = several days, 2 = a week or more, and 3 = nearly every day). The total score ranges from 0 to 27, with higher scores indicating higher severity of depressive symptoms (Cronbach’s α = 0.82). The Hospital Anxiety and Depression Scale-Anxiety was used to assess anxiety. Participants were asked if they currently experienced seven symptoms (each item ranges from 0 [not at all] to 3 [most of the time]). The total score ranges from 0 to 21, with higher scores indicating a higher anxiety level (Cronbach’s α = 0.80).

Covariates

Covariates included basic demographic factors known to influence health status, including age, education years, marital status (married or not married), income (1 = US$0-US $4999; 2 = US$5000-US$9999; 3 = US$10 000-US$14 999;
Statistical Analyses

The analytic sample included 1492 older Chinese American men. Descriptive statistics (mean, SD, frequency, and percentage) were used to describe the characteristics of study participants. Bivariate analyses ($\chi^2$, one-way analysis of variance, and Kruskal-Wallis tests) were conducted to examine the association between smoking status, health profile indicators, and demographic covariates. Finally, multivariate regression (ie, negative binomial regression, binary logistic regression, and ordered logit regression) analyses were performed to examine the relationship of smoking status and health status after controlling for covariates. In model 1, demographic variables (including age, education, income, marital status, and health insurance coverage) were adjusted among older Chinese Americans. In model 2, in addition to demographics, smoking pack-year was adjusted to examine the difference in health profiles between current and former smokers. All analyses were performed using SAS, version 9.4 (SAS Institute, Inc, Cary, NC).

RESULTS

Sample Characteristics

Table 1 displays the demographic characteristics of the study sample (N = 1492). The mean age of the study sample was 72.5 years (SD = 7.94 years). Of the sample, 65% had a smoking history, including 375 current smokers (25.1%) and 599 former smokers (40.1%). Compared to never and former smokers, current smokers were younger (age = 69.9 ± 7.4 years), less educated (8.2 ± 4.4 years), and less likely to be insured (62.3%). Although younger, current smokers had a longer smoking pack-year history (29.2 ± 20.8 pack-years) compared to former smokers (26.3 ± 24.9 pack-years). The majority of all participants...
reported their current health and quality of life to be good or very good (42.0% and 47.7%, respectively). In bivari-
ate analyses, differences were observed in the health status and profiles of study participants based on smoking status. A higher percentage of former smokers rated their current health status as poor (20.3%; $P = .009$) and reported a history of heart disease (19.0%; $P < .001$), stroke (8.0%; $P = .028$), hypertension (56.9%; $P < .001$), and high cholesterol (46.5%; $P = .002$) compared to current smokers. Further, former smokers had a higher level of anxiety (mean ± SD = 2.1 ± 2.9) and depression (mean ± SD = 2.0 ± 3.5) and a higher mean number of medical conditions compared to current smokers ($P < .001$). A higher percentage of current smokers reported their quality of life to be poor (6.4%; $P = .009$) (Table 1).

Multivariate Outcomes

Next, we tested multivariate models to examine the influence of smoking status on health profiles, controlling for demo-
graphic factors and smoking pack-year history. Tables 2 and 3 display model results. Compared to former smokers (model 2), current smokers were less likely to have heart disease (odds ratio [OR] = 0.59; 95% confidence interval [CI] = 0.39-0.90), hypertension (OR = 0.54; 95% CI = 0.41-0.72), high cholesterol (OR = 0.74; 95% CI = 0.56-0.99), thyroid disease (OR = 0.44; 95% CI = 0.21-0.90), depression (rate ratio [RR] = 0.76; 95% CI = 0.58-0.99), and anxiety (RR = 0.72; 95% CI = 0.59-0.89), and they had fewer overall chronic medical conditions (RR = 0.79; 95% CI = 0.70-0.88) after adjusting for smoking pack-year history and demographics. However, compared to never smokers (model 1), current smokers were less likely to have hypertension (OR = 0.60; 95% CI = 0.44-0.81), depression (RR = 0.71; 95% CI = 0.54-0.94), and anxiety (RR = 0.79; 95% CI = 0.64-0.97), and they had fewer overall chronic medical conditions (RR = 0.86; 95% CI = 0.76-0.96) and lower perceived quality of life (OR = 2.11; 95% CI = 1.04-4.29). Former smokers reported poorer self-rated health (OR = 1.58; 95% CI = 1.11-2.26) and were more likely to have high cholesterol (OR = 1.36; 95% CI = 1.06-1.75) compared to never smokers.

