THE HEALTH IMPACT OF CARING FOR GRANDCHILDREN ON GRANDPARENT CAREGIVERS: A LONGITUDINAL STUDY IN TAIWAN

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A dissertation submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Health Policy and Management

Chapel Hill
2011

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ABSTRACT

Li-Jung Elizabeth Ku: The Health Impact of Caring for Grandchildren on Grandparent Caregivers: A Longitudinal Study in Taiwan
(Under the direction of Sally Stearns, PhD)

This dissertation seeks to determine the impact of caring for grandchildren on the health and health care utilization of Chinese grandparent caregivers. While the current literature on grandparent caregiving has largely shown negative health impact, most of these studies were based in the U.S. and thus grandparents in other countries and cultures have been under-represented. Using four waves of the Survey of Health and Living Status of the Elderly in Taiwan, this longitudinal study not only contributes to cross-cultural comparisons but also addresses methodological issues in the current literature. Panel data analyses are used to estimate the effect of caregiving while controlling for caregiver selection using both fixed effects and instrumental variables. Results show health improvement among grandparent caregivers in measures of self-rated health, mobility limitations, and depressive symptoms. No significant difference is found in health care utilization by grandparent caregiving status, except that caregivers in skipped-generation households or those who have continued to provide care for more than three years are more likely to report having unmet health needs. The overall findings support our hypothesis that caring for grandchildren can be beneficial for the health of grandparents in the Chinese cultural context.

ACKNOWLEDGEMENT

I would like to first thank my advisor, Dr. Sally Stearns, for my competition of this dissertation would not have been possible without her continuous support. I am also grateful for the intellectual support of my committee members, Drs. Shoou-Yih Daniel Lee, Dilworth-Anderson, Bob Konrad, and Courtney Van Houtven.

One important lesson I have learned in the past two years is that it takes much more than my own ability or will to reach my goal and I am indebted to so many who supported me during this dissertation process. I would like to list them as my three support teams below:

Technical Support Team: Daniel Belsky, Jeff Federspiel, Laura D'Arcy, Nathan Nickel, Danny Yeh, Young Kyung Do, and Emmeline Chuang. Thanks for the wonderful resources at the UNC Writing Center, especially for what I learned from Nigel Caplan and Gigi Taylor.

Emotional Support Team: Each of my writing group members who has shared this journey with me since 2008, including Ching-Ching Lin, Emma Wang, and Aiko Hattori.

Spiritual Support Team: Members of my small faith group at UNC Newman Center who have become my family in the US, and special thanks go to Juraj Kavoc and Theresa Hsieh for having faith in me during times of trial. I am grateful for the prayers by so many whom I could not name individually: Sisters of Our Lady of China, Chinese Dominican Sisters, Sisters of Providence, the Focolarini, and friends in my home parish in Chiayi, Taiwan.

Last but not least, I want to thank my parents for their unconditional love and support, especially their countless hours of prayers that made the impossible possible.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

TLSA	Taiwan Longitudinal Study on Aging
PRC	People's Republic of China
CES-D	Center for Epidemiologic Studies-Depression
SWLS	The Satisfaction with Life Scale
MG	Multigenerational households
SG	Skipped-generation households
FE	Fixed-effects
IV	Instrumental variables

CHAPTER 1. INTRODUCTION

In traditional Chinese culture, grandparents commonly help to care for grandchildren in three-generational families [Strom et al., 1996]. Although within the cultural context, grandparents in Taiwan have long been involved with grandchild care, evidence shows that the percentage of grandparents caring for grandchildren under three years old increased by seven percentage points in the past 20 years following increased female labor force participation [Statistical Bureau, 2006]. Despite the rise of grandparent caregiving in Taiwan, little is known about the health impact on grandparents caring for grandchildren [Lo and Liu, 2009].

While the current literature on grandparent caregiving has largely shown negative health impact, most of these studies were based in the U.S. and thus grandparents in other countries and cultures have not been well-represented. Previous research on grandparents of different ethnic groups has also shown that that cultural norms and traditions can shape expectations about grandparent roles and subsequently affect grandparent well-being [Goodman and Silverstein, 2002]. Therefore, this dissertation seeks to investigate the relationship between caregiving and grandparent's health and determine if positive health impacts exist for Chinese elderly grandparents.

The main objective of this study is to determine whether Taiwanese grandparents experience effects of caregiving on their physical, mental health, and health care utilization compared to grandparents not caring for grandchildren. This chapter begins with background information on Chinese grandparenthood and the significance of this study, followed by the

specific aims and structure of this dissertation.

1.1 Chinese Grandparenthood

Taiwanese society which has kept the long tradition of Chinese culture, differs significantly from the People's Republic of China (PRC) in its current social, political, and economic conditions [Berndt et al., 1993]. For the purpose of this study, the term "Chinese" is used as a term for the shared ethnicity/ culture between Taiwan and the PRC; however, this study also distinguishes Taiwanese grandparents from grandparents in the PRC in terms of nationality. Although grandparenthood is a universal experience shared by people of different cultures, grandparenting could have very different meanings for people with different cultural values. In a society that emphasizes collective goals over individual goals, the contributions of grandparents to the welfare of their extended families fulfill a cultural norm of familism and are highly valued [Yan, 2003]. Chinese grandparents typically do not share the American norm in considering their participation in grandchild care as interfering with their adult children [Kamo, 1998]. Rather than considering caring for grandchildren as a burden or a disruption to their daily life, Chinese grandparents are more likely to think of caring for grandchildren as a source of 'family happiness' which enables them to achieve intergenerational reciprocity [Sheng and Settles, 2006]. The other distinctive feature of grandparenting in Chinese culture is the notion of filial piety [Silverstein et al., 2006]. An expression of Chinese filial culture is often found in grandparents' assistance with childcare in exchange for financial support from their adult children, regardless of whether the parents live with or apart from the adult children [Hermalin et al., 1998]. In summary, grandparents in Taiwan anticipate frequent interactions with their grandchildren and have positive views

toward their role as caregivers.

Major differences between grandparent caregivers in the US and in Taiwan are not limited to cultural context, but also in the rationale for providing grandchild care. Taiwanese grandparents caring for grandchildren often reported that their adult children work full-time [Chang, 2007; Lo and Liu, 2009], a reason that is quite different from American custodial grandparents whose adult children are sometimes unavailable due to substance abuse, illness, or incarceration [Roe et al., 1996; Emick and Hayslip, 1999; Goodman and Silverstein, 2002]. Given the huge contrast in the circumstances of grandchild care and the differences between the two family traditions, it is likely that the proposed study on Taiwanese grandparents will yield quite different findings from the US literature. Thus, instead of drawing conclusions based on findings in the US, it is important to identify the health effects specifically for grandparent caregivers in Taiwan.

Currently, Taiwan is undergoing a demographic change of two forces which makes it a very interesting case study. On the one hand, Taiwan has entered the rank of an aging society since 1993, with a growing population of elderly currently making up more than 10% of its entire population [Department of Statistics, 2011]; on the other hand, Taiwan's birth rate has plummeted from 7.04 in 1951, to 2.10 in 1984, and to 1.05 children born per childbearing-age woman in 2009 [Department of Statistics, 2009]. These statistics have several important implications. First, an increased life expectancy implies that older people will spend more years of their lifetime in grandparenthood. Moreover, the combination of having few grandchildren and an emphasis on family lineage makes grandparents more likely to volunteer for grandchild care. Previous research has found that that more resources are available for grandchild care when the ratio of grandparents to grandchildren drops as a result

of the declining birth rate [Sheng and Settles, 2006]. The need for childcare support also increased following Taiwan's industrialization and increased female labor force participation [Directorate General of Budget, 2006]. The impact of this demographic change is confirmed by a rising trend of grandparent caregivers in Taiwan in the last two decades. A national survey of the female population in Taiwan in 2006 showed that among married women between ages 15 and 64 with kids, 25% reported having the grandparents as primary caregivers for a grandchild under age three; this figure further increased to 38% if the study sample was limited to women with youngest child born in the last three years [Directorate General of Budget, 2006].

While the phenomenon of grandparent caregiving is becoming more common in Taiwan, there is very little research done to investigate this important question of health consequence for caregivers. Only three published studies have looked at grandparents' health in association with caring for grandchildren in Taiwan as of December, 2010. Furthermore, all three studies had major weaknesses in their study designs that may have limited the validity of their findings [Liu, 2001; Chi, 2004; Lo and Liu, 2009]. Therefore, the health impact of caring for grandchildren among Chinese grandparents remains an important question to be studied.

1.2 Study Significance

This study builds and improves upon existing literature on the health of grandparent caregivers in several ways. First, using data from a less studied culture, this dissertation contributes to cross-cultural comparisons and our understanding of the role of caregiving contexts. While existing literature has often shown that caring for grandchildren is

detrimental to the health of the grandparents based mainly on studies of grandmothers in the US, this dissertation provides a unique opportunity to test that premise in a population with different cultural background and reasons for caregiving to grandchildren. Results from this study contribute to an emerging body of international literature that may differ from the conclusion about the negative health impact of grandparent caregiving in the US.

In addition to advancing our knowledge about grandparent caregivers, this longitudinal study seeks to improve the methodology used by prior cross-sectional studies to determine a causal relationship between caregiving and caregivers' health. By using a nationally representative sample instead of local convenience samples, this study can provide results with good external validity for grandparent caregivers across Taiwan and also reduce selection bias. Another strength of this study is that by examining a wide range of physical and psychological health outcomes, this study allows a robustness check on study estimation and a comparison of differential effects for different health outcomes.

Finally, this dissertation offers important policy insights for Taiwan. Given the fast growth of Taiwan's aging population and a rising trend of grandparent caring for grandchildren, there is an urgent need to understand the health impact on caregivers because caregiving affects a growing proportion of the Taiwanese population. Instead of making policy recommendations based on findings from countries, it is important to identify the health effects specifically for grandparent caregivers in Taiwan. While study findings help grandparents by informing them about the likely health consequences of caregiving, there are also implications for the adult children generation. If a net positive health impact is found for grandparent caregivers, encouraging grandparents' involvement with grandchild would mean additional help to the middle generation. In conclusion, by assessing the net health impacts

on grandparent caregivers, this dissertation provides valuable information for all generations and inform the future formulation of social policies in Taiwan.

1.3 Purpose of This Dissertation

Considering the lack of previous research on the health impacts associated with caregiving among Chinese grandparents, the main objective of this study was to determine the direction of the effects of caregiving on grandparents' health and health services utilization among grandparent in Taiwan. This study used a longitudinal sample from the Survey of Health and Living Status of the Elderly in Taiwan. This dissertation addresses the following three specific aims:

Aim 1: To estimate the effects of caring for grandchildren on the physical health, mental health, and health services utilization of Taiwanese grandparents using panel data methods

This study compared the health and health services use of Taiwanese grandparents using different classifications of caregiver status. Grandparent caregiver status was defined by patterns of living arrangement or by caregiving status over time. The four outcome measures of the physical and mental health of grandparents were: self-rated health status, mobility limitations, depression, and satisfaction with life. The three measures of health services use included unmet health needs, frequent clinic visits, and frequent outpatient care use. Multivariate regression analyses were used to estimate the impact of caregiving on seven health-related outcomes, controlling for grandparent socio-demographic and social support variables. Fixed-effects panel data method (FE) was used to control for selection of healthier caregivers and unobserved confounding from time-invariant factors in estimating the health impact of grandparent caregiving.

Aim 2: To determine the marginal effect of ever being a grandparent caregiver on the elder's health and health services use after controlling for selection into caregiving

To address the simultaneous determination of grandparent caregiving and caregiver's health, this study used an instrumental variable (IV) methods with and without person fixed effects to estimate the health impact of grandparent caregiving for those who had ever been a caregiver for their grandchildren during the decade from 1993 to 2003. This analysis examined the same outcomes of interest as Aim 1 but differed in the classification of caregiver and analytical models used to address the endogeneity of caregiving.

Aim 3: To estimate the effect of transitions in caregiving on the health and health services utilization of grandparents in Taiwan

In addition to determine the overall effect of grandparent caregiving, it is important to understand whether the transition into or out of caregiving has a bigger impact than the duration of caregiving. This analysis examined the health effects of continuity and transition in caregiving status by distinguishing these four types of transition: grandparents who started care, continued care, stopped care, and those never provided caregiving across two survey waves. The outcomes of interest investigated were the same as those in Aim 1 and Aim 2.

1.4 Structure of This Dissertation

Chapter 2 reviews the literature on grandparenting and health and identifies methodological challenges that the current study seeks to improve in its study design. The data source, research methods, analysis variables used in this study and descriptive statistics are presented in Chapter 3. Chapter 4 (Paper 1) reports the effects of caring for grandchildren on grandparents' health and health services use using the FE methods which addressed

selection from time-invariant unobserved variables. Chapter 5 (Paper 2) seeks to determine the causal effect of caregiving by addressing the concern of reverse causality from health to caregiving using the IV estimation approach. Chapter 6 (Paper 3) investigates whether types of caregiving transitions have different impacts on caregivers' health and health services use among Taiwanese grandparents. These three manuscripts are prepared for submission to individual targeted journal instead of a single results chapter. Due to the required format for each manuscript, information regarding the shared data source and analysis measures will be repeated in these three chapters. Chapter 7 is the conclusion chapter which summarizes results from all three papers, discusses study limitations and directions for future research.

CHAPTER 2. LITERATURE REVIEW

Although a large amount of literature was found on the topic of grandparent caregiving, many of the earlier findings need to be viewed with caution due to issues with study designs. Therefore, in addition to summarizing previous findings, several important methodological challenges in the field were summarized, followed by a discussion of how this dissertation addresses each challenge through study design. Furthermore, given the importance of culture difference discussed in Chapter 1, more emphasis will be put on research in Chinese grandparents as well as studies conducted on Asian-American populations in the US despite the small number of publications. These studies are considered more relevant to this dissertation due to the shared culture in study population, and their findings are discussed in greater detail.

2.1 Grandparenting and Health

2.1.1 Grandparent caregiving

While many US studies have examined the role of grandparent caregivers based on legal custody, that classification is of little relevance in the Taiwanese context. Previous studies in Taiwan often used living arrangement and time spent between grandparents and grandchildren to categorize various types of grandparent caregiving. For instance, one of the first studies on grandparent caregiving in Taiwan focused on surrogate parenting with various levels of care defined by the hours spent by the grandparents [Chu, 1983]. Living arrangement in terms of co-residence of different generations is another crucial element in

defining the type of caregiving provided by grandparents. Jendrek's study was among the first to categorize the grandparenting role in the US into three categories: custodial, coparenting, and daycare grandparents [Jendrek, 1993]. Since then, studies have increasingly accounted for the presence of at least one adult child by separating multigenerational households from skipped-generation households [Goodman and Silverstein, 2002; Musil and Ahmad, 2002; Blustein et al., 2004; Hughes et al., 2007]. Findings from those studies showed that the impact of caregiving was mitigated for those elders living with a partner or an adult child in the household. Therefore, it is important to separate grandparents who provide assistance in caring for a grandchild from those who are the primary caregivers in examining the effects of caregiving. It is also important to note that being a primary or a secondary caregiver was subjectively defined by the respondent rather than determined by living arrangement. For example, grandparents living in a three-generation household may or may not consider themselves as caregivers for their grandchildren.