DISCUSSION

This study represents one of the first attempts to evaluate differences in the health profiles of older Chinese American men based on smoking status. Consistent with the extant literature,1,22 smoking rates in this sample were elevated. Of the sample, 25% reported being a current smoker, with another 40% reporting former smoking. Observed smoking prevalence rates are consistent with those obtained in prior studies of Chinese American men (range = 14%-34%).23,24 However, in the general US population, the current smoking rate for adults aged 65 years and older is 8.8%.25 Risk factors for continued smoking were consistent with available epidemiological data, with current smokers in our sample more likely to be younger, less educated, and uninsured.23,26 These findings underscore the importance of ensuring that proven strategies to prevent and reduce tobacco use reach the entire population, particularly vulnerable groups.

On average, participants in this sample reported at least one chronic illness, with the most prevalent being hypertension, high cholesterol, and diabetes. Consistent with prior research,27,28 current smokers and former smokers were more likely to report poor self-rated health and lower quality of life than never smokers. However, unlike the majority of prior research findings on the negative health effects of smoking,14 current smokers in this study were less likely to report a chronic condition compared to former or never smokers. Indeed, with few exceptions, former smokers reported the poorest overall health status. One possible explanation of these observations is the selection-bias or healthy smoker effect.29 The healthy smoker effect may bias the association between current smoking status and health conditions by suggesting a protective effect of smoking on health. For example, as individuals who smoke begin to experience chronic and other life-threatening illnesses, smoking rates have been shown to decline.30 As such, among samples of older adults, individuals who have continued to smoke may be those persons who have experienced fewer major health conditions or diseases related to smoking earlier in life. Although multivariate models controlled for both age and insurance status, in examining the relationships between smoking status and health, current smokers were younger and may not have yet developed a chronic illness. In addition, current smokers were more likely to be uninsured, which may have impacted the identification of existing but undiagnosed disorders. Furthermore, differential misclassification31 can be another potential explanation. In this study, current smokers may be more reluctant to visit physicians than former or never smokers. As a result, current smokers may be less aware of the presence of chronic conditions. Further research is needed to confirm the healthy smoker effect or differential misclassification as a driver of study findings.

Study findings also have implications for tobacco preven-
tion and control research and clinical practice in underserved populations. A quarter of the sample were current smokers. From a public health standpoint, it is imperative for smokers to quit smoking to prevent the onset of smoking-related ill-
nesses. Furthermore, cessation among smokers with chronic
diseases can reduce hospitalizations, disease-related complica-
tions, and the mortality associated with chronic conditions.32 Prior studies had identified several risk factors for continued smoking among Chinese American men, including immigrant status, lower levels of English proficiency, education level, and acculturation. In addition, smoking behavior is an acceptable
culture norm among Chinese individuals.23,33-35 In PINE,
over 40% of older Chinese Americans were identified as hav-
ing low levels of acculturation to US society and a low level of health literacy.36 These factors can also increase barriers to participation in smoking cessation interventions or programs in this population.

A further barrier to reducing smoking among Chinese American men is the lack of tobacco prevention and control initiatives addressing the needs of this high-risk population. To date, smoking cessation interventions specifically targeting older adult smokers are limited; and while some researchers have focused on smoking cessation treatments for Chinese Americans,37 to our knowledge, none has specifically focused on older Chinese American men. Given the paucity of research in this area, additional efforts are warranted to
Table 2. The Associations Between Smoking Status and Health Profiles Among Older Chinese American Men (N = 1492)∗

<table>
<thead>
<tr>
<th>Variable</th>
<th>Heart Diseasesb</th>
<th>Hypertensionb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Model 1</td>
</tr>
<tr>
<td>Smoking status</td>
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</tr>
<tr>
<td>Current vs never smoker</td>
<td>0.67 (0.44-1.02)</td>
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<tr>
<td>Former vs never smoker</td>
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</tr>
<tr>
<td>Current vs former smoker</td>
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<td>0.59 (0.39-0.90)</td>
</tr>
<tr>
<td>Demographics</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>1.03 (1.00-1.06)</td>
</tr>
<tr>
<td>Education</td>
<td>1.07 (1.04-1.10)</td>
<td>1.09 (1.04-1.13)</td>
</tr>
<tr>
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<tr>
<td>Not married</td>
<td>1.45 (0.95-2.21)</td>
<td>1.87 (1.09-3.21)</td>
</tr>
<tr>
<td>Not insured</td>
<td>0.92 (0.63-1.34)</td>
<td>0.82 (0.49-1.36)</td>
</tr>
<tr>
<td>Smoking pack-years</td>
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</tr>
<tr>
<td></td>
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<td></td>
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<tr>
<td>High Cholesterolb</td>
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<tr>
<td>Smoking status</td>
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<tr>
<td>Current vs never smoker</td>
<td>1.02 (0.75-1.37)</td>
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<tr>
<td>Former vs never smoker</td>
<td>1.36 (1.06-1.75)</td>
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<td>0.74 (0.56-0.99)</td>
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<td>0.99 (0.97-1.01)</td>
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<tr>
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<td>1.03 (1.00-1.06)</td>
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<tr>
<td>Income</td>
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<td>1.06 (0.94-1.20)</td>
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<tr>
<td>Not married</td>
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<tr>
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<tr>
<td>Smoking pack-years</td>
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<td></td>
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<tr>
<td>No. of Medical Conditionsf</td>
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</tr>
<tr>
<td>Smoking status</td>
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<td>Current vs never smoker</td>
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<td>Former vs never smoker</td>
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<td>1.01 (1.00-1.02)</td>
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<td>1.02 (1.01-1.03)</td>
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<tr>
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<td>0.99 (0.95-1.03)</td>
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<td>Anxiety Levelf</td>
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<tr>
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<td>Income</td>
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<tr>
<td>Not married</td>
<td>1.30 (1.01-1.65)</td>
<td>1.20 (0.88-1.64)</td>
</tr>
<tr>
<td>Not insured</td>
<td>1.08 (0.89-1.30)</td>
<td>1.15 (0.90-1.46)</td>
</tr>
<tr>
<td>Smoking pack-years</td>
<td>N/A</td>
<td>1.00 (0.99-1.00)</td>
</tr>
</tbody>
</table>

Abbreviation: N/A, not applicable.

a Data are given as odds ratio (95% confidence interval) for heart diseases, hypertension, high cholesterol, thyroid disease, and number of medical conditions. Data are given as rate ratio (95% confidence interval) for depression level and anxiety level. Model 1: smoking status (never, current, or former smoker) + demographics; model 2: smoking status (current or former smoker) + demographics + smoking pack-years.

b Binary logistic regression.

c Never smoker and former smoker were used as the reference in model 1 and model 2, respectively.

d P < .001.

e P < .05.

f Negative binomial regression.
develop campaigns to promote cessation awareness and engagement in treatment programs that meet the cultural and language needs (e.g., development of Chinese language materials that incorporate social and cultural factors37) of this population. Furthermore, both former and current smokers in this study reported chronic high-frequency smoking. Health promotion interventions are needed for former smokers in this population to improve physical and mental health functioning and to reduce risk for mortality associated with reported chronic health conditions.

Study Limitations

Despite several strengths of the study, limitations should be noted. First, given the nature of cross-sectional studies, only associations can be established. The temporal sequence between smoking, quitting smoking, and onset of medical conditions cannot be determined in this study. Future longitudinal study is needed to further value the causality among study variables. As in most large-scale surveys, information was based on smoking status and health conditions were based on self-report and not confirmed by objective methods. Although research has suggested that self-reported smoking status is highly accurate,38 self-reported chronic health information is less reliable.39 Second, smoking status was only assessed based on cigarette smoking. Other types of tobacco use were not measured in the PINE data. In addition, other social determinants of health, such as environmental conditions, quality of housing, and neighborhood disorder, may have influences on older people’s health profile that were not able to be controlled in the study due to data limitation. Last, data were collected from participants living in and around the Chicago metropolitan area. Consequently, study results may not be generalizable to other samples of older Chinese American men living in different geographical locations. As such, additional research is needed to replicate current findings and to approve upon study limitations.

CONCLUSIONS

Consistent with the extant literature, rates of smoking were elevated among this sample of older Chinese American men. However, counter to study hypotheses, former smokers had worse overall health profiles compared to never and current smokers. Study findings suggest the importance of health promotion interventions for former smokers and the need to develop culturally targeted health promotion interventions (chronic disease management, smoking cessation, and lung cancer screening) for current smokers and former smokers to reduce the risk of future poor health.

Table 3. The Associations Between Smoking Status, Self-Rated Health, and Quality of Life Among Older Chinese Men (N = 1492)†