2.1.2 Caregivers' Health Outcomes

A critical review of the literature on the health of caregiving grandparents concluded existing studies consisted primarily of grandmothers in the US [Grinstead et al., 2003]. A considerable amount of research has examined grandparent caregivers' physical and psychological health [Grinstead et al., 2003; Hayslip and Kaminski, 2005; Kolomer, 2008]. Physical health outcomes studied include self-rated health, chronic conditions, functional limitations [Grinstead et al., 2003; Hayslip and Kaminski, 2005; Hughes et al., 2007]. Psychological health outcomes investigated include depressive symptoms, caregiver burden, stress, mood, quality of life, and life satisfaction [Jendrek, 1993; Bowers and Myers, 1999;

Goodman and Silverstein, 2002; Grinstead et al., 2003].

Earlier studies on US grandparent caregivers usually found negative effects such as poor physical conditions and undesirable changes in health behaviors among those caring for grandchildren [Marx and Solomon, 2000; Grinstead et al., 2003; Baker and Silverstein, 2008]. Exhaustion is a common health concern expressed by grandparent caregivers [Jendrek, 1993; Roe et al., 1996; Waldrop and Weber, 2001], as are chronic health problems ranging from coronary heart disease to insomnia [Roe et al., 1996; Strawbridge et al., 1997; Lee et al., 2003; Kolomer, 2008]. Among all the measures of psychological well-being, depression and stress are the two most visible signs reported by grandparent caregivers [Lo and Liu, 2009]. A rich literature has documented higher depressive symptoms among caregiving grandparents than non-caregivers [Minkler et al., 1997; Musil and Ahmad, 2002; Blustein et al., 2004].

Despite much evidence of negative impact associated with caregiving, there are also findings to suggest that caring for grandchildren can bring a positive outlook to the grandparents. In a study where the grandparents were asked about their stress and reward of raising a grandchild, 54% of custodial grandparents reported that the experience was both stressful and rewarding, 19% reported it was mostly stressful, and 27% thought it was mostly rewarding [Giarrusso et al., 2000]. Giarrusso and colleagues (2000) summarized a few cases in which caring for a grandchild would have psychological benefits for the grandparents. For example, caring for a grandchild can provide a meaningful new role for a grandparent, leading the grandparent to feel more useful and productive [Emick and Hayslip, 1999]. It can also make grandparents feel good that they are able to simultaneously help their children and grandchildren [Burton, 1992]. The most significant benefit to mental health indicated by

grandparents in several studies was that caregiving gave them an increased purpose for living [Burton, 1992; Jendrek, 1993; Pruchno, 1999; Grinstead et al., 2003].

While more studies reported negative health impact among grandparent caregivers, some studies still found a salutary (beneficial) effect on the health of caregivers. Specifically, these findings of beneficial effects came from large, population-based surveys that have representative sample. A study using panel data from the National Survey of Families and Households (NSFH) found no significant effects of grandparent caregiving on changes in self-rated health [Szinovacz et al., 1999]. Another longitudinal study using the Health and Retirement Study (HRS) revealed that grandmothers who started or who continued to babysit grandchildren reported better self-rated health than grandmothers who provided no care [Hughes et al., 2007]. As caring for a grandchild may lead to both negative and positive consequences on grandparents' health outcomes, it is important to identify what may cause one group of grandparents to experience different effects from other grandparents [Grinstead et al., 2003]. For instance, the health impact on grandparents may depend on the duration and the level of caregiving, as well as characteristics of the grandchildren.

The research interest behind caregiving duration is related to two different hypotheses: (1) long-term caregivers may show worsening health over time [Solomon and Marx, 1999]; (2) caregivers who recently assumed responsibility in caring for a grandchild may experience the greatest change in health [Minkler et al., 1997]. The majority of evidence from previous longitudinal studies of grandparent caregivers seemed to support the second hypothesis. The transition into grandchild care in the US has been shown to be highly correlated with elevated levels of depression [Minkler et al., 1997; Szinovacz et al., 1999]. A recent review on the literature in the US concluded that a new transition into caregiving has negative effects

on grandparents health outcomes [Musil et al., 2011]. Adaptation to the caregiving role among grandparents over an extended period, however, is manifested in a return to prior levels of well-being [Minkler et al., 1997; Szinovacz et al., 1999; Hughes et al., 2007].

The most common measure of the level of caregiving used in studies of grandparents was full-time versus part-time [Bowers and Myers, 1999; Musil and Ahmad, 2002]. A study that examined the consequence of caring for grandchildren by caregiving level showed that full-time caregiving grandmothers had less energy and vitality than part-time caregivers, and less energy and vitality were associated with more burden and stress [Bowers and Myers, 1999]. Part-time grandparent caregivers also reported the highest level of grandparenting satisfaction, compared to both the full-time and the non-caregivers.

A number of US studies identified grandchildren's health and behavior as having a significant impact on the health of grandparents [Bowers and Myers, 1999; Burnette, 1999; Sands and Goldberg-Glen, 2000]. Previous studies in Taiwan also explored different effects on grandparents' health based on three grandchild characteristics: grandchildren's age, the number of grandchildren cared for by the grandparents, and the difficulty associated with caring for a specific grandchild. Two studies reached a similar conclusion that grandchildren's age was negatively associated with the health of caregivers: more grandmothers reported lower quality of life among those who cared for older grandchildren, and the greatest difference was found in the domain of mental health [Liu, 2001; Chi, 2004]. While Chi found that the number of grandchildren did not affect the health of the grandparents, Liu reported that whether the grandmothers considered the grandchild difficult to care for was the most significant predictor of their quality of life outcomes.

2.1.3 Caregivers' Health Services Utilization

Compared to the wealth of literature on caregivers' health outcomes, many fewer studies examined grandparent caregivers' health care utilization, and these studies looked mostly at the use of preventive services. Caring for grandchildren has been found to reduce a grandparent's time for self-care, such as exercising or going to the doctor and make them less likely to engage in preventive health services, such as screening tests or flu vaccination [Roe et al., 1996; Hughes et al., 2007; Baker and Silverstein, 2008]. Research has found a tendency for African-American grandmothers raising their grandchildren to downplay their own health problems and symptoms [Minkler et al., 1992].

In a study on preventive health behaviors among grandmothers, Baker and Silverstein argued that two opposing factors influence the utilization of health services by the caregivers: raising a grandchild will increase the perceived barriers to preventative health behaviors due to the demand of caregiving but also increase the grandparents' motivation to stay healthy [Baker and Silverstein, 2008]. This study tested that hypothesis and found that long-term caregivers were more likely to report influenza vaccination than non-caregivers, while grandmothers who recently began caregiving showed suppression of preventive behaviors during the transition into care. This finding on the effect for the new caregivers seemed to echo with the study by Minkler and colleagues showing that caregivers who recently assumed grandchild care responsibility would experience the most change in health [Minkler et al., 1997].

2.2 Methodological challenges in the current literature

2.2.1 The lack of a control group

Many earlier studies on grandparent caregivers in the US interviewed caregivers only but did not include those who were not providing care [Minkler et al., 1992; Jendrek, 1994; Roe et al., 1996]. Although these were mostly exploratory, qualitative studies that interviewed caregiving grandmothers, the problem of a single-group design is that one cannot separate the possible physical and mental health effects of the caregiving role from changes associated with normal aging [Butler and Zakari, 2005]. In other words, while studies on caregiving grandparents reported negative effects on health, similar health declines were also found among other elders and thus were not unique to caregiving. Therefore, it is important to include non-caregiving grandparents to allow for a proper comparison. This dissertation included a sample of non-caregivers to correct for the single group threat.

2.2.2 Cross-sectional study design

A critical review of the literature on the health of grandparents raising grandchildren from 1980 to 2002 found that most earlier studies only used cross-sectional designs. [Grinstead et al., 2003]. While most existing studies highlighted the negative aspect of caregiving in the past, a few recent longitudinal studies using four to six years of data [Fuller-Thomson et al., 1997; Blustein et al., 2004; Hughes et al., 2007], found that dramatic changes in the health of grandparent caregivers were rarely observed. These results suggested that many of the health deficits reported in earlier studies could reflect poor health prior to caregiving, not the consequences of caregiving [Hughes et al., 2007]. More than one period of data is required to control for baseline health status in observational studies and to establish the causal relationship between caregiving and health beyond the association observed in cross-sectional studies. Longitudinal study designs also allow for research on more nuanced questions about the transition into and out of caregiving. The literature has found that while

grandparents who recently began caregiving were more likely to be depressed than the non-caregivers, those who continued to provide care or stopped caring for a grandchild were not more depressed [Baker and Silverstein, 2008]. Therefore, it is important to use panel data that trace both the elder's health status (mental and physical) and the history of caregiving to determine the long-term effects of caregiving.

2.2.3 Caregiver selection

Given that caregiving status in observational studies has not been assigned randomly, one key challenge in obtaining causal estimate of the effect of caregiving is caregiver selection. The issue of selection can further be broken down into (1) selection into and (2) selection out of caregiving. The first kind of selection has been well-documented among US custodial grandparents who had poorer health prior to becoming caregivers [Strawbridge et al., 1997; Szinovacz et al., 1999; Hughes et al., 2007]. An opposite situation occurs when healthier grandparents volunteer for grandchild care, as a study of Chinese elderly found that grandparents in skipped-generation households tended to be the youngest and healthiest among that study sample [Silverstein et al., 2006]. Either of those situations described above constitutes caregiver selection, but this kind of selection bias could be controlled for with panel data. Drawing from the literature on the health effects of informal caregivers, econometric methods such as using person fixed effects can be a useful tool to control for unobserved differences between the caregivers and the non-caregivers if the differences were based on time-invariant factors [Do, 2008; Coe and Van Houtven, 2009].

While there are potential solutions to the first kind of selection due to individual heterogeneity, the second kind of selection is much harder to address. Among the many reasons why a grandparent decides to stop caregiving, it is highly likely that the decline in

health experienced by a caregiver could make him or her re-evaluate that choice. The decision to provide caregiving then becomes endogenous with caregivers' health status and reverse causality is a concern. In this case the health advantage observed among caregivers should not be considered as a result of caregiving. While this issue is clearly a major concern for all research regarding grandparenting and health, only one study was identified that addressed the endogeneity of intergenerational living arrangement with two-stage least squares estimation [Silverstein et al., 2006]. Therefore, one of the novel contribution of this dissertation is to use IV estimation to address the fact that caregiving status may be endogenous. Controlling for selection due to choice of caregiver status is key to obtaining unbiased estimators of the health impact on grandparent caregivers.

Besides the concerns about internal validity described above, many earlier studies on grandparent caregivers used only convenience samples and thus lacked external validity to the grandparent population at large. This is a particular a concern for Chinese grandparents since previous studies done in Taiwan all had major weaknesses [Liu, 2001; Chi, 2004; Lo and Liu, 2009]. All relied on cross-sectional data of convenience sampling from a specific locality in Taiwan, and two of the three studies did not include a control group of non-caregiving grandparents [Liu, 2001; Chi, 2004]. Given the limitations with existing studies, this dissertation seeks to address external validity by using a nationally representative longitudinal sample of Taiwanese elderly to investigate the health impact on grandparent caregivers.

2.3 Culture and its impact on grandparent caregiving

Culture, which has numerous definitions, was referred to as "a group's way of life" by

Aranda and Knight in their Sociocultural Stress and Coping Model for caregivers [Aranda and Knight, 1997]. According to this model, people of the same culture are members of a group sharing the same values, beliefs, or traditions that influence the stress and coping process experienced by caregivers and, ultimately, affect caregiving health outcomes [Aranda and Knight, 1997]. A focus on ethnicity and culture has been proposed for research seeking to explain the differences in caregiving health outcomes among different ethnic groups [Knight and Sayegh, 2010]. Although this dissertation does not include samples from two cultures, the concepts of the Sociocultural Stress and Coping Model provide the framework to guide this current study and support formulation of study hypotheses that will be discussed in Chapter 3.

Grinstead and colleagues, in their extensive literature review, concluded that more diversity in study populations is needed to advance our knowledge about the health of caregiving grandparents since existing studies consisted primarily of grandmothers in the US [Grinstead et al., 2003]. A review of the literature published either in Chinese or English identified only three previous studies that looked at Taiwanese grandparents' health in association with caring for grandchildren [Liu, 2001; Chi, 2004; Lo and Liu, 2009]. Not only is the literature on the health of grandparent caregivers limited in Taiwan, no published study on this specific topic was found from the PRC. However, a few studies examined the relationship between intergeneration social support and the health status of Chinese elders in the PRC [Liu et al., 1995; Chen and Silverstein, 2000; Silverstein et al., 2006]. When we expanded our search of literature to grandparent caregiving in other East Asian countries that share a similar value system from the Confucian tradition [Kim et al., 1999], we only identified two additional studies which interviewed Asian-American grandparents who cared

for their grandchildren, although the health impact of caregiving was not their main research question [Yoon, 2005; Kataoka-Yahiro, 2010]. Table 2.1 provides a summary of these eight studies on the health of caregiving grandparents of East Asian cultures.

The three previous studies on Taiwanese grandparents' health in association with caring for grandchildren did not reach similar conclusions in their findings [Liu, 2001; Chi, 2004; Lo and Liu, 2009]. Liu's study (2001) focused on the quality of life of 318 grandmothers caring for grandchildren six years old or younger and concluded that the sample reported above average quality of life scores. Chi's study (2004), which included only grandparent caregivers in skipped-generation household (SG) households using purposive sampling (n=321), found that caregivers reported poor health status as measured by the SF-36 scale. Finally, the study by Lo and Liu, which was the only study to include a control group of non-caregivers, reported no statistically significant differences in measures of quality of life or depression between the caregiver (n=45) and non-caregiver groups (n=48) [Lo and Liu, 2009]. However, that study was likely to suffer from low statistical power as a result of its small sample size. In addition to varied findings, prior studies were limited in terms of the rigor of their study designs due to the use of cross-sectional data from a specific locality in Taiwan.

Evidence from the surveys conducted in China highlighted the role of intergenerational reciprocity in studying the physical and psychological well-being of Chinese elderly population. For example, living with both children and grandchildren was found to be positively associated with better life satisfaction among Chinese elders [Silverstein et al., 2006]. The instrumental support provided by the elderly also had a positive association with their psychological well-being [Chen and Silverstein, 2000]. Although the authors in that

study defined their measure of instrumental support to include both housework assistance and baby-sitting, the positive results seemed highly relevant to the effects of grandparent caregiving, given that no other study was found on the exact topic of caregiver's health.

Another lesson learned from previous studies on Chinese grandparents was that receiving financial support from children improves the outlook of elderly parents in the PRC [Chen and Silverstein, 2000], and intergenerational transfer was closely related to caring for grandchildren. Silverstein and colleagues in their Anhui Province study found that living in a skipped-generational household was positively associated with grandparents' well-being relative to those living alone [Silverstein et al., 2006]. Interestingly, the authors argued that the primary reason why living in a skipped-generation household was psychologically beneficial to grandparents was due to the remittances received from their absent adult children as a time-for-money exchange for their caring for the grandchildren. This finding suggests that analysis of Chinese grandparents should control for the receipt of financial transfer due to its potential effect as a moderator between caregiving and caregiver's well-being.

In a study of Chinese- and Korean- American grandparent caregivers in New York City, Yoon described this population as extensive caregivers providing day care to grandchildren while both parents were at work [Yoon, 2005]. Although this study did not directly examine the health impact on caregivers, when asked about major problems with caregiving, 34% of the grandparents reported having health problems which might affect their caregiving. In another study of Filipino American grandparents, the author reported similar finding that the grandparents provided extensive care to grandchildren and viewed their roles as a normal expectation rather than a burden [Kataoka-Yahiro, 2010]. This exploratory study of 47

Filipino American grandparents collected data on perceived health status and found that role satisfaction was a significant predictor of perceived health among caregivers. On the other hand, this study did not find a significant association between role stress with perceived health among this group of caregivers.

2.4 Conclusion

While this comprehensive literature review discusses many aspects in the research on the health of grandparent caregivers, this dissertation does not address all issues identified in the literature. Considering both the scarcity and the exploratory nature of the existing studies on grandparents of East Asian cultures, this dissertation seeks to contribute to our understanding of the effects of caring for grandchildren on the health of grandparents in the following areas: (1) to strengthen internal validity through a longitudinal study design with control groups, (2) to reduce selection bias by applying econometric methods, (3) to improve external validity by using a national representative sample, and (4) to establish evidence from a less studied culture, specifically the Taiwanese grandparent population.

Table 2.1 Review of the literature on the health of grandparent caregivers of East Asian cultures

Author (year)	Study population	Study design	Health outcomes	Key finding
Taiwan				
Liu (2001)	320 grandmothers caring for grandchildren aged 0-6 in Hualien County.	Single-group cross-sectional study; systematic sampling from telephone book	Quality of life (WHOQOL-BREF Taiwan version)	Caregivers reported above than average quality of life score
Chi (2004)	321 SG caregivers whose grandchildren were in junior high schools in central Taiwan	Single-group cross-sectional study; Purposive sampling	Health status measured by SF-36	Caregivers reported low level of health status
Lo and Liu (2009)	45 grandparent caregivers and 48 non-caregivers at least 60 years old in southern Taiwan	Cross-sectional; Convenience sampling	Quality of life and Depression measured by SF-36	No significant difference in quality of life or depression by caregiving status.
China				
Liu et al. (1995)	Elders in the 1991 Survey of Health and Living Conditions of the Aged Persons in the Wuhan province	Cross-sectional; Probability sample	Self-rated health (five-point scale)	Instrumental support provided by the elders had no negative effect on health
Chen and Silverstein (2000)	Persons aged 55 and over in the 1992 baseline survey of the Beijing Multidimensional Longitudinal Study on Aging	Cross-sectional; Probability sample	Psychological well-being measured by PGCMS	Culturally traditional parents benefit more than the less traditional from baby-sitting their grandchildren
Silverstein et al. (2006)	2001 survey of elders living in rural Anhui Province	Cross-sectional; Probability sample	Depression; life satisfaction	Intergenerational co-residence is associated better life satisfaction, but providing instrumental support did not affect depression.
Asian-Americans				
Yoon (2005)	50 Chinese-American and 51 Korean-American grandparent caregivers aged between 46 and 81 in New York City	Single-group cross-sectional study; Convenience sampling		34% of the grandparents said they had physical health problems as a major problem they face with caregiving
Kataoka-Yahiro (2010)	47 Filipino American grandparents providing extensive caregiving to their grandchildren.	Single-group cross-sectional study; Convenience sampling	Perceived health status measured using the Cantril Ladder	Role satisfaction was a significant predictor of perceived health among caregivers

SG: skipped-generation household; SF-36: 36-item short form health survey; PGCMS: the Philadelphia Geriatric Center Morale Scale

CHAPTER 3. RESEARCH DESIGN AND METHODS

3.1 Overview

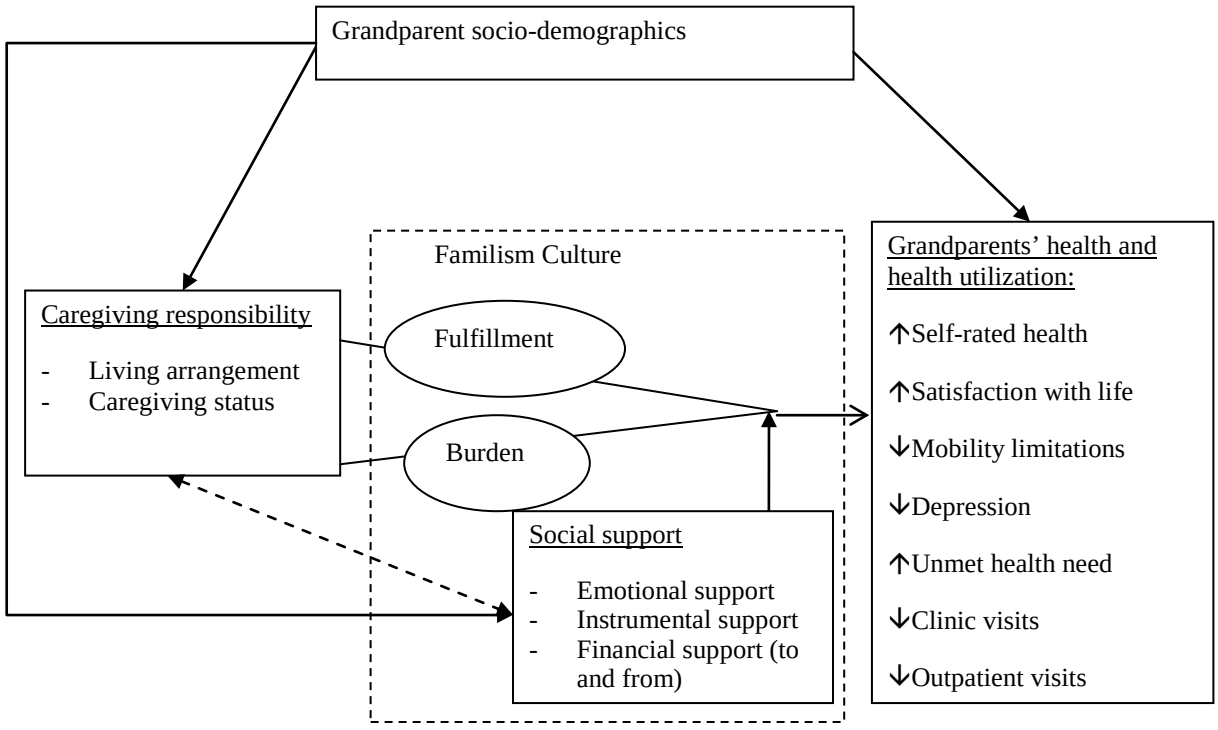
The three manuscripts in Chapter 4 to 6 each investigate part of a broad research question on the health impact of caring for grandchildren among Taiwanese grandparents. This chapter provides an overview of the research design and methods used in these three papers, with some repetitions in the methods sections in each of these chapters. All three papers shared the same data source but used different analytical models. Chapter 4 examines the health effects of caring for grandchildren using FE methods to control for selection from time-invariant unobserved person-level variables. Chapter 5 uses the IV estimation approach to estimate the health effect of grandparent caregiving by addressing the concern of reverse causality from health to caregiving. Chapter 6 investigates whether caregiving transition and continuity have different impacts on caregivers' health and health services use among Taiwanese grandparents. While the three studies examined common outcome variables, the major difference was in the main explanatory variable of grandparent caregiving. Each study analyzed different dimensions of caregiving, such as household living arrangement and transitions in caregiving to examine differential impacts associated with caregiving.

3.2 Conceptual framework

The conceptual model guiding empirical analysis is presented in Figure 3.1. While previous research has shown both positive and negative effects associated with grandparent caregiving, most existing studies have focused on the negative consequences by citing

Pearlin's Stress Process Model of Caregiving [Pearlin et al., 1990]. In this model, which was originally proposed for family caregivers for persons with dementia, caregiving leads to high levels of burden and is viewed as a stressor. The burden and stress associated with fulfilling these demands have been strong predictors of depression and self-rated health [Musil and Ahmad, 2002]. However, one major difference between grandparent caregivers and other type of family caregivers is that the grandchild care recipient is usually young and healthy. This means that caregiving could bring a more positive outlook for a grandparent caregiver instead of observing the decline of a loved one. Furthermore, the Sociocultural Stress and Coping Model [Knight and Sayegh, 2010] highlights the influence of cultural values and offers a better framework for the study of Taiwanese grandparents.

Figure 3.1 Conceptual model of grandparent caregiving and grandparents' health



According to Knight and Sayegh's model, caregivers may appraise their responsibilities differently based on their cultural values and receive different levels of social support within different cultural environments, and thus may experience different outcomes as a result of caregiving [Kim, 2005]. For example, many studies of adult children caring for old parents among Asian populations have focused on the cultural value of familism. Familism is defined as a strong identification and solidarity of individuals with their family [Knight and Sayegh, 2010]. Although this dissertation does not include a cross-culture comparison, we expect that caring for grandchildren can contribute to better health outcomes for the caregivers by fulfilling a culture norm in the Taiwanese society.

While caregiving in practice could have both positive and negative effects on the health of grandparents, it is the net of those two opposing effects that will be estimated empirically. Given that grandparents are faced with both fulfillment and burden from their roles as caregivers, this study argues that caregiving in the Chinese cultural context is likely be beneficial for grandparents' physical and mental health.

Our hypotheses related to caregivers' health services use are somewhat different from the health outcomes discussed above. Caregiving, on the one hand, may allow the grandparents less time to go the doctor, which in turn reduces health services utilization and possibly increases unmet health needs. However, if caring for grandchildren actually makes the grandparents healthier, then they may also feel less of a need to see the doctors and have less outpatient use. Therefore, the effect we were able to estimate empirically in this study would also be the net of those two opposing effects.

In addition to the main relationship between caregiving and caregivers' health, the conceptual model also includes the role of social support. Previous studies in the PRC

reported evidence of how intergenerational exchanges of social support have a positive impact on the elderly's mental health [Chen and Silverstein, 2000; Silverstein et al., 2006]. In the current study of Taiwanese grandparents, three types of social support were considered as factors between grandparent caregiving and caregivers' health. Because it is common for Chinese grandparents to receive financial support from their adult children as a "time-for-money-exchange" for their assistance with grandchild care [Silverstein et al., 2006], financial support must be controlled for in the analysis to distinguish it from the effect of caregiving on caregivers' health. However, since the relationship between social support and caregiving decision can be jointly determined (as depicted by the two-way dotted arrows in Figure 3.1), using potentially endogenous social support measures in estimating the effect of caregiving on caregivers' health may result in biased estimates at the effect of caregiving on health. Although this study does not model the relationship between grandchild care and social support directly, in our analysis we assess this potential bias by estimating our models with and without including social support variables as explanatory variables.

Finally, by controlling for grandparents' socio-demographics, this study accounts for observed individual characteristics that the existing literature has found to affect the relationship between grandchild care and grandparents' health. One key factor to consider is the baseline physical and mental health status of the respondent since it is crucial to separate the health impact of caregiving from the underlying health conditions of grandparent caregivers that may affect their decision to provide care to grandchildren. The use of person-level fixed effects will control for these factors as well as all other time-invariant person characteristics.

3.3 Data source

Data for this study come from the Survey of Health and Living Status of the Elderly in Taiwan, also known as the Taiwan Longitudinal Study on Aging (TLSA), and the original datasets were provided by the Bureau of Health Promotion, Department of Taiwan. It is part of a multi-year collaborative project between the University of Michigan Population Studies Center and the Bureau of Health Promotion, Department of Health Taiwan (formerly known as Taiwan Provincial Institute of Family Planning) [Hermalin et al., 1998]. The first wave of the survey was conducted in 1989 using a three-stage equal probability sampling design [Hermalin et al., 1998]. The first sampling stage consisted of a sample of 56 administrative units (referred to as townships) from 331 townships excluding areas of aboriginal populations. Blocks (*lins*) in the selected townships served as clusters and were selected with probabilities proportional to their size in the second stage. In the third stage, two eligible respondents were selected by systematic random sampling from each selected block. Although there was no explicit rule of selecting one respondent per household in the TLSA sampling, given that only two individuals were randomly selected from the address register in each block, the principal investigator A.I. Hermalin confirmed that it was highly unlikely to have more than one person interviewed upon selection from the same household (Personal email communication, September 24, 2010).

The design of the TLSA yielded a final sample that represented the entire Taiwanese population aged ≥60 in 1989. Follow-up interviews with the same respondents were done in 1993, 1996, 1999, and 2003. Since the survey questions on grandparent caregiving first appeared in 1993, this study used four waves of data from 1993 until 2003, which was the

latest wave available at the time of our data application in January, 2009[1]. One important strength of this longitudinal survey was its high response rates that varied between 79% to 91% during the study period (see Table 3.1 for details). Table 3.1 also shows sample attrition by cohort which is defined by the respondents' age groups. A second birth cohort drawn from the population aged 50-66 was added in 1996, and a third birth cohort aged 50-56 was added in 2003 to replenish the sample and keep it representative of the Taiwanese population aged 50 or above [Bureau of Health Promotion, 2003]. The sample size used in our study is different from the numbers shown in the Table below due to other exclusion criteria to be discussed in the next section.

Table 3.1 Sample attrition and response rates of TLSA

Waves	**Cohort**	**Persons Interviewed**	**(age)**	**Persons deceased[1]**	**Non-response**	**Response Rate (%)**
1993	1	3155	(64+)	587	312	91.0
1996	1	2669	(67+)	1047	333	88.9
	2	2462	(50-66)	9	570	81.2
1999	1	2310	(70+)	1486	253	90.1
	2	2130	(53-69)	110	222	90.6
2003	1	1743	(74+)	2133	173	91.0
	2	2035	(57-73)	253	174	92.1
	3	1599	(50-56)	4	423	79.1
Source	Taiwan Bureau of Health Promotion (2006)					
Notes: Rows shaded gray mark each cohort's entry to our study sample [1]Persons deceased were excluded in response rate calculation						

The TLSA dataset does not provide information on survey strata or clusters due to its random sampling design described above, but it provides sample weights to adjust for different selection probabilities of different cohorts entering the survey. Because the selection rates used for both cohorts 2 and 3 were lower than for cohort 1, for descriptive analysis

[1]The latest TLSA wave of 2007 was released in July, 2010

which included all three cohorts, we used the weights by wave as provided in the instructions to TLSA data users (Table 3.2). The weight variables displayed below are normalized to have a mean of 1.0, and unlike many other surveys, the simplified weight provided in the TLSA does not equal to the inverse of sampling fraction, nor does the weight adjust for survey non-response rate [Bureau of Health Promotion, 2007]. Although these weights do not correct for sample attrition, they were the best information available to make TLSA sample representative of the elderly population in Taiwan.

Table 3.2 Survey weights for combined cohort analysis in TLSA

Year	Cohort (age)	Sample size	Weight
1996	1 (67+)	2669	0.64
	2 (50-66)	2462	1.4
1999	1 (70+)	2310	0.64
	2 (53-69)	2130	1.4
2003	1 (74+)	1743	0.48
	2 (57-73)	2035	1.25
	3 (50-56)	1599	1.25

Source: Taiwan Bureau of Health Promotion (2006)

One important strength of the TLSA is that it contains very rich data on the elderly respondents as well as their adult children and other household members. These data allow us to identify living arrangement patterns for each of the three generations. They also provide an opportunity to create other family-level variables at the adult children level that could be used as instrumental variables (see Section 3.5.4) for our analysis. A limitation of this dataset, however, is the lack of full comparability of all survey questions across waves. In other words, despite being a panel study, changes in different part of the questionnaires occurred in different years could limit the usefulness of some key variables due to changes in measurement. We will discuss how this problem pertains to the construction of our study variables in Section 3.5 Variable Definition.