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-Rated Health</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current vs never smoker</td>
<td>0.88 (0.64-1.20)</td>
<td>1.10 (0.71-1.68)</td>
</tr>
<tr>
<td>Former vs never smoker</td>
<td>1.14 (0.87-1.50)</td>
<td>1.58 (1.11-2.26)</td>
</tr>
<tr>
<td>Current vs former smoker</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.01 (0.99-1.03)</td>
<td>1.02 (1.00-1.05)</td>
</tr>
<tr>
<td>Education</td>
<td>1.02 (0.99-1.04)</td>
<td>1.01 (0.98-1.04)</td>
</tr>
<tr>
<td>Income</td>
<td>0.83 (0.75-0.91)</td>
<td>0.72 (0.61-0.85)</td>
</tr>
<tr>
<td>Not married</td>
<td>0.96 (0.65-1.40)</td>
<td>1.07 (0.66-1.73)</td>
</tr>
<tr>
<td>Not insured</td>
<td>0.84 (0.63-1.12)</td>
<td>0.71 (0.48-1.06)</td>
</tr>
<tr>
<td>Smoking pack-years</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Quality of Life</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current vs never smoker</td>
<td>1.20 (0.90-1.62)</td>
<td>2.11 (1.04-4.29)</td>
</tr>
<tr>
<td>Former vs never smoker</td>
<td>1.03 (0.80-1.32)</td>
<td>1.14 (0.57-2.28)</td>
</tr>
<tr>
<td>Current vs former smoker</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.98 (0.96-0.99)</td>
<td>0.93 (0.89-0.98)</td>
</tr>
<tr>
<td>Education</td>
<td>0.97 (0.95-0.99)</td>
<td>1.00 (0.94-1.07)</td>
</tr>
<tr>
<td>Income</td>
<td>0.86 (0.78-0.94)</td>
<td>0.85 (0.68-1.07)</td>
</tr>
<tr>
<td>Not married</td>
<td>1.25 (0.88-1.77)</td>
<td>1.11 (0.42-2.95)</td>
</tr>
<tr>
<td>Not insured</td>
<td>0.91 (0.69-1.19)</td>
<td>0.92 (0.48-1.74)</td>
</tr>
<tr>
<td>Smoking pack-years</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Abbreviation: N/A, not applicable.
†Data are given as odds ratio (95% confidence interval). Model 1: smoking status (never, current, or former smoker) + demographics; model 2: smoking status (current or former smoker) + demographics + smoking pack-years.
†Ordered logit regression.
†Never smoker and former smoker were used as the reference in model 1 and model 2, respectively.
†P < .05.
†P < .001.
ACKNOWLEDGMENTS
We are grateful to Community Advisory Board members for their continued effort in this project.

Financial Disclosure: The effort of Matthews on this project was partially supported by the University of Illinois at Chicago Center for Clinical and Translational Science, which is supported by the National Center for Advancing Translational Sciences, National Institutes of Health, through grant UL1TR 002003 (Tobacman LS and Mermelstein RJ, http://grantome.com/grant/NIH/UL1-TR002003-01, 2016). Simon was supported by National Institute on Aging grants (R01 AG042318, R01 MD006173, R01 CA163830, R34MH 100443, R34MH100393, P20CA165588, R24MD001650, and RC4 AG039085), the Paul B. Beeson Award in Aging, the Starr Foundation, the American Federation for Aging Research, the John A. Hartford Foundation, and the Atlantic Philanthropies.

Conflict Of Interest: The authors assert that they have no conflict of interest.

Author Contributions: Li: study concept and design, acquisition of data, and analysis of data. Li and Matthews: interpretation of data and preparation of the manuscript. Dong and Simon: study concept and design, acquisition of data, and critical revision of the manuscript.

Sponsor’s Role: No study sponsors had any role in the study design, conduct of the study, data collection, data interpretation, or preparation of the manuscript.

REFERENCES
Health Service Use Among Chinese American Older Adults: Is There a Somatization Effect?

Lin Jiang, PhD,* Fei Sun, PhD,† Wei Zhang, PhD,‡ Bei Wu, PhD,§ and XinQi Dong, MD¶

BACKGROUND/OBJECTIVES: Somatization of depressive symptoms among Chinese American older adults remains understudied. This study aimed to identify whether the relationship between depressive symptoms and use of health services (ie, doctor visits, hospital, and emergency department) could be due to pain and whether acculturation played a role in the relations among depressive symptoms, pain, and health service use.

DESIGN AND PARTICIPANTS: Secondary data came from the Population Study of Chinese Elderly in Chicago that surveyed 3159 Chinese community-dwelling older adults in the greater Chicago area. The average age was 76.3 years (standard deviation = 8.4); 57.95% were female). Negative binominal models were used to identify the effects of depression and pain on each type of health service use, controlling for sociodemographics and health-related factors (eg, chronic illness).

MEASUREMENTS: Depressive symptoms were assessed using the Patient Health Questionnaire-9; pain was assessed by self-reported pain severity. Participants were classified into low, moderate, and high acculturation groups based on acculturation scores.

RESULTS: Depressive symptoms and pain were positively related to health service use on the bivariate level. For groups with both low and high acculturation levels, depression and pain each independently predicted more health service use, whereas for the group with a moderate acculturation level, the effect of somatization was substantialized.

CONCLUSION: Depression largely influenced health service use independently and partially through pain for older Chinese Americans. The somatization tended to be only salient for the moderate acculturation group, calling for more research attention to the complicated effect of acculturation. J Am Geriatr Soc 67:S584–S589, 2019.

Key words: acculturation; depression; health service use; somatization

The older population of the United States is becoming more ethnically diverse and includes a rapidly growing Asian population. In 2010, more than 1 million older Asians lived in the United States; by 2050, this population will rise to 7.5 million, accounting for 9% of the total older adult population. The older Chinese American population, the largest among older Asians, will grow even more rapidly, calling for more attention to the emerging service needs that will be associated with this demographic trend.

Depression is the most prevalent mental health issue affecting older Americans. The exact prevalence rate of depression among older Chinese Americans remains unclear, but depressive symptoms are reported as widespread in this population. A study in 2017 found that 55% of Chinese American older adults reported having some depressive symptoms. However, due to language barriers, low health literacy, and somatic presentations, depression among Chinese American older adults remains understudied.

The purpose of this study was to address this knowledge gap by examining the relationship between depressive symptom among Chinese American older adults and their use of health services that could be due to expressions of physical pain and affected by different acculturation levels.

According to Lipowski, somatization is “a tendency to experience and communicate somatic distress and symptoms unaccounted for by pathological findings, to attribute them to physical illness, and to seek medical help for them” (p. 1359). Rohlof et al said somatization includes both “psychological aspects of somatic complaints” (p. 794) and “aspects connected to the medical system” (p. 794).
Somatization of psychological distress influences people’s help-seeking behaviors. For example, seeking a doctor due to the somatic expression of psychological distress was found prominent in Asian immigrants in the United Kingdom but not for the non-Asian populations.13 Suen and Tusaie14 also pointed out that Asian patients have had unnecessary medical examinations because they often expressed depression through somatic symptoms, and some even requested a change of physicians when their somatic symptoms failed to improve. Lu et al15 found that when compared with American participants, Chinese participants in Hong Kong are more likely to report somatic symptoms instead of depressed feelings. The somatic symptoms include fatigue, pain, loss of appetite, and sleep problems.16,17

However, chronic pain is a predominantly somatic symptom strongly associated with depressive symptoms among Chinese American older adults.18 One of the reasons for these findings is that the open expression of emotional problems is not encouraged in traditional Chinese culture. This means that Chinese may lack specific psychological terminology to describe their emotions, and furthermore, they may not have access to psychological treatment that is acceptable to them. Another factor to consider is the traditional Chinese belief that the body and mind are closely interrelated instead of separate. Thus, they believe that treatment of physiologic symptoms would heal their mental or emotional problems.19

Chinese American older adults are influenced by both Chinese traditional culture and American culture because more than 80% of Chinese American older adults were born outside of the United States. More than 30% of them came to the United States after the age of 60.20 Thus acculturation level may affect their attitudes toward somatic symptoms and depression. This notion is supported by Wong-Stokem20 who found that Asian Americans with a high acculturation level were more likely to discuss personal issues with mental health professionals and report fewer somatic complaints. A similar pattern was found in Australian Chinese immigrants in that those with high acculturation levels tended to have similar depression rates and help-seeking practices corresponding to Western patterns.21 Additionally, acculturation levels may affect the utilization of health services. In general, immigrants with higher acculturation levels are more likely to access healthcare services in the host country than immigrants with a lower acculturation level.22 However, this pattern might differ depending on health service type. Chinese immigrants who lived in the United States for fewer years tend to use the emergency department (ED) services more often than their counterparts who lived in the United States longer because of their lack of health insurance and little knowledge of the healthcare system.23 Therefore, we examined the three common yet distinctive types of health services—doctor visits, hospitalization, and ED—in this study.

Evidence so far suggests a need to examine the somatization effect in the older Chinese American population within the context of different acculturation levels.24 For this reason, this study aims to shed light on whether the relationship between depressive symptoms and use of health services (ie, doctor visits, hospital, and ED) could be due to the expressions of physical pain, and to examine the relationships between depressive symptoms, pain, and health service use in the context of different acculturation levels. More specifically, the tentative hypotheses are as follows: (1) that depressive symptoms would be related to more pain; and (2) that pain could help explain why depressive symptoms led to health service use; and (3) the mediation effect would manifest differently in groups with different acculturation levels.

METHOD

Data

This study used secondary data from the Population Study of Chinese Elderly (PINE) that adopted a community participatory approach by involving community-based service agencies in research design, recruitment, and data collection. Community partners included the Chinese Health, Aging, and Policy Program at Rush University, Northwestern University, and more than 20 community services organizations in the greater Chicago area. Data were collected through face-to-face interviews with standardized questionnaires and transferred to a Web-based platform afterward for storage. The study included 3159 Chinese American older adults aged 60 to 109.

MEASUREMENTS

Depressive symptoms

Depressive symptoms were measured by using the Patient Health Questionnaire (PHQ-9). Participants were asked to identify how often they had been bothered by the following symptoms in the last 2 weeks: (1) changes in sleep, (2) changes in appetite, (3) fatigue, (4) feelings of sadness or irritability, (5) loss of interest in activities, (6) inability to experience pleasure/feelings of guilt or worthlessness, (7) inability to concentrate or making decisions, (8) feeling restless or slowed down, and (9) having suicidal thoughts. Responses were evaluated from 0 (not at all) to 3 (nearly every day) (Chen et al). The total scores ranged from 0 to 27 with higher scores referring to more severe depressive symptoms.26 Cronbach’s α of PHQ-9 in the PINE study was .82, indicating this measure is reliable to use in this study population.