3.4 Sample selection

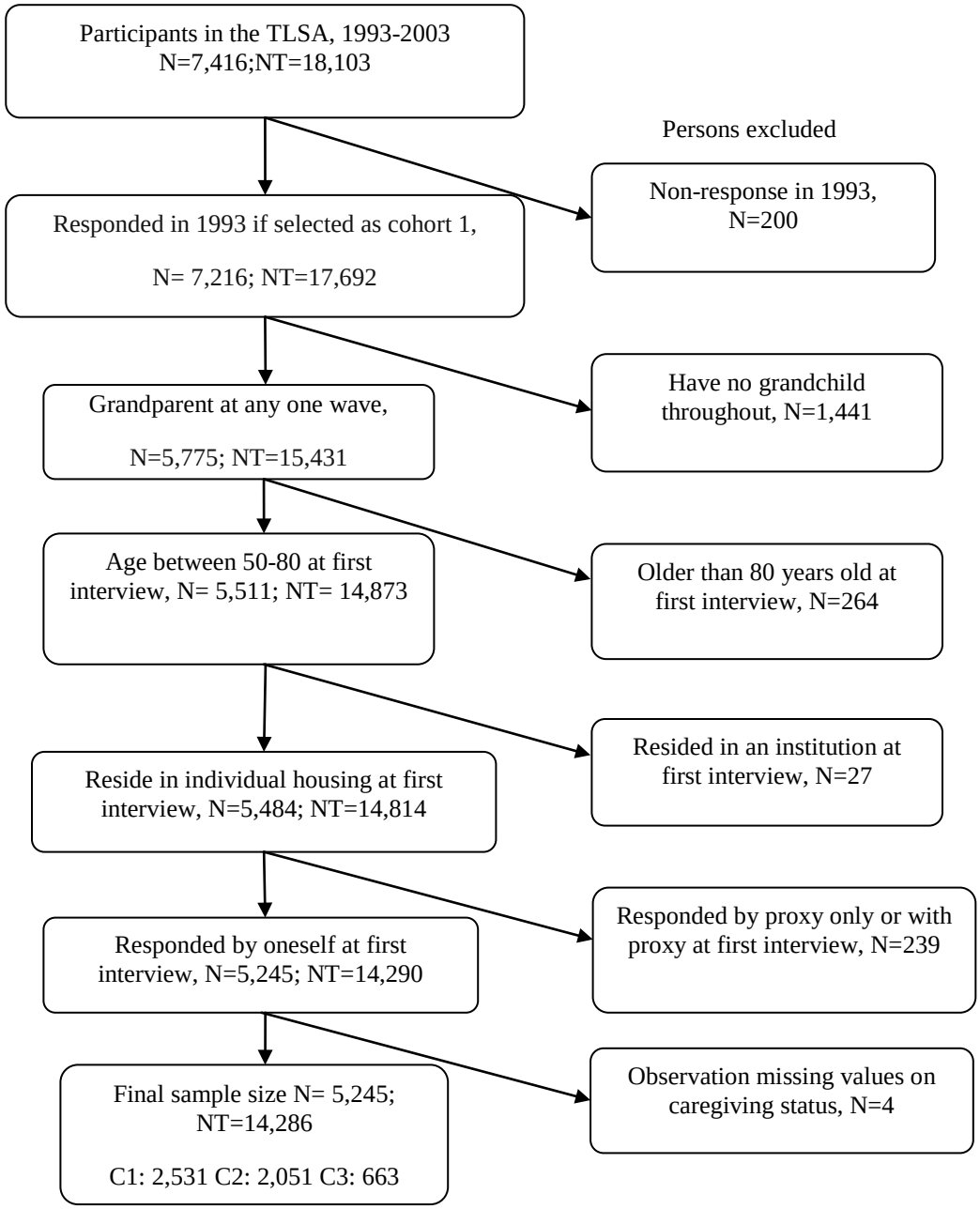
The analytical sample selected for this study included three cohorts of grandparents aged 50 and above from four waves (1993-2003) of the TLSA panel that included the survey questions on grandparent caregiving. Inclusion criteria used in sample selection for this analysis were that the sample person must be:

1) a respondent in 1993 if they were in Cohort 1 of the survey;
2) a grandparent in at least one of the four survey waves;
3) between 50 and 80 years old at the initial survey;
4) living in a non-institutional setting at the initial survey; and
5) a respondent (i.e., no proxy response) at the initial survey.

Figure 3.2 shows the selection of our sample from the pooled TLSA sample of 7,416 people to the final analysis sample of 5,245 people. There were 200 persons who were first interviewed in 1989 but were missing in the 1993 survey; since the 1993 survey was used as the baseline for cohort 1 in our study, we excluded those people even though they may have responded in later waves. The second and the main inclusion criterion we used was to limit our sample to those who had at least one grandchild in any wave of the survey; 5,775 people were identified as grandparents. We then excluded 264 people in the oldest cohort (cohort 1) due to exceeding the age limit of 80 in 1993. The upper age limit was applied since the oldest old are much less likely to have young grandchildren who need to be cared for, and also are more likely to have health problems not attributed to caregiving [Hughes et al., 2007; Lin, 2009]. Persons who resided in an institution or those who responded by proxy at their initial interview during the study period (e.g., 1993 for cohort 1, 1996 for cohort 2 and 2003 for cohort 3) were excluded for reasons similar to those described above. However, persons who

lived in the community at baseline but subsequently moved into institutions or responded by proxy during follow-ups remained in the sample. After excluding observations with missing values on caregiving status, our final study sample contained a total of 5,245 grandparents from three cohort groups with a total of 14,286 person-wave observations.

Figure 3.2 Study sample flow chart



N: Number of unique persons; NT: Number of person-year observations; C: Cohort

3.5 Variable definitions

Study variables with their definitions and types are summarized in Table 3.3. Details on variable construction are discussed in separate sections below.

Table 3.3 Summary of study variables

Variables	Definition/Measure	Type
Dependent variables		
Self-rated health	1. Poor 2. Not so good 3. Average 4. Good 5. Excellent	Ordinal (1-5)
Satisfaction with life	A summary of yes/no responses to 4 questions ranging from 0 (least satisfied) to 4 (most satisfied)	Ordinal (0-4)
Functional limitations	1. Stand continuously for 15 minutes 2. Squat 3. Raise both hands over your head 4. Grasp or turn objects with your fingers 5. Lift or carry something weighing 11-12kg 6. Run a short distance (20-30 meters)	Count (0-6)
Depression	A summary score of 10 CES-D items ranging from 0 to 30.	Continuous
Unmet health needs	Did not go to see a doctor despite feeling ill? Yes/ no	Binary
Frequent clinic visits	Had ≥3 visits to a Western medical clinic in the past month	Binary
Frequent outpatient care use	Had ≥4 visit to any of the following three service provider in the past months: Western medical clinics, Chinese medical clinics, or pharmacies.	Binary
Key explanatory variables		
Grandchild care status*		
By living arrangement (Chapter 4)	1. Non-caregivers 2. Multigenerational household caregivers 3. Skipped-generation household caregivers 4. Babysitters	Categorical
By current status (Chapter 4)	1. Never-caregivers 2. Current caregivers 3. Former caregivers	Categorical
By experience (Chapter 5)	1. Never-caregivers 2. Ever-caregivers	Binary

Variables	Definition/Measure	Type
By change in status (Chapter 6)	1. Started care, 2. Stopped care 3. Continued care 4. No care	Categorical
Instrumental variables		
No. of adult children ever-married	Total number of adult children who are either married/divorced/separated/widowed	Continuous
No. of grandchildren	Total number of grandchildren one has	Continuous
Other explanatory variables		
Sociodemographics		
Age groups	50-59, 60-69, 70-79, 80+	Categorical
Gender	Male, female	Binary
Ethnicity	Fukianese, Hakka, Mainlander and other ethnicity	Categorical
Education level	Illiterate, no formal education but literate, primary school, middle school and above	Categorical
Marital status	Married vs. not currently married (divorced/separated/widowed/single)	Binary
Work status	Currently working or not	Binary
Economic status	1.Have great difficulty paying monthly living expense 2.Have a little difficulty paying monthly living expense 3.Have enough money 4.Have plenty of money	Categorical
Location	Urban, rural	Binary
Coresident with adult child	Have at least one adult child living in the household	Binary
Social support		
Emotional support	1 Very satisfied 2. Satisfied 3. Average 4. Unsatisfied 5.Very unsatisfied	Categorical
Received support in household chores	Yes, no	Binary
Provide financial support to adult children	Yes, no	Binary
Receive financial support from adult children	Yes, no	Binary
Chronic disease indicators		
Health conditions	1.High blood pressure	Binary

Variables	Definition/Measure	Type
	2.Diabetes 3.Heart disease 4.Stroke 5.Cancer 6.Bronchitis, pneumonia, or other respiratory ailment 7.Arthritis or rheumatism 8.Gastric ulcer 9.Liver or gall bladder disease	

*Table 3.5 provides more details on construction of this measure

3.5.1 Dependent variables: Caregiver health outcomes

We examine four health outcome variables covering both the physical and mental health of grandparents. These four outcomes were grouped into two measures of good health and two measures of poor health. These measures were selected based on findings from the literature as well as data availability. The two measures of good health were self-rated health and satisfaction with life. Previous research has found that self-rated health is strongly related to other more objective measures of health status, such as physical exams, as well as many health criteria ranging from chronic, functional, to emotional status [Atchley, 1997]. Life satisfaction was selected not only based on previous literature [Bowers and Myers, 1999; Szinovacz et al., 1999; Silverstein et al., 2006], but because it could capture the potential benefit of caregiving.

Functional status is another key indicator of health status. Although this indicator usually measures the degree of limitation people have in carrying out activities of daily living (ADLs), in this study mobility limitations were selected as a measure of poor health instead of ADLs following the work of Hughes and colleagues [Hughes et al., 2007]. We argue that mobility limitation can better capture the health consequence of caring for grandchildren than

the degree of frailty which is at the core of ADLs. In other words, a grandparent with many ADL limitations seems a less likely candidate for the task of caring for grandchildren. The second measure of poor health was depression. Although depression is the most widely studied mental health outcome in the literature on grandparent caregiving [Grinstead et al., 2003], the available data from most surveys (including TLSA) are self-reported depression symptoms, rather than clinically-defined depression disorder indicators.

The following paragraphs discuss how we define each measure using survey responses:

Self-rated health

Self-rated health is measured using a 1-5 ordinal scale on the following question:

> "Regarding your state of health, do you feel it is: excellent, good, average, not so good, or poor?"

Satisfaction with Life Scale (SWLS)

The measure of satisfaction with life was adopted from the Life Satisfaction Index A (LSIA) [Neugarten et al., 1961]. The original LSIA consisted of 20 items asking whether the respondents agreed or disagreed with the attitude statement, but the SWLS used in this survey included different numbers of items in different survey waves. Table 3.4 compares the changes in SWLS items across survey year. We selected the 4 items used in 1993 to be the basis for measuring life satisfaction in this study. For each of the four questions below, the respondent was asked about whether he or she agreed or disagreed with the sentence on feeling about life, and each "yes" response was counted as a 1 and a "no" was a 0. We then created a summary score of SWLS ranging from 0 (least satisfied) to 4 (most satisfied).

1) Has your life been better than most people's lives?
2) Have these few years been the best in your life?
3) Do you expect that in the future happy things will occur?
4) Are you satisfied with your life?

Mobility limitations

The TLSA asked respondents about their mobility function using items adapted from the Nagi scale [Nagi, 1976]. Due to variations in the number of scale items surveyed across waves, we chose the common six tasks that were available from 1993 to 2003. For each of the six items below, respondents were asked to choose among one of the following four responses: whether they had no problem, had some difficulty, had great difficulty, or were unable to perform the tasks.

1) Stand continuously for 15 minutes
2) Squat
3) Raise both hands over your head
4) Grasp or turn objects with your fingers
5) Lift or carry something weighing 11-12kg
6) Run a short distance (20-30 meters)

We considered it a mobility limitation if a respondent had some or more difficulty performing the specific functional task. We then aggregated the six items to obtain the total number of mobility limitations with a score of 6 indicating the greatest degree of limitation.

Depression

Depressive symptoms were measured using a 10-item Chinese version of the original 20-item Center for Epidemiological Studies Depression (CES-D) Scale [Radloff, 1977], which has been validated in cross-cultural studies including Chinese populations [Krause and Liang, 1992; Ofstedal et al., 1999]. For each of the ten questions below, respondents were asked to rate the frequency of their experience on a four-point scale.

In the past week, have you experienced the following situations or feelings?

1) Not interested in eating, have a poor appetite

2) Feel that doing everything was exhausting
3) Sleep poorly (Unable to sleep soundly)
4) Feel you were in a terrible mood
5) Feel lonely (isolated, with no companion)
6) Feel people around you weren't nice to you (unfriendly)
7) Feel anguished
8) Unable to gather your energy to do things (Had no will to do anything)
9) Feel joyful
10) Feel that your life was going well"

Frequency response items:
⓪No
①Rarely (one day)
②Sometimes (2-3 days)
③Often or always (over 4 days)

Since the ninth and tenth questions listed above ask about positive affect, their response options were coded in reverse order. We then summed up the scores of frequency response from all ten questions to get a total score ranging from 0 (not depressed) to 30 (most depressed). A score of CES-D scale ≥ 10 indicates probable clinical depression [Andersen et al., 1994].

3.5.2 Dependent variables: Caregiver health services utilization

In order to evaluate whether the demand of caregiving for grandchildren resulted in a reduction in the elder' own health services use [Roe et al., 1996; Baker and Silverstein, 2008], this dissertation examined outpatient utilization because it is the most common and accessible form of health services in Taiwan and should also be a more sensitive measure than hospitalization. Since lower healthcare use may or may not be beneficial for the grandparents, we also included a measure of "unmet health needs" to address that question about implication.

Unmet health needs

We used a discrete measure of whether a person has any unmet need in health care based on the response to the following question:

> "In the past three months, have you been in discomfort and thought about seeing a doctor but didn't go?"

Frequent clinic visits

Regarding office visits, the TLSA asked the respondents "In the past month, have you ever been to a Western medical clinic (excluding hospitalization or emergency unit)?" and for those whose reply was positive, the next question was "how many times have you ever been there?"

Although we intended to use the number of visits as a continuous measure, the response category of "too many to recall" was added only in 1996. Since this option resulted in an increase of outlier responses that accounted for 8% of all responses in that wave, we chose to dichotomize this measure. Because our goal was to determine whether caregiving leads to excessive health services use rather than any utilization, we dichotomized this measure using a cutoff of three visits per month to identify frequent use. The distribution of this variable showed that while 40% had no visit, 36% had at least two visits, and 21% had at least three visits per month. All those who replied with "too many to recall" were combined with others who reported at least three visits in the past month to a category and coded as one for frequent clinic visits.