Acculturation

In the PINE study, acculturation was measured by the Acculturation Scale, described by Parker et al as “derived from a validated acculturation scale used in minority populations with an overall alpha of .92, a language alpha of .90, a media alpha of .86, and a social relations alpha of .78” (p. 1932).21 The scale was translated into Chinese, and its content and translations were approved by community leaders and older adults in the Chicago Chinese community.22 This multidimensional scale has 12 questions, each on a 5-point Likert-type scale including language use (1 = only Chinese, 5 = only English), media use preference of English and Chinese media (1 = only Chinese, 5 = only English), and ethnic social relations (1 = only Chinese, 5 = only Americans). The Cronbach’s α of this Acculturation Scale was .88.23 Because the distribution of acculturation is skewed, it was not categorized by standard deviation; instead, the 1/3...
Hierarchical models and Sobel tests were repeated for the mediating effect implied in the hierarchical models. Sobel tests were run to further pinpoint the significance of depression, followed by a second model with added control variables. The only significant effect of depression from .20 (p < .01) but not for hospitalization and ED utilization. Pain severity was evaluated by the Quality of Life (QOL) and Bodily Pain questions. It consists of five questions on health, life quality, and self-reported pain. Two questions of self-reported pain include (1) How much bodily pain have you had during the past 4 weeks from 1 (not at all) to 6 (very seriously)? and (2) during the past 4 weeks, how much did pain interfere with your daily life from 1 (no interference) to 5 (very serious interference)? The scores of these two questions were calculated together with the higher scores indicating greater pain.

Health service use

Healthcare utilization was measured using three indicators: times of visiting physician/doctor’s clinic in the past 2 years; times of ED visits in the past 2 years; and times of hospitalization in the past 2 years. The responses for these three measures ranged from 0 to 20 times or more. In this study, times of visiting physician, hospitalization, and ED utilization were three dependent variables.

Control variables

Control variables included age (in years), sex (1 = female), education (in years), income (range: 1 = <$5000 to 10 = ≥$45,000), length of time in the United States (in years), number of chronic diseases (range: 0-6), any disabilities in activities of daily living (ADLs; 1 = Yes; 0 = No), any disabilities in instrumental activities of daily living (IADLs; 1 = Yes; 0 = No), and medical insurance status (1 = yes).

Analysis strategies

SAS software, v.9.2 was used for data analysis. Bivariate correlation analyses were run among depression, acculturation, and pain. Following this, hierarchical negative binomial models were chosen because of the distribution and nature of the outcome variables (ie, counts). Analyses were conducted to identify the main effect of depression as well as the mediating effects of pain. The first model only included depression, followed by a second model with added control variables. The final model included pain. Sobel tests were run to further pinpoint the significance of the mediating effect implied in the hierarchical models. Hierarchical models and Sobel tests were repeated for the three acculturation groups.

RESULTS

Table 1 presents descriptive statistics of the study population. The average age of participants was 76.25 years; almost half of them were women (42.05%). Their average annual income level was between $5000 and $10,000. The average education level was close to 9 years of schooling. Their average time living in the United States was 20 years. Almost one-third (33.16%) of the participants reported having one chronic condition. Most of them (75.96%) reported having no health insurance, and half of the participants had an ADL limitation (49.61%) or a limitation with an IADL (50.39%).

We tested the bivariate relations among depression, pain, and acculturation (data not shown). Pain was related to both depression and acculturation; more pain was related to higher levels of depression (r = .38; p < .01) but to lower levels of acculturation (r = -.05; p < .05). Because acculturation might influence the expression of pain, we distinguished three groups based on their acculturation levels. Table 2 shows the results for the low acculturation group. The main effect of depression on each of the three types of health service use was significant, in that higher levels of depressive symptoms were related to more doctor visits (B = .02; p < .01), hospitalization (B = .10**; p < .01), and ED visits (B = .06**; p < .01). A partial mediation via pain was found for doctor visits, as evidenced by the change in the coefficient of depression from .20 (p < .01) to .02 (p < .01) that was significant (Sobel test score z = 3.77; p < .01). The pain was also found related to any types of health service use.

Regarding the moderate acculturation group (Table 3), depression was not related to any health service use after controls and pain were added. The Sobel tests suggest that a full mediation effect existed for doctor visits (Sobel test score z = 3.54, p < .01) but not for hospitalization and ED use. The pain was found to be only related to doctor visits.

Finally, Table 4 presents the results for the high acculturation group. Depression remained significantly related to each of the three types of health service use after controls and pain were added. The only significant mediation effect of depression via pain was found for doctor visits such that
the coefficient changed from .16 (p < .01) to .02 (p < .01), with a Sobel test score z = 3.72 (p < .01), implicating a partial mediation. The pain was found related to doctor visits and hospital use.