Frequent outpatient care use

Regarding outpatient care use, the TLSA asked similar questions about monthly utilization in two other outpatient settings besides a Western medical clinic: visits to a

Chinese medical clinic and visits to a pharmacy. Instead of examining each setting separately, we chose to combine them together for the following two reasons: First, our initial analysis showed that while almost 60% of the respondents reported using a Western medical clinic, only 12% made a visit to a Chinese medical clinic in the past month of the survey. Secondly, the measure of pharmacy visit does not capture the full picture of prescription drugs in Taiwan's healthcare system, because in Taiwan all medical clinics are allowed to hire on-site pharmacists to dispense prescription drugs in addition to community pharmacies [Chang, 2009]. Given that each of these three measures alone represented only part of outpatient service/ drug utilization, we added all outpatient care visits together to create a broad measure of access to outpatient care services in Taiwan. We also dichotomized this variable for similar reasons discussed above to identify frequent use of outpatient care. The distribution of this variable showed that while 29% had no outpatient use in the past month, 33% had at least three visits, and 25% had at least four visits. A value of one on this variable indicated the elder had at least 4 outpatient visits in the past month.

Table 3.4 Satisfaction with Life Scale (SWLS) items in TLSA, 1993-2003

Wave		1993		1996		1999	2003
SWLS	1	Has your life been better than most people's lives?	1	Has your life been better than most people's lives?	1	Same 1-10 items except reverse wording in (5), added 11-12	Same 12 items as 1999
	2	Have these few years been the best in your life?	2	Are you satisfied with your life?	2		
	3	Do you expect that in the future happy things will occur?	3	Do you find what you do interesting?	3		
	4	Are you satisfied with your life?	4	Have these few years been the best in your life?	4		
			5	If it was possible (to do again or to do over) , would you NOT willing to change your past?	5	If it was possible (to do again or to do over) , would you want to change your past?	
			6	Do you expect that in the future happy things will occur?	6		
			7	Should you live better than you do now?	7		
			8	Do you feel that most of what you do is monotonous and of no interest?	8		
			9	Do you feel old and tired?	9		
			10	Would you say your life has matched your hopes?	10		
					11	Do you feel that you live in a safe environment?	
					12	Are you satisfied with your living environment (considering pollution, climate, noise, natural scenery…)?	

3.5.3 Key explanatory variable: Grandparent caregiving

Rather than treating grandparent caregiving as a simple dichotomous measure, we explored four different ways to classify grandparent caregiving by combining information with other factors. In our first study (Chapter 4) we defined grandparent caregivers in two ways, first by using information on the elder's living arrangement and secondly by history of caregiving. The first classification by living arrangement consists of the following four types: caregivers in (1) multigenerational (MG) households, (2) skipped-generation (SG) households in which the grandparents do not live with the adult children who are the parents of the grandchildren they help caring for, (3) babysitters in situations where the grandparents do not reside with the adult children or grandchildren, or (4) non-caregivers. We chose this refined measure of grandparent caregiving since previous studies have shown the importance of distinguishing between grandparents who are the primary caregivers from those who are babysitters [Minkler and Fuller-Thomson, 2001; Hughes et al., 2007].

The four categories of grandparent caregiving status were formed from yes/ no responses to three sets of survey questions on whether the respondent helped care for grandchildren and whether he or she lived with either the adult children or the grandchildren generation (Table 3.5).

Table 3.5 Living Arrangement and Grandparent Caregiving Status

	Types of grandparent caregiving status			
Survey questions	MG caregivers	SG caregivers	Babysitters	Non-caregivers
(1) Do you currently provide assistance to babysit your grandchild(ren) of adult child __?	Yes	Yes	Yes	Yes/ No
(2) Do you live with adult child __?	Yes	No	No	No
(3) Do you have a grandchild in the household?	Yes	Yes	No	Yes/ No
Yes/ No indicates survey responses used to construct the four categories of grandparent caregiving status				

MG: Multigenerational households SG: Skipped-generation household

The first question was used to separate caregivers from non-caregivers, and the second

question categorized caregivers by co-residence with adult children. The third question further divided caregivers into skipped- generational vs. babysitters, depending on whether the grandchild is living with the grandparent caregivers. Although both the first and the third questions referred to grandchildren , only question (1) defined a grandchild as being below high school age, and our study also used this age restriction in defining grandchild care recipients. For the third question, a discrete measure of "having at least one grandchild in the household" was created by summing the number of household members whom the respondent identified as a grandchild. Although an explicit question of "Do you live with any grandchild?" was included in the TLSA, we chose not to use that response due to a high rate of missing values but instead derived our own measure of coresident grandchildren. That information was also used as a cross-check for caregiving status since by definition any caregivers other than babysitters should be living with their grandchildren despite observed errors in responses.

The first two questions were asked repeatedly to grandparents in relation to each adult child, but for the purpose of our research, we defined the type of grandchild care status per grandparent. As long as the grandparent responded "Yes" in question (1) for one adult child, the respondent is considered a caregiver even if he or she reported "No" when asked about helping with other adult children. Similarly, since a caregiver in a multigenerational household might be caring for more than one grandchild, the grandparent could also meet the definition of a skipped-generational household when the parent of another care recipient was absent. To make the four grandchild care status measure mutually exclusive, we consider grandparent caregivers in multigenerational households to be the dominant category when another caregiving status also applies. This assumption is presumably reasonable given that

the presence of any adult children should in theory provide more support to caregiving grandparents.

In addition to the three survey questions shown in Table 3.5, we used other criteria to ascertain a respondent's grandparent caregiver status. A caregiver must have responded positively to the following three criteria: (1) be a grandparent in the same wave they self-identified as caregivers; (2) have the youngest coresident grandchild at age 18 or younger if only caring for any coresident grandchild; and (3) report the frequency of their caregiving activity as either often or occasionally rather than not responding to the frequency question. Thus, we changed a respondent's caregiving status to being a non-caregiver if they did not meet the above criteria. Among our study sample which includes 5,245 grandparents in at least one of the four survey waves: seven people reported as a current caregiver while never being a grandparent; about 5% of caregivers reported that they lived with only adult grandchildren older than 18; and about 9% of caregivers did not indicate the frequency of their caregiving activity. We decided to use a more conservative definition for grandparent caregiving status since the measure was based on self-report only and the majority of the respondents were non-caregivers.

The second classification of caregivers used in our first study (Chapter 4) divided grandparents into three groups based on history of caregiving: being a (1) current or (2) former caregiver compared to (3) never-caregivers. A current caregiver is defined as being a caregiver in the current survey while a former caregiver does not care for grandchildren in the current wave but did in any previous wave. While the first classification by living arrangement is determined at each wave, the second classification incorporates changes in caregiving status across waves for an individual. This measure allows us to study the effects

of caregiving over time and determine if there is a lagged effect.

In our second study (Chapter 5) we used a single dichotomous measure of caregiving which distinguished those who were ever-caregivers during their time in the survey from others who never had the experience. This dichotomous variable of "ever-caregiving" equals zero for a person for each wave until he or she reported caregiving and then equal to one for all subsequent waves. Those grandparents who reported "No" throughout the entire study period for all adult children were the non-caregiver comparison group.

Although we considered controlling for a measure of intensity of care (e.g., often vs. occasionally) collected in the TLSA, after preliminary analyses we found a strong correlation between being a current caregiver and providing grandchild care assistance often (correlation coefficient>0.85). Thus, in this study we chose to use only the classifications of caregiving status but not the intensity of care measure given that the two variables were presumably measuring similar constructs.

In our third study (Chapter 6) the key explanatory variable is a measure of change in caregiving defined as grandparent caregiving transition status. First, a respondent's caregiving status was ascertained at the first wave in each consecutive person-interval. The person's caregiving status at the second wave is then compared with the measure at baseline to define caregiving transition as follows: (1) those who did not care for grandchildren at one wave but started caregiving by the next wave; (2) those who cared for grandchildren continuously across two waves; (3) those who cared for grandchildren at one wave but stopped by the next wave; and (4) those who provided no care at two consecutive waves. This variable is operationalized as a series of dichotomous variables: started care, stopped care, and continued care, with no care at both waves as the reference category.

3.5.4 Instrumental variables (IVs)

Since selection into caregiving due to one's own health status can be an issue of concern, IVs are used to address the correlation between the observed grandparent caregiving status and unexplained factors affecting health outcomes. The criteria for a good IVs are: (1) they are directly related to the endogenous explanatory variable (i.e., grandparent caregiving), and (2) they have no direct effect on outcome variables (i.e., grandparents' health) but only an indirect effect though its association with caregiving.

The use of IVs has not been documented previously in the literature of grandparent caregiving. We considered several characteristics of the adult children generation to predict grandparent caregiving including the percent of adult children who are males and whether the eldest adult child is a son. Family structure variables have been used successfully in IV models predicting elder parent caregiving [Van Houtven and Norton, 2004; Bolin et al., 2008; Coe and Van Houtven, 2009]. Variables related to gender and marital status of adult children are ideal candidate instruments because filial support in Taiwanese society is characterized by co-residence with the eldest son and their wife [Ofstedal et al., 1999]. However, as we decided to combine IV estimation with control of fixed effects, the analysis required IVs that vary over time. Since the elders were much beyond their childbearing age, variable such as the percent of male adult children were not time-varying unless the death of adult children occurred. Therefore, our final choice of IVs included two time-varying variables: (1) the number of ever-married adult children, and (2) the number of grandchildren in the family. We chose the definition of ever-married (including those who are currently divorced or separated) in defining the marital status of adult children because the likelihood of having any grandchildren will be higher if the adult generation has ever been married. Subsequently,

having more grandchildren is likely to increase a grandparent's likelihood of being a caregiver.

3.5.5 Other explanatory variables

Other variables that are likely to influence both grandparent caregiving and caregiver health outcomes controlled for in our study fall into these three categories: (1) grandparents' socio-demographics, (2) social support for grandparents, and (3) chronic condition indicators and health behaviors of the elders.

Sociodemographic variables include age, gender, ethnicity, education level, marital status, work status, economic status, geographic location, co-residence with adult children, and number of grandchildren. Data on the respondent's age, gender, ethnicity, and education were extracted from a special file of background variables that the TLSA compiled on individual time-invariant characteristics. This file offered a single value on those background variables after correcting for inconsistent response that might occur in a particular wave, and thus is a better source for constructing control variables. Age was measured in years based on the respondent's age reported in the 2003 background file, and then the number of years between each previous wave and the most recent wave was subtracted to obtain a consistent measure of age across the ten year study period. In our analysis age groups start with the youngest of 50-59 years old and increase in decades until the oldest category of age 80 and above. Ethnicity for the three main ethnic groups in Taiwan is categorized as Fukianese, Hakka, Mainlanders and other ethnicity unspecified. Level of education completed consisted of three categories: illiterate, elementary school (including those report being literate without no formal education) or middle school and above (more than 6 years of formal schooling).

While we used the definition of "ever-married" for the adult children generation, a

stricter definition of “currently-married” or “co-habiting” was used for measuring marital status among the grandparent sample for a different purpose. The impact of marital status on the elderly’s health is likely to differ between those currently married vs. those divorced or windowed, and thus the definition of currently-married, is more relevant for the grandparent population [Glei et al., 2005]. Work status is an indicator of whether the respondent is currently employed or not. Economic status is a 3-category variable based on the respondent’s evaluation of whether one had enough income to cover monthly expenses. The bottom category of this variable represents those with any difficulty in making ends meet while the top category includes those who report having plenty of money. Location of the respondent’s current residence is collapsed into rural/ urban difference with urban representing dwelling in small to large cities. Finally, we use an indicator to account for the co-residence of at least one adult child in the household.

Four types of social support representing intergenerational transfers were constructed from survey responses. First, emotional support received by the elderly is defined as “On a scale of 1-5, how satisfied are you with the degree your family members or friends show their concern about you?” Secondly, instrumental support received is based on the question asking whether the respondent is primarily responsible or if he or she has help with household chores. Financial support is defined in two directions: support received from any adult children and support provided by them to the elders. This measure was constructed from the question that asked the respondent to name the relationship with family members who he or she gave money to or received money from in the past year.

We included nine chronic disease indicators that were available in the TLSA from 1993 to 2003 as health-related control variables: high blood pressure, diabetes, heart disease,

stroke, cancer, respiratory ailment, arthritis or rheumatism, gastric ulcer, and liver or gall bladder disease. We did not control for grandparents' health behaviors such as smoking or drinking because they may be jointly chosen with the caregiving decision whereas chronic disease onset is less likely to be affected directly by caregiving. We did not control for health insurance status because all citizens living in Taiwan are covered by the mandatory national health insurance system since 1995 [Bureau of National Health Insurance, 2010]. The last set of variables included in our analysis are a set of wave and cohort dummy variables which accounted for baseline differences in health outcomes among birth cohorts and any time trend effects.

3.6 Analysis plans

3.6.1 Overview of the estimation strategy

To test our hypothesis that caregiving has net positive effects on Taiwanese grandparents, the general structure of multivariate regression model used to estimate the health impact of grandparent caregiving is specified as follow:

$$HO_{it} = \alpha + \beta_1 GC_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (1)$$

where *HO* represents one of the four health outcomes or three health services utilization measures for grandparent *i* at time *t*. Grandparent caregiving status (*GC*), as discussed in Section 3.5.3**,** is classified in four different ways depending on the research question for each study. *X* is a vector of other explanatory variables including sociodemographic and social support of the grandparents, and ε is the error term. The coefficient β is of main interest as it represents the effect of grandparent caregiving under various classifications. While grandparents may experience both the positive and negative aspects of caregiving, what we are able to estimate empirically is the net of those two opposing effects. We expect the net

effect estimate β to be positive for favorable health outcomes such as self-rated health and negative for unfavorable health outcomes such as mobility limitations because we hypothesize that on average, health improvement will be found among Chinese grandparent caregivers.

Our hypotheses related to caregivers' health services follow the literature on grandmothers' preventive health behaviors which identified two opposing factors that influence the utilization of health services by caregivers [Baker and Silverstein, 2008]. Caregiving, on the one hand, may allow the grandparents less time to go the doctor, which in turn reduces health services utilization and possibly increases unmet health needs. However, if caring for grandchildren leads to health improvement for the caregivers, then they will have both less outpatient use and lower unmet health needs. Once again, the effects of grandparent caregiving on health services use being estimated are the net effects. We hypothesize that β is negative since caregiving is likely to lower grandparents' health services use but is positive for unmet health needs since caregiving is likely to reduce an elder's time for self-care.

Finally, all models used clustering by individual to adjust standard errors for correlations between repeat observations of the same respondent over time.

3.6.2 Testing for and controlling for selection into caregiving

The estimation strategy for the equation specified above depends on the type of outcome measures examined as well as concerns of caregiver selection. We use ordinary least squares (OLS) regressions in all four measures of caregivers' health status, which are called linear probability models (LPM) for dichotomous dependent variables of health services use. Although other estimation methods such as ordered logit model may be more appropriate for

the nature of an outcome such as self-rated health, we select the OLS models for the purpose of using fixed-effects (FE) panel data methods [Wooldridge, 2002]. This method controls for person-specific unobserved characteristics that are time-invariant, including baseline health status for each individual when data consist of repeated observations of the same individual. If healthier individuals are more likely to assume the role of grandparent caregivers, the OLS estimates of the effects of caregiving are likely to be biased upward. Thus, the FE model was used to control for unobserved time-invariant variables such as caregivers' baseline health and adjust for this upward selection bias.

Although FE methods provide a way to combat endogeneity by controlling for selection on the unobservable factors that do not change over time, endogeneity remains a concern in estimation when grandparents make their decision about caring for their grandchildren based on their health status. When caregiving and health outcomes are determined simultaneously, there is a concern of reverse causality, and estimates from the OLS models may be biased due to the correlated errors in the two simultaneous equations. Therefore, in addition to FE methods, we employed an IV estimation approach. The first stage equation used in our IV estimation is specified as follow:

$$GC_{it} = \gamma_1 Z_{it} + \gamma_2 X_{it} + \varepsilon_{it} \quad (2)$$

The likelihood of grandparent caregiving (*GC*) is a function of instrument variables (*Z)* and other covariates (*X*). Grandparent sociodemographic and social support variables are also included in equation (1) shown earlier. If the instruments are valid, IV estimation produces consistent estimates of the effect of caregiving on health by correcting for the endogeneity from contemporaneous selection.

We conducted three specification tests to examine the empirical strength and validity of

the instruments. First, we reported F-test statistics from the first-stage regression to evaluate the strength of our IVs. A joint-F-test value greater than 10 implies that the IVs are significantly associated with the likelihood of caregiving. Secondly, we conducted over-identification test to determine whether our IVs were validly excluded from the outcome equation. Finally, we tested for the endogeneity of the caregiving variable by testing the null hypothesis that being a caregiver was not determined jointly with one's current health status. Rejecting this null hypothesis suggests that IV estimation was needed to obtain consistent estimate on the health impact of grandparent caregiving. Results from these specification tests are reported in Section 5.4 in Chapter 5.

Other methodological issues

Among the control variables included in regression models to explain caregivers' heath, measures of social support and co-residence with adult children raise concern of potential endogeneity. For instance, while in our model we controlled for social support assuming they existed before grandparent becoming a caregiver, we also acknowledge a potential bias exists if one's social support changes after the uptake of the caregiver responsibility. Similar to the concern described for the endogenous caregiving variable, the estimated effects of caregiving on caregiver's health may be biased if the measures of social support were highly endogenous in our models. Therefore, as a sensitivity analysis, we estimated reduced form equations by excluding those four measures of social support, and because the results remained largely unchanged to the third decimal point, we decided to keep the social support measures in our final analytical models.

3.7 Descriptive statistics

To provide an overview of the study sample at baseline, bivariate analyses were conducted to identify the main characteristics of grandparent caregivers. To determine differences in grandparent characteristics by caregiving status, chi-square tests were performed for categorical variables and two-sample t test with unequal variances for continuous variables.

Table 3.6 shows summary statistics by grandparent caregiving status using the study sample from the baseline wave of 1993. Among grandparents aged 64 years and older in Taiwan in 1993, about 18% reported being caregivers for their grandchildren (n=454). In the bivariate analysis of health outcomes by caregiver status at baseline, caregivers seem to be healthier than the non-caregivers in all measures. They reported better self-rated health status, higher satisfaction with life, fewer mobility limitations, and higher CES-D score. We did not find the two groups to differ on any of the health services utilization measures.

Next we compare the elders' family characteristics by caregiving status. No caregivers had only adult co-resident grandchildren since our definition of caregivers required that they cared for a grandchild at aged 18 or below. While the survey only collected information on the ages of grandchildren living in the same household with the grandparent, we found that among caregivers, 59.9% of them cared for pre-school aged (≤6 years old) coresident grandchildren. The percentage of grandparents with coresident pre-school aged grandchildren was much lower for the non-caregivers (12.1%). Grandparent caregivers reported a significantly higher number of adult children and ever-married adult children, as well as more grandchildren than the non-caregivers. Caregivers on average had 11.9 grandchildren while non-caregivers had 10.8 grandchildren. However, we did not find the percent of adult

children who were male to differ significantly by grandparent caregiver status. Among those who self-identified as caregivers, the average number of adult children they helped with grandchild care was 1.4. Since the TLSA does not have a direct question on how many grandchildren the grandparents helped care for at one point in time, this estimate of 1.4 suggests that grandparent caregivers provided care to more than one grandchild as well as grandchildren from multiple families. In a separate analysis on the duration of caregiving among the caregivers, we found that on average a caregiver cared for grandchildren for 1.4 waves, which approximates 4.2 years considering the interval between each wave was 3 years. About 68% of grandparents provided caregiving in one wave and 24% provided caregiving in two waves.

A comparison of the pattern of living arrangement between caregivers and non-caregivers showed that caregivers were much more likely to be in a mutigenerational (MG) household than the non-caregivers (80.2% vs. 43.6%). Among those who were caregivers, the majority lived with both the adult children and grandchildren generations followed by those living in skipped-generation (SG) family (8.1%). On the other hand, the percentages of non-caregivers who had no grandchildren in the household (i.e., lived with either adult child only or with spouse only) were much higher than those among the caregivers.

Grandparent social and demographic characteristics also differed by their caregiving status. Grandparent caregivers were more likely to be grandmothers than grandfathers. Since the sample used for this descriptive analysis at baseline only included the first cohort in 1993, there was no grandparent under age 64. Looking at the age distribution of our sample, 60.4% of the caregivers were between age 60 and 69, and they appeared to be significantly younger than the non-caregivers as only 49.1% were younger than 70. As for social support,

caregivers were more likely to report being either satisfied or very satisfied with emotional support from family and friends than the non-caregivers. They were also more likely to receive financial support from their adult children than the non-caregivers.

Because the previous analysis used data for the sample from the baseline survey while our full sample included three cohorts of grandparent with a wide range in age, we examined the associations between grandparents' age and their caregiver status (Figure 3.3). This analysis was performed on the full sample (N=14,286) but did not use sampling weights since the weights were originally devised to adjust for the age distribution of grandparents [Bureau of Health Promotion, 2007] The proportion of non-caregivers among the grandparent sample increased with age, and the increase was offset by a decrease in the number of MG caregivers as age advanced. For instance, 18% of our sample at age 65 were MG caregivers but the proportion dropped to 7% in the older sample at age 75. The proportion of SG caregivers and babysitters in the sample, on the other hand, did not change significantly with age advancement.

3.8 Conclusion

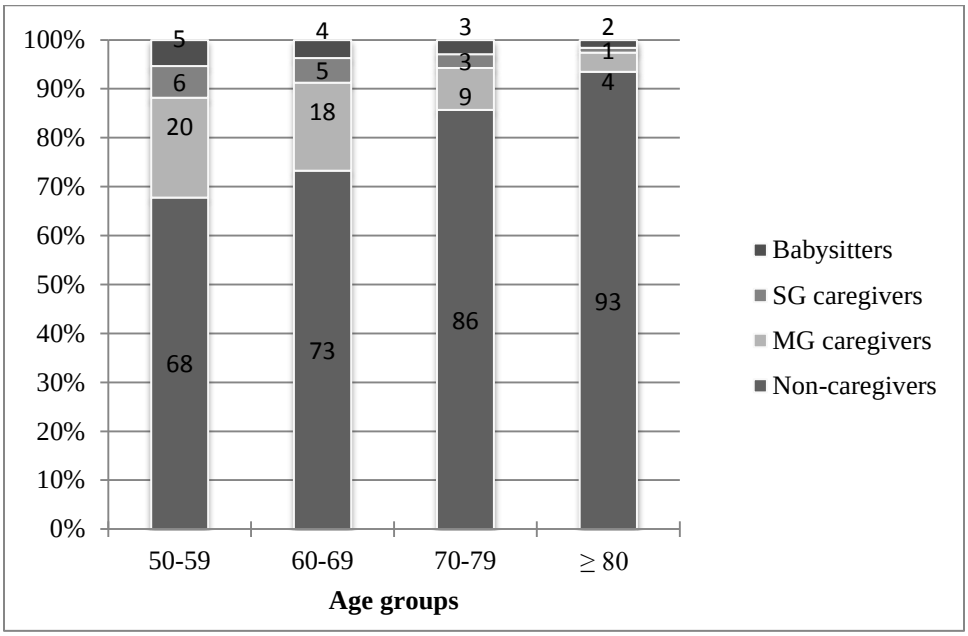
This chapter summarizes the methods used in this dissertation by introducing the conceptual framework, data source, variable constructions, and analysis plan. The next three chapters provide distinct manuscripts addressing the following three research questions:

1) Does caring for grandchildren among Taiwanese grandparents lead to better physical and mental health and lower health services use after controlling for their baseline health status?
2) What is the impact of grandparent caregiving (defined as ever-being a caregiver) in

Taiwan on health and health services use, after controlling for the endogeneity of caregiving and health?

3) Does the transition into caregiving have a bigger impact than continued caregiving on the changes of health and health services use among Taiwanese grandparent caregivers?

Figure 3.3 Distribution of caregiver status by grandparents' age groups



MG: Multigenerational households; SG: Skipped-generation households

Table 3.6 Summary statistics of study sample by grandparent caregiving status, 1993

	Caregiver (n=454)		Non-caregiver (n= 2077)		
Variable	Mean or %	SD	Mean or %	SD	p-value ‡
Health outcomes					<0.001
Self-rated health					
Poor	0.9%		5.4%		
Not so good	16.1%		18.4%		
Average	37.7%		34.6%		
Good	26.2%		23.0%		
Excellent	19.2%		18.6%		
Life satisfaction scale (0-4)	2.6	(1.3)	2.3	(1.4)	0.002
Mobility limitations (0-6)	1.0	(1.3)	1.3	(1.7)	<0.001
CES-D (0-30)	5.9	(5.4)	6.8	(6.0)	0.001
Unmet health need (yes/no)	10.6%		10.4%		0.889
frequent clinic visits (yes/no)	15.5%		18.4%		0.146
frequent total visits (yes/no)	19.4%		21.7%		0.272
Family characteristics					
Only non-coresident grandchild	11.7%		52.9%		
Has minor (<=18) coresident grandchild	88.3%		25.2%		
Only adult (>18) coresident grandchild	0.0%		21.9%		
Has pre-school (<=6) coresident grandchild	59.9%		12.1%		
No. of adult children	5.3	(1.8)	4.7	(2.1)	<0.001
Percent of male adult children	52.5%		51.8%		
No. of adult children ever-married	4.9	(1.8)	4.3	(2.2)	<0.001
No. of grandchildren	11.9	(6.2)	10.8	(7.0)	<0.001
No. of adult children helped with	1.4	(0.7)			
Living arrangement					
Multigenerational household	80.2%		43.6%		
Skipped-generation household	8.1%		3.2%		
Living with adult child only	5.3%		20.5%		
Living with spouse only	4.6%		22.5%		
Living alone	1.4%		8.2%		
Missing info on co-residence	—		2.0%		
Covariates					
Female	58.8%		42.4%		<0.001
Age group					<0.001
60-69	60.4%		49.1%		
70-79	38.3%		48.3%		
80+	1.3%		2.6%		
Marital status					0.094

Table 3.6 Summary statistics of study sample by grandparent caregiving status, 1993

	Caregiver (n=454)		**Non-caregiver (n= 2077)**		
Variable	Mean or %	SD	Mean or %	SD	p-value ‡
married	28.4%		32.5%		
div/sep/widowed/single	71.6%		67.6%		
Ethnicity					0.364
Fuchien	65.0%		63.0%		
Hakka	16.4%		16.4%		
Mainlander	16.4%		19.2%		
Other	2.2%		1.5%		
Education years					0.184
0 years	43.4%		39.0%		
1-6 years or literate	39.4%		41.4%		
>= 7 years	17.2%		19.7%		
Location					0.375
Rural	55.1%		57.3%		
Urban	44.9%		42.7%		
Working currently					<0.001
Yes	15.4%		23.9%		
Economic status					0.148
Have difficulty	11.0%		12.5%		
Have enough money	54.6%		53.3%		
Have plenty of money	34.1%		34.2%		
Social support					
Emotional support (1-5)	4.2	(0.8)	4.1	(0.8)	0.028
Receive support with chores	62%		62%		0.139
Financial support to children	7%		6%		0.778
Financial support from children	70%		59%		<0.001

Notes: Study sample at baseline include only cohort 1 (aged 64 or above) at 1993 wave

‡X^2 test for categorical variables and paired-t test for interval variables

CES-D: Center for Epidemiological Studies Depression scores

CHAPTER 4. THE IMPACT OF CARING FOR GRANDCHILDREN ON THE HEALTH AND HEALTH SERVICES UTILIZATION OF GRANDPARENTS IN TAIWAN

[Target journal: The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences]

4.1 Abstract

Objectives: The objective of this study is to estimate the impact of caring for grandchildren on the physical health, psychological well-being, and health services utilization of Taiwanese grandparents.

Methods: The study sample consisted of 5,245 grandparents aged 50 and older from four waves of the Survey of Health and Living Status of the Elderly in Taiwan (1993-2003). Compared to non-caregivers, caregivers were classified according to two different criteria: by living arrangement or by caregiving status across waves. Panel data regression analyses were used to identify the impact of grandparent caregiving on health-related outcomes, while controlling for grandparents' socio-demographics and social support.

Results: More than 25% of all Taiwanese grandparents reported caring for grandchildren in 2003. Compared to the changes in health outcomes reported by non-caregivers, current caregivers experienced better self-rated health, fewer mobility limitations, and fewer depressive symptoms, but no significant difference in life satisfaction after caregiving. Among the three types of caregivers, caregivers in multigenerational households experienced the most health improvement, while babysitters reported no statistically significant change in health. Skipped-generation caregivers reported fewer mobility limitations after caregiving.

No significant difference was found in outpatient utilization by caregiving status, except that skipped-generation caregivers were more likely to have unmet health needs.

Discussion: Findings of positive health effects support the hypothesis that caring for grandchildren is beneficial for grandparents in the Chinese cultural context. These positive health impacts were identified after controlling for unobserved time-invariant caregiver characteristics, although bias from selection into caregiving may still be a concern.

4.2 Introduction

In traditional Chinese culture, grandparents often help care for grandchildren in three-generational families [Strom et al., 1996]. Taiwanese society has kept the tradition of Chinese culture but differs significantly from People's Republic of China (PRC) in its current social, political, and economic conditions [Berndt et al., 1993]. Although within the Chinese cultural context, grandparents in Taiwan have long been involved with grandchild care, evidence shows that the percentage of grandparents caring for grandchildren under three years old increased by seven percentage points in the past 20 years following increased female labor force participation [Directorate General of Budget, 2006]. Despite the rise of grandparent caregiving in Taiwan, little is known about the health impact on grandparents caring for grandchildren [Lo and Liu, 2009]. A review of the literature identified only three previous studies that looked at Taiwanese grandparents' health in association with caring for grandchildren [Liu, 2001; Chi, 2004; Lo and Liu, 2009]. Furthermore, all three studies used only cross-sectional data from a specific locality in Taiwan. This study seeks to determine the health impact of grandparent caregiving by using a nationally representative longitudinal sample of Taiwanese elderly with improved methodology.

Goodman and Silverstein, in their study comparing White, African American, and Latino grandmothers in the US, found that cultural norms and traditions can shape expectations about grandparent roles and subsequently affect grandparent well-being [Goodman and Silverstein, 2002]. Grinstead and colleagues in their extensive literature review concluded that more diversity in study populations is needed to advance our knowledge about the health of caregiving grandparents since existing studies consisted primarily of grandmothers in the US [Grinstead et al., 2003]. Our interest in studying the health impact among Chinese caregivers is based on the premise that caring for grandchildren fulfills a cultural norm of intergenerational reciprocity [Sheng and Settles, 2006]. We expect that the health consequences of caregiving experienced by Taiwanese grandparents are likely to differ from those in the US due to the influence of culture.