**DISCUSSION**

This study aimed to identify how a somatization effect might vary in Chinese American older adults with different acculturation levels. The three hypotheses presented earlier were largely supported. Somatization effect was sustained on the three conditions: depressive symptoms were significantly associated with pain, depressive symptoms were related to doctor visits, and this association between depressive symptoms and doctor visits became diminished after adding a pain variable in the model. Somatization effects were found to manifest differently among groups with different acculturation levels.

We found that depression was a robust correlate for any health service use (ie, doctor visits, hospitalization, and ED visits) for both low and high acculturation groups. Depressive symptoms could arise due to a medical condition that led to health service use. Another explanation could be that both groups sought help from healthcare providers for different reasons. We speculate that the low acculturation group may be not aware of available mental health services in the United States and therefore seek depression treatment at their doctor visits. For the high acculturation group, this symptom could reach a threshold that led to health service use. Another explanation could be that both groups sought help from healthcare providers for different reasons. We speculate that the low acculturation group may be not aware of available mental health services in the United States and therefore seek depression treatment at their doctor visits. For the high

<table>
<thead>
<tr>
<th>Table 3. Depression, pain, and service use among participants with moderate acculturation levels using negative binominal analyses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Doctor visits</strong></td>
</tr>
<tr>
<td><strong>B (SE)</strong></td>
</tr>
<tr>
<td>Depression</td>
</tr>
<tr>
<td>Pain</td>
</tr>
<tr>
<td>Controls</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Education</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Income</td>
</tr>
<tr>
<td>Years</td>
</tr>
<tr>
<td>Insurance</td>
</tr>
<tr>
<td>ADL/IADL</td>
</tr>
<tr>
<td>Illness</td>
</tr>
<tr>
<td>Illness</td>
</tr>
</tbody>
</table>

Abbreviations: ADL, activity of daily living; IADL, instrumental activity of daily living; ED, emergency department; SE, standard error.

aYears = years in the United States.

bIllness = number of chronic illnesses.

Note: B indicates unstandardized coefficients. ** p < .01; * p < .05.
Table 4. Depression, pain, and service use among participants with high acculturation levels using negative binomial analyses

<table>
<thead>
<tr>
<th></th>
<th>Doctor visits</th>
<th></th>
<th>Hospital</th>
<th></th>
<th>ER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B (SE)</td>
<td>B (SE)</td>
<td>B (SE)</td>
<td>B (SE)</td>
<td>B (SE)</td>
</tr>
<tr>
<td><strong>Depression</strong></td>
<td>.03** (.01)</td>
<td>.16** (.04)</td>
<td>.02** (.01)</td>
<td>.10** (.02)</td>
<td>.03** (.01)</td>
</tr>
<tr>
<td><strong>Pain</strong></td>
<td>.04** (.01)</td>
<td>.07* (.03)</td>
<td>.02** (.01)</td>
<td>.07* (.03)</td>
<td>.01 (.01)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td>.04 (.03)</td>
<td>.01 (.00)</td>
<td>.00 (.01)</td>
<td>.02 (.01)</td>
<td>.01 (.01)</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>−.01 (.04)</td>
<td>−.01 (.01)</td>
<td>.01 (.01)</td>
<td>.03 (.02)</td>
<td>.02** (.01)</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>−.65 (.34)</td>
<td>−.13** (.05)</td>
<td>−.11 (.07)</td>
<td>−.51** (.18)</td>
<td>−.05 (.06)</td>
</tr>
<tr>
<td><strong>Years</strong></td>
<td>−.29** (.12)</td>
<td>−.04* (.02)</td>
<td>−.00 (.03)</td>
<td>−.01 (.07)</td>
<td>−.02 (.02)</td>
</tr>
<tr>
<td><strong>Insurance</strong></td>
<td>.01 (.01)</td>
<td>.01 (.01)</td>
<td>−.00 (.00)</td>
<td>−.05* (.01)</td>
<td>−.00 (.00)</td>
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<tr>
<td><strong>ADL/IADL</strong></td>
<td>3.9** (.46)</td>
<td>.74** (.08)</td>
<td>−.01 (.10)</td>
<td>.05 (.24)</td>
<td>.01 (.09)</td>
</tr>
<tr>
<td><strong>Illness</strong></td>
<td>−.2 (.36)</td>
<td>−.04 (.06)</td>
<td>.12 (.08)</td>
<td>.31 (.19)</td>
<td>.03 (.07)</td>
</tr>
</tbody>
</table>

Abbreviations: ADL, activity of daily living; IADL, instrumental activity of daily living; ED, emergency department; SE, standard error.
*Years = years in the United States.
**Illness = number of chronic illnesses.

Note: B indicates unstandardized coefficients. ** p < .01; * p < .05.

acculturation group, their primary physician might be an entry point where they can receive referrals for mental health specialists or services because Medicare covers depression screening every year at their primary care physician’s office. We assumed that the high acculturation group would use more professional help from mental health specialists to deal with depression than the low acculturation group. These explanations are speculative because data were not available regarding whether participants sought direct help from doctors or asked the doctor for a referral to a mental health specialist. Still, such correlations beg more research given the cross-sectional nature of this study.