As we searched for studies of Chinese grandparents as well as studies in other East Asian countries that share a similar value system from the Confucian tradition [Kim et al., 1999], we were surprised by the scarcity of publications identified using relevant electronic databases . Not only is the literature on the health of grandparent caregivers limited in Taiwan, but when we expanded our search to published studies in the PRC, we only found studies that examined the association between intergeneration social support and the health status of Chinese elders in the PRC [Liu et al., 1995; Chen and Silverstein, 2000; Silverstein et al., 2006]. As we continued to search for studies conducted in other East Asian countries, we only identified two additional studies which interviewed the Asian-American grandparent caregivers but did not specifically focus on the health of caregiving grandparents[Yoon, 2005; Kataoka-Yahiro, 2010]. Considering the lack of research on this important issue, this current

study seeks to add to the international literature of grandparent caregiving by providing evidence from a less studied Chinese culture.

The objective of this study is to compare the physical health and psychological well-being of Taiwanese grandparents by caregiving status. Our hypothesis is that grandparents in Taiwan should experience health improvement as a result of caring for grandchildren. Furthermore, this longitudinal study seeks to move beyond cross-sectional studies to determine the relationship between grandparent caregiving and caregivers' health, as estimates from cross-sectional studies may be biased by healthier persons being more likely to choose to be caregivers. Using a sample representative of the elderly population in Taiwan, this longitudinal study provides a novel assessment of the health impact of caring for grandchildren.

Conceptual Model

The conceptual model guiding this current study is presented in Figure 4.1. Caregiving in practice could have both positive and negative effects on the health of grandparents, such as increased social engagement and higher stress. We estimate the net of these two opposing effects that can be estimated empirically since we could only observe the sum of those two effects on any health outcome. Given that grandparents are faced with both fulfillment and burden from their roles as caregivers, this study hypothesizes that caregiving for grandchildren will be beneficial for grandparents' physical and mental health based on the theory of the Sociocultural Stress and Coping Model [Knight and Sayegh, 2010].

According to this model, caregivers may appraise their responsibilities differently based on their cultural values and receive different levels of social support within different cultural environments, and thus may experience different outcomes as a result of caregiving [Kim,

2005]. For example, many studies of adult children caring for old parents among Asian populations have focused on the cultural value of familism. Familism is defined as a strong identification and solidarity of individuals with their family [Knight and Sayegh, 2010]. Although this study does not include cross-culture comparisons, we expect that health consequences of grandparent caregiving in Taiwan will be different from those in Western populations because caring for grandchildren has different meaning in Chinese as compared to Western cultural contexts.

Our hypotheses related to caregivers' health services utilization are different from the physical and mental health outcomes discussed above. Previous studies have shown that caregiving reduces a grandparent's time for self-care, such as exercising or going to the doctor, and may also make them less likely to engage in preventive health services such as screening tests or flu vaccination [Roe et al., 1996; Hughes et al., 2007; Baker and Silverstein, 2008]. Qualitative studies which interviewed grandparent caregivers found that grandmothers raising their grandchildren tended to "play down" the severity of their own health problems and to delay seeking medical help [Roe et al., 1996]. Conversely, if caregiving improves the health of elderly caregivers, as we have hypothesized for our study of health outcomes, then fewer health services may be needed. Even though these two reasons are very different in terms of underlying motivation, they both work in the same direction, so this study hypothesizes that grandparent caregivers will have lower outpatient use compared to otherwise similar non-caregivers, and that skipped-generational caregivers will be most likely to report having unmet health needs.

In addition to the main relationship between caregiving and caregivers' health, the conceptual model also includes the role of social support. Previous studies in the PRC also

reported evidence of how intergenerational exchanges of social support have a positive impact on the elderly's mental health [Chen and Silverstein, 2000; Silverstein et al., 2006]. In the current study of Taiwanese grandparents, three types of social support were considered as factors correlated with both grandparent caregiving and caregivers' health. Because it is common for Chinese grandparents to receive financial support from their adult children as a "time-for-money-exchange" for their assistance with grandchild care [Silverstein et al., 2006], financial support should be controlled in analysis to distinguish that from the effect of caregiving on caregivers' health. However, since the relationship between social support and caregiving decision can be jointly determined (as depicted by the two-way dotted arrows in Figure 3.1), including potentially endogenous social support measures in estimating the effect of caregiving on caregivers' health may result in biased estimates. Although this study does not model the relationship between grandchild care and social support directly, in our analysis we assess this potential bias by estimating our models with and without the inclusion of social support variables.

Finally, by controlling for grandparents' socio-demographics, this study accounts for observed individual characteristics that the existing literature has found to affect the relationship between grandchild care and grandparents' health. One key factor to consider is the baseline physical and mental health status of the respondent since it is crucial to separate the health impact of caregiving from the underlying health conditions of grandparent caregivers that may affect the decision to provide care to grandchildren.

4.3 Methods

Data Source

The Survey of Health and Living Status of the Elderly in Taiwan, also known as the Taiwan Longitudinal Study on Aging (TLSA), includes a nationally represent sample of the Taiwanese population aged ≥60 in 1989 [Bureau of Health Promotion, 2003]. Follow-up interviews with the same respondents were done in 1993, 1996, 1999, and 2003. In addition to the first birth cohort selected in 1989, a second birth cohort of the population aged 50-66 was added in 1996 and a third birth cohort aged 50-56 was added in 2003 [Bureau of Health Promotion, 2003]. A strength of the TLSA is its high response rates which varied between 79% to 91% during the ten-year period for this study.

The selection of the initial TLSA panel was conducted in 1989 using a three-stage equal probability random sampling design [Hermalin et al., 1989]. However, sample weights are available for different selection probability of different cohorts. Since two individuals were randomly selected from each residential block (*lin*), it was highly unlikely to have more than one person selected from the same household; the TLSA has always been used without further adjustment for household clusters.

Sample

The analytical sample included three cohorts of grandparents aged 50 and above from four waves (1993-2003) of the TLSA panel that included the survey questions on grandparent caregiving. Inclusion criteria were that the sample person must be:

1) a respondent in 1993 if they were in Cohort 1 of the survey;
2) a grandparent in at least one of the four survey waves;
3) between 50 and 80 years old at the initial survey;
4) living in a non-institutional setting at the initial survey; and

5) a respondent (i.e., no proxy response) at the initial survey.

Figure 4.1 shows the selection of our study sample from the pooled TLSA sample of 7,416 people to the final analysis sample of 5,245 people. Since the 1993 survey was used as the baseline for cohort 1 in our study, we excluded 200 non-respondents in 1993 even though they may have responded in later waves. The second and main inclusion criterion was to limit our sample to those who had at least one grandchild in any wave of the survey; 5,775 people were identified as grandparents. We excluded 264 people in the oldest cohort (cohort 1) due to exceeding the age limit of 80 in 1993. The upper age limit was applied since the oldest old are much less likely to have young grandchildren who need to be cared for, and also are more likely to have health problems not attributed to caregiving [Hughes et al., 2007; Lin, 2009]. Persons who resided in an institution or those who responded by proxy at their initial interview (e.g., 1993 for cohort 1, 1996 for cohort 2 and 2003 for cohort 3) were excluded for reasons similar to those described above. However, persons who lived in the community at their initial interview but subsequently moved into institutions or responded by proxy during follow-ups remained in the sample. After excluding observations with missing values on caregiving status, our final study sample contained 5,245 grandparents and a total of 14,286 person-wave observations over ten years.

Measures of grandparent caregiving

Rather than treating grandparent caregiving as a simple dichotomous measure, we combined information on the elder's living arrangement and history of caregiving to define grandparent caregiving status in two ways. We chose a more refined measure of grandparent caregiving following previous studies which have shown the importance of distinguishing

between grandparents who are the primary caregivers from those who are babysitters [Minkler and Fuller-Thomson, 2001; Hughes et al., 2007]. The first classification of caregiver resulted in the following four types: caregivers in (1) multigenerational (MG) households, (2) skipped-generation (SG) households in which the grandparents do not live with the adult children who are the parents of the grandchildren they help caring for, (3) babysitters in situations where the grandparents do not reside with the adult children or grandchildren, or (4) non-caregivers. These four categories of grandparent caregiving status were formed from yes/ no responses to three survey questions on whether the respondent helped caring for grandchildren and whether he or she lived with either the adult children or the grandchildren generation (Table 4.1).

The second classification of current caregiving status divided grandparents into three groups based caregiving history: being a (1) current or (2) former caregiver compared to (3) never-a caregiver. Current caregiver is defined as being a caregiver in the current survey while former caregiver refers to not providing grandchild care in the current wave but has done so in any previous wave. While the first classification by living arrangement is determined at each wave, the second classification incorporates changes in caregiving status across waves for an individual. This measure allows us to study the effects of caregiving over time and determine if caregiving affects health following termination of caregiving in the second classification. We also created an indicator of whether the elder was living with any adult child to separate the effect of caregiving from the effect of co-residence.

Health measures

We examined four health outcomes covering both the physical and mental health of grandparents listed below:

1. **Self-rated health was measured** using a 1-5 ordinal scale on the following question: "Regarding your state of health, do you feel it is: excellent, good, average, not so good, or poor?"
2. **Satisfaction with life** in the TLSA questionnaire was adopted from the Life Satisfaction Index A (LSIA) [Neugarten et al., 1961]. We selected the 4 items used in 1993 to be the common basis for measuring life satisfaction. Each item asked respondents whether they agreed or disagreed with statements indicating contentment and discontentment with their current lives (e.g., better life than most other people, satisfied with life, life meets expectations, etc.). We then created a summary score of life satisfaction ranging from 0 (least satisfied) to 4 (most satisfied).
3. **Mobility limitations** comprised the following six activities: standing continuously for 15 minutes, lifting or carrying 11–12 kg, squatting, reaching over one's head, grasping with one's fingers, and running or jogging a short distance (20–30 meters). We considered it a mobility limitation if a respondent had some or more difficulty performing the specific functional task. We then aggregated the six items to obtain the total number of mobility limitations with a score of 6 indicating the greatest degree of limitation.
4. **Depressive symptoms** were measured using a 10-item Chinese version of the original 20-item Center for Epidemiological Studies Depression (CES-D) Scale [Radloff, 1977], which has been validated in cross-cultural studies including Chinese populations [Krause and Liang, 1992; Ofstedal et al., 1999]. We constructed a measure of depressive symptoms by using the weighted sum of the 0-3 scores from all ten questions, yielding a total score ranging from 0 to 30 [Andersen et al., 1994].

Health services utilization measures

We examined three measures related to caregivers' health services use:

1. **Unmet health needs** used a discrete measure of whether a person has any unmet need in healthcare based on the response to the following question: "In the past three months, have you been in discomfort and thought about seeing a doctor but didn't go?"
2. **Frequent clinic visits** was a dichotomous measure of whether the respondent had at least *three* visits to Western clinics in the past month. The term Western medical clinic was used to distinguish from Chinese medicine and it only referred to outpatient visits excluding hospitalization or emergency unit. We could not use the number of visits as continuous variables due to a response category of "too many to recall" that was only added in 1996 and accounted for 8% of all responses. Because our research interest was to determine whether caregiving leads to excessive health services utilization rather than any utilization, we dichotomized this measure using at least three clinic visits per month to identify frequent use of health care services.
3. **Frequent outpatient care visits** was defined dichotomously by whether the respondent had at least *four* visits to any of the following three outpatient care setting in the past month: (1) a Western medical clinic; (2) a Chinese medical clinic; or (3) a pharmacy. Instead of examining each outpatient setting separately, we chose to aggregate the number of visits to create a broad measure of access to outpatient care utilization in Taiwan. This measure could not be used a continuous variable for the same survey measurement issue discussed above. We also dichotomized this variable using at least four outpatient visits per month as a measure of excessive utilization.

Other covariates controlled for in this study fall into three categories: (1) grandparents'

socio-demographics, (2) social support for grandparents, and (3) wave and cohort dummy variables. Sociodemographic variables included gender, age, marital status, ethnicity, education level, geographic location, work status, and economic status. Four types of social support representing measures of intergenerational transfers were emotional support, instrumental support, financial support received from as well as provided by any adult child to the elderly respondent. We included nine indicators of chronic disease available in the TLSA during the entire study period such as high blood pressure or stroke. The use of person fixed effects (FE) methods essentially controlled for baseline health status for each person as well as other unobserved time-invariant characteristics. Finally, a set of wave and cohort dummy variables accounted for baseline differences in health outcomes among birth cohorts and the effects of time..

Analyses and Models

Descriptive analyses were used to estimate national prevalence of grandparent caregivers and identify their main characteristics among Taiwanese grandparents 50 years and older at the latest 2003 wave. The descriptive statistics were weighted to reflect the TLSA sampling design and represent the elderly population in Taiwan at that time. We did not weight our multivariate analysis since we controlled for age, and sampling weights were primarily needed to correct for age distribution of different cohorts [Bureau of Health Promotion, 2007]. To determine differences in demographic characteristics across caregiving categories, we used chi-square tests for categorical variables and one-way analyses of variance (ANOVA) tests for continuous variables.

The general structure of the multivariate regression models used to estimate the health

impact of grandparent caregiving is:

$$HO_{it} = \alpha + \beta_1 GC_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (1)$$

where *HO* represents one of the four health outcomes for grandparent *i* at time *t*, *GC* is a measure of grandparent caregiving status in four categories, *X* is a vector of other covariates including sociodemographic and social support of the grandparents, and ε is the error term. The coefficient vector β_1 represents the net health effect of grandparent caregiving. We expect the net effect estimate β_1 to be positive for favorable health outcomes such as self-rated health and negative for unfavorable health outcomes such as mobility limitations.

To test our hypothesis that caregiving has net positive effects on Taiwanese grandparents, we estimated both the naïve ordinary least squares model (OLS) and OLS plus person fixed effects model (FE). Although other estimation methods such as an ordered logit model may be more appropriate for categorical measures of health, FE methods for non-linear models often cannot be estimated due to problems of perfect prediction [Wooldridge, 2002]. We chose the OLS models for the purpose of using person fixed effects. The person fixed effects (which can be denoted as α_i) are used to control for person-specific unobserved characteristics that are time-invariant, including baseline health status for each individual when data consist of repeated observations of the same individual. Because healthier individuals are more likely to assume the role of grandparent caregivers, the OLS estimates of the effect of caregiving are also likely to be biased upward. Thus, the FE model was used to adjust for this selection bias.

For the dichotomous health services utilization measures, we present results from both the naïve OLS model and the FE model where an OLS model is also known as a linear probability model (LPM). However, one known concern for this model is that it may

generate predictions that are outside the 0 and 1 range of the dichotomous outcome. After checking the distribution of the predicted probabilities after LPM-FE estimations, we found that less than 1% of the predictions fell outside the probable range in the model of unmet health needs while all predictions were bounded between 0 and 1 for the other two utilization measures. Therefore, we proceeded with the LPM model.

To estimate the health impact associated with grandparent caregiving, we regressed grandparents' health outcomes on a categorical measure of caregiving status, while controlling for other covariates such as grandparents' socio-demographics and social support variables described above. If the measures of social support were highly endogenous with grandparent caregiving, then estimates of the effects of caregiving could be biased since our model included those measures as covariates. For sensitivity analysis we estimated reduced form equations by excluding those four measures of social support, and the results on the coefficients of caregiving status remained largely unchanged to the third decimal point. Thus, our final models controlled for the level of grandparents' social support. We performed complete case analyses on observations with no missing data and estimates were obtained separately for the two classifications of caregiving status. All models adjusted for clustering by individual to correct standard errors for correlations between repeat observations of the same respondent over time.

4.4 Results

Table 4.2 shows the estimated prevalence of grandparent caregivers in Taiwan and compares grandparents by caregiving status in 2003 since this was the only wave that included all three birth cohorts of the study sample. The descriptive statistics were weighted

to reflect the TLSA sampling design and represent the elderly population in Taiwan. Among grandparents who were 50 and older in Taiwan in 2003, more than 25% reported helping to care for grandchildren. The descriptive statistics used two kinds of caregiver classification. According to the first classification by living arrangement, 15.9% of all grandparents were caregivers in multigenerational households, 6.1% in skipped-generation households, and 3.7% reported babysitting their grandchildren while living in separate households. According to the second classification by caregivers' current status, among those who self-identified as non-caregivers in 2003, about 30% of them were in fact former caregivers so only 51% of all grandparents had not been a caregiver.

Bivariate comparisons of grandparent characteristics found significant differences in most socio-demographic variables by caregiving status. As expected, grandparents who were either a current or a former caregiver ever was more likely to be a grandmother than a grandfather. Looking at the age of the grandparents, all three groups of caregiver by living arrangement were significantly younger than non-caregivers by about 5 years with an average of 61. In comparison to those never-caregivers, current caregivers were more likely to be married, had more years of education, and were living in an urban area. A significant difference was also found in social support received by the elderly across subgroups. Caregivers in all types of living arrangement were more likely to report being either satisfied or very satisfied with emotional support from family and friends than the non-caregivers. Grandparent caregivers across all households were also more likely to receive financial support from their adult children than the non-caregivers. Compared to the never-caregivers, we found that a lower prevalence of chronic conditions such as high blood pressure and diabetes among the current caregivers, while former caregivers reported a significantly higher prevalence of health

conditions than the never-caregivers.

On the health outcome measures, we found a similar pattern that current caregivers seemed to be healthier than the never-caregivers, but former caregivers appeared to be the least healthy among all. Significant differences by caregiving status were found in self-rated health, mobility limitations, and depression (CES-D score) when using either of the two caregiver classifications. Among the three health services utilization measures, current caregivers were more likely to have unmet health needs than the non-caregivers regardless of their type of living arrangement. Nevertheless, these associations between caregiving and health differences need to be further examined in multivariate analyses to control for the potential confounding by age and other factors.

The regression coefficients in Table 4.3 and Table 4.4 show the effects of grandparents caring for grandchildren compared to non-caregivers on each of the four health measures using two different classifications of caregiving status. Table 4.3 displays both OLS and FE regression results from the first classification which categorizes caregivers by living arrangement. The number of observations varied by model since missingness varied by dependent variable and we used casewise deletion separately for each outcome measure. While many coefficients were significantly different from zero in the OLS models, those estimated effects either attenuated or disappeared in the FE estimates. Although the OLS estimates showed large differences in the effect of caregiving on health, those effects were like to be overstated due to the selection of healthier grandparent caregivers. Coefficients from the FE models are the preferred estimates since the results from F-tests on individual FE intercepts were significant in all regression models (shown in the last rows in both Table 4.3 and Table 4.4). After controlling for observed confounding using FE models, we still find

results showing some positive effect of caregiving on grandparents' health.

Table 4.3 shows the OLS and FE regressions on physical and mental health outcomes for the three type of caregivers based on living arrangement classification. Compared with non-caregivers, multigenerational caregivers showed significant changes associated with caregiving in three of the four outcomes examined: they reported higher self-rated health, fewer mobility limitations and less depression, although the effect on life satisfaction disappeared in the FE estimates. The health effects on skipped-generational caregivers or babysitters were in similar direction as the effects on multigenerational caregivers, although they were usually smaller and often non-significant in the FE estimates.

Table 4.4 presents the OLS and FE regression results on grandparents' health based on current caregiving status. Overall, the comparison between current caregivers and those who never provided care in the past showed that they experienced better health outcomes except life satisfaction. Moreover, these effects of caregiving were significant after controlling for co-residence with adult children. On the other hand, the effects associated with being a former caregiver was only found in lower likelihood of mobility limitation but not in other outcomes.

Table 4.5 and 4.6 show the OLS and FE regression estimates on three health services utilization measures by two classifications of caregiving status, similar to Table 4.3 and Table 4.4. Based on living arrangement classification, the only significant FE estimates on the effect of caregiving were found in skipped-generation caregivers as they had higher likelihood of unmet health needs (Table 4.5). Based on caregivers' current status, former caregivers were less likely to have unmet health needs or outpatient care use compared to those never-caregivers, although these differences were no longer significant in the FE

models (Table 4.6). Overall, the regression coefficients of grandparent caregiving on health services utilization outcomes were small (about 1 to 2 percentage point) and not statistically significant at conventional levels.

To highlight key findings, Figure 4.3 and 4.4 display the results on the coefficients of interest based on our preferred FE models. We grouped the four outcomes into two measures of good health and two measures of poor health to highlight that with our hypothesis of improved health among caregivers, positive effects are expected for measures of good health such as self-rated health and negative effects are expected for measures of poor health such as mobility limitations. The bars in different shades represent point estimates for different types of caregivers and the horizontal axis of zero represent the null hypothesis of having the same effect as the non-caregivers. The error bars in the figure show the 95% confidence intervals around the estimated coefficients.

The bars in Figure 4.3 show that caregiving was associated with improvements in three outcomes except for the life satisfaction rating. Multigenerational caregivers experienced significant health improvement in three health measures, whereas the effects for babysitters were never statistically significant. Skipped-generation caregivers reported significantly fewer mobility limitations but no significant changes in other health outcomes. Overall, multigenerational caregivers seemed to have the most positive experience associated with caregiving in comparison with the other two groups in regards to the effects on health.

Figure 4.4 demonstrates the effects of caregiving based on the second classification comparing current and former caregivers to the non-caregivers, and the effects of co-residence with adult children independent of caregiving are also shown. Overall, the direction of the health effects associated with caregiving confirmed our hypotheses for both current

and former caregivers. While current caregivers had better health status and fewer depressive symptoms when compared to non-caregivers, the positive effect of caregiving did not seem to persist for those who stopped caregiving, or at least the effect could not be detected consistently over time. Mixed results were found regarding the effect of co-residence with adult children. Grandparents living with at least one adult child in the household reported higher mobility limitations, and this seemed to suggest that the choice of living with adult children was related to the health needs of the grandparents.

The bar graphs in Figure 4.5 show that while the effects of caregiving on the elders' health services utilization had wide confidence intervals, the likelihood of having any unmet health need was significantly higher for skipped-generation caregivers. The likelihood of having ≥3 clinic visits or four outpatient care visits was not negatively associated with caregiving responsibility as we hypothesized. The bar graphs in Figure 4.6 showing the effects of caregiving on current and former caregivers convey a similar message: In our analysis, the effect of being a current or former caregiver on unmet health need or frequent outpatient care use was not significant.

4.5 Discussion

This study compared the physical health and psychological well-being of Taiwanese grandparents by caregiving status and found that the effect of caregiving varied by the health outcome examined. The results showed the benefit of caregiving was most evident in reducing mobility limitations and depression, and these health effects remained after using person fixed effects to control for potential selection into caregiving. In descriptive analysis we found that grandparent caregivers reported better health status, fewer limitations, and

better mental health than the non-caregivers. The estimates from the FE models confirmed the importance of controlling for unobserved differences between individuals who provided grandchild care and those who did not since we observed a reduction in the effect size of the health impact of caregiving relative to estimates from the OLS models. That comparison suggested that healthier Taiwanese grandparents were also more likely to care for grandchildren, so it was important to control for selection into caregiving based on an individual's prior health.

The health measures examined in the current study included both physical and mental health outcomes. Our findings of significant health improvements rather than declines in self-rated health status, mobility limitation, and depression associated with grandparent caregiving were rarely observed among grandparent caregivers in the US with one exception. A study of babysitting grandmothers showed that those who cared for their grandchildren for 200 to 500 hours of care per year reported a decline in depressive symptoms [Hughes et al., 2007]. However, in the current study the beneficial effect on depression is found among multigenerational caregivers instead of babysitters, which supports our hypothesis that the effect of grandparent caregiving depends on the cultural context of the caregiver. Importantly, the caregivers in multigenerational households presumably had the support and involvement of the parents of the children, whereas in the US many parents are not involved and may be in challenging situations such as incarceration.

Although previous research in the US has usually found significant negative effects on the mental health of grandparent caregivers [Minkler et al., 1997; Strawbridge et al., 1997; Szinovacz et al., 1999], in the current study we did not find an impact on the psychological well-being of Chinese grandparents measured by the life satisfaction scale. One explanation

for the insignificant effect may be due to the measurement of satisfaction with life. Since this measure only had a scale of 0 to 4, it could be less sensitive to detect changes in the perception of a respondent.

Compared with the significant findings on three of the four health measures, most of our estimates of the effect of caregiving on grandparents' health utilization were statistically insignificant except that caregivers in skipped-generation households were more likely to have unmet need in healthcare. The increase in unmet health need was consistent with findings from previous research in the US that caring for grandchildren often made the grandparents fall behind in their own medical visit schedule [Roe et al., 1996]. Since the current study found mainly positive effects of caregiving on the health of Taiwanese grandparents, one could speculate that the demand for healthcare services would also go down. However, we found that skipped-generation caregivers were more likely to report unmet need than non-caregivers. This was the only negative consequence associated with caregiving found in our study.

Because the TLSA is not a survey about caregiving or grandparenting, two important data limitations should be noted for this analysis. First, there was no standard definition of caring for grandchildren, and no exact measure of caregiving by hours was reported in the survey. The caregiving status variable based on the grandparent's answer to whether he or she helped care for a grandchild is entirely subjective. Another important limitation is that the age of a grandchild cared by the grandparent is unknown; the survey questions only refer to grandchildren as 18 years old or younger when asking grandparents about their caregiving activity. Furthermore, the small percentage of babysitters (3.6%) and skipped-generational caregivers (4.1%) in our national representative sample also limit our power to detect

statistically significant effects of caregiving for those subgroups, since the majority of our grandparent sample consisted of non-caregivers or multigenerational caregivers.

In addition to those data limitations, in this study we regarded measures of social support as exogenous variables since results from our empirical analysis seemed to support that assumption. However, in theory certain type of social support (i.e. financial support) may have a bigger influence on a grandparent's decision to become a caregiver than the other, and therefore future studies should consider interaction effects between social support and caregiving. Furthermore, our estimate of the health impact on grandparent caregivers may still suffer from potential selection bias such as reverse causality or measurement error, despite the use of panel data methods. Future analyses will explore instrumental variables estimation to investigate the extent of remaining selection bias.

Despite these limitations, this study on Taiwanese grandparents is among the very few longitudinal studies to build the international literature on grandparent caregivers and facilitate cross-cultural comparisons. While many studies found negative health effects of caregiving among custodial grandparents in the US, the positive health impact found in this study among Chinese grandparent caregivers suggests the importance of culture differences in studying caregivers' health. We found that caring for grandchildren was beneficial for the physical and mental health of Taiwanese grandparents within a culture that emphasizes intergenerational reciprocity or, more broadly, in a culture in which grandparent caregiving is normative. More specifically, caring for grandchildren was most beneficial for grandparents in a multigenerational household living with both adult children and grandchildren.

Considering the lack of previous research on grandparent caregiving in Taiwan, findings from this nationally representative sample indicate net positive health gains for grandparents

caring for their grandchildren. Given the fast growth of Taiwan's aging population and the rise of grandparent caregiving, it is reassuring to find that grandparents have not suffered negative health consequences of caregiving on a population level. Our finding may also be welcomed by the adult child generation as they might be more willing to ask the grandparents for childcare assistance if they see caregiving is beneficial and not creating a burden. While this study highlights the positive side of grandparent caregiving, future research on grandparent-grandchild interactions is needed to look at how the care recipient is affected before considering any broad policy recommendations to encourage grandparents to provide care for their grandchildren.

Figure 4.1. Conceptual model of grandparent caregiving and grandparents' health

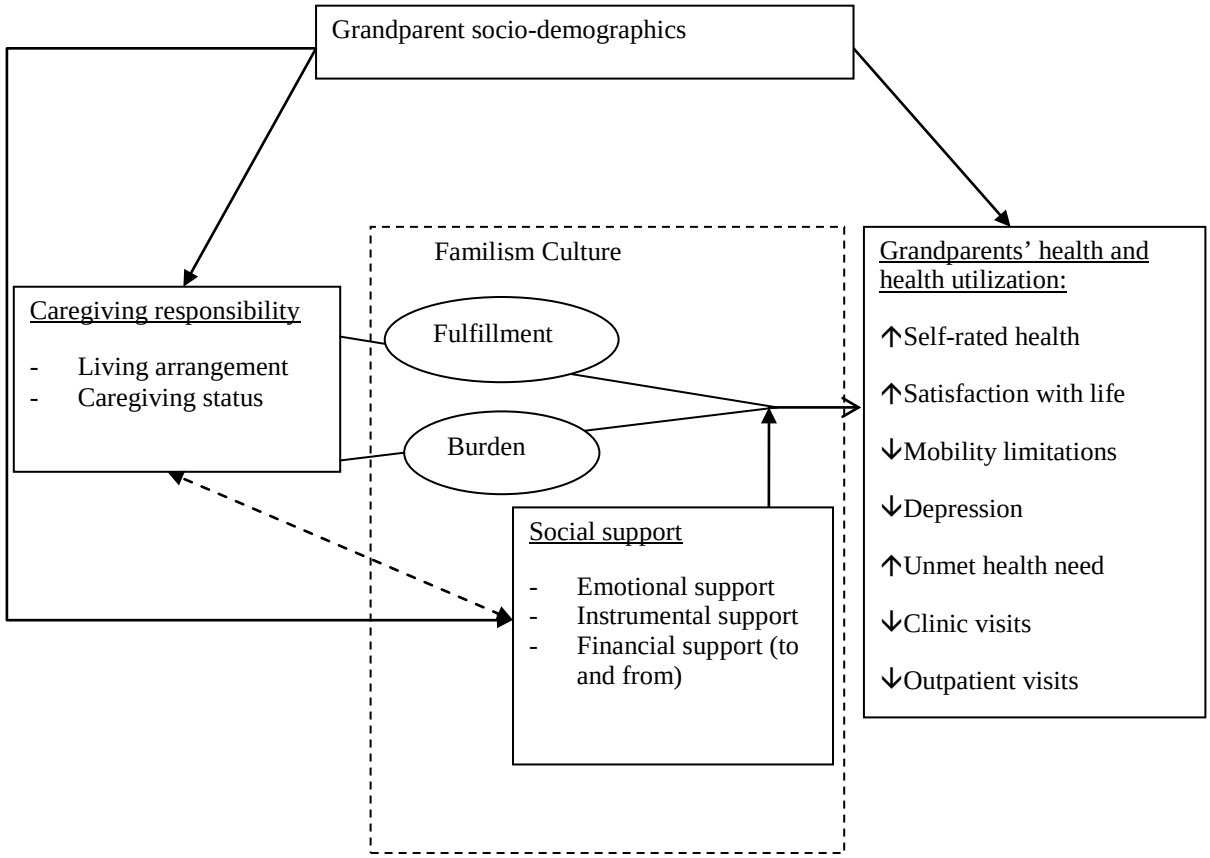