One major finding of this study is that a full or partial somatization effect was only found in the use of doctor visits but not for hospitalizations and ED visits. It is possible that medical conditions that trigger hospitalizations and ED visits can be more acute and life-threatening. Often the pain caused by depression tends to be chronic and subtle and is therefore treated at a doctor’s visit. Secondly, the somatization effect was salient in the moderate acculturation group and partially existent in the low and high acculturation groups. This suggests that regardless of acculturation levels, Chinese American older adults tend to visit doctors for depression treatment because they experienced some pain, particularly for the moderate acculturation group.

The different manifestation of somatization effects across three acculturation levels implies a nonlinear and complicated effect of acculturation on depression. Mak and Zane examined over a thousand Chinese Americans between ages 18 and 65 in Los Angeles County and found acculturation did not directly correlate with somatic disorders. The authors suggested that the somatization effect was more likely a stress response due to heightened distress and psychosocial stressors, rather than a cultural tendency to express psychological problems in somatic terms. We concur with this proposition such that those at the moderate acculturation stage might experience ongoing struggles associated with the adaptation process. This is also consistent with some studies, such as Wu et al., who found that depressive symptoms are not linearly associated with acculturation. Their high levels of psychosocial stress are likely to manifest in physical or somatic symptomology that leads to their use of doctor visits. Therefore, the low acculturation group, mostly referring to newly arrived immigrants, may be protected by a health advantage due to the “immigrant paradox” effect, and the most acculturated group is protected by their good adjustment to American society including the healthcare services system. For the middle acculturation group, they may be more vulnerable to depression because of their acculturation stress and more likely to seek a doctor’s help for their pain. They may not be aware of its mental health cause.

This study had a few limitations. The data did not specifically ask participants about whether they visited psychiatrists or mental health specialists. We were not sure whether participants counted their visits to mental health specialists in their reports of doctor visits. Second, the data from the PINE study was collected in the Chicago area. Thus it is hard to generalize the results to the entire Chinese population of older adults in the United States. Third, the measure of pain was a subjective appraisal that might not represent physical pain. The lack of a measure of somatic symptoms in this study might be another limitation. To counteract this limitation, we correlated the feelings of pain with the total number of 13 possible physical pain types (e.g., headache or earache). The average number of pain type was 1.66 (SD = 1.54) and highly correlated with feelings of pain.

In conclusion, somatization entails the existence of underlying feelings of depression not recognized by the person, although the person may be aware of all the physical correlates of these underlying difficulties. Despite its small prevalence rate, somatization appeared to be a disorder that affects older adults across countries and cultural groups. Evidence suggests that the somatization effect is particularly salient among older adult immigrants, due to their home country’s cultural values and the challenges associated with adaptation to the host culture.

We found that a somatization effect existed in a sample of Chinese American older adults in this study, and it further shed some light on the reasons behind it. The somatization
effect was less associated with values of the home culture or that of the host country for older Chinese Americans adults, but more with stress and distress during the acculturation process. This is manifested by the fact that only those in the moderation acculturation levels had the most salient somatization effect. During the acculturation process, individuals are more likely to encounter challenges and difficulties that cause depressive feelings that fail to be recognized by their cognitive system. That is, people may not recognize they are depressed due to new situations encountered in their host country, and instead, they may report depressive symptoms like pain or fatigue. Future studies can expand examinations to the role of other somatic symptoms, such as fatigue and changes in sleep patterns, in influencing health service use.

This study has implications for health, mental health, and community social service providers. Primary care physicians appear to be a major source of help for this group. Thus although it is important for them to treat physical pain and symptoms, they must recognize the underlying mental health concerns behind some of the physical symptoms in older Chinese American clients and refer them to appropriate mental health and community social service providers. Mental health professionals (e.g., psychologists, psychiatrists) need to ensure that their services, such as counseling, skill training, and other therapies, are accessible and culturally appropriate. Community social service providers can collaborate with Chinese community resources, such as local Chinese places of worship, retirement clubs, and associations for older adults, to assist them with daily living difficulties that may exacerbate their psychological distress.

ACKNOWLEDGMENTS

We thank the PINE study for providing data and statistical analysis.

Financial Disclosure: We did not receive any funding for this research.

Conflict of Interest: We have no conflicts of interest to disclose.

Author Contributions: Lin Jiang and Fei Sun were in charge of the conceptualization, research design, literature review, data analysis, and preparation of the manuscript. Wei Zhang analyzed the results and wrote the conclusion. Bei Wu contributed to the conceptualization and the discussion. XinQi Dong provided data and guidance for research and manuscript editing.

Sponsor’s Role: There was no sponsor for this study.

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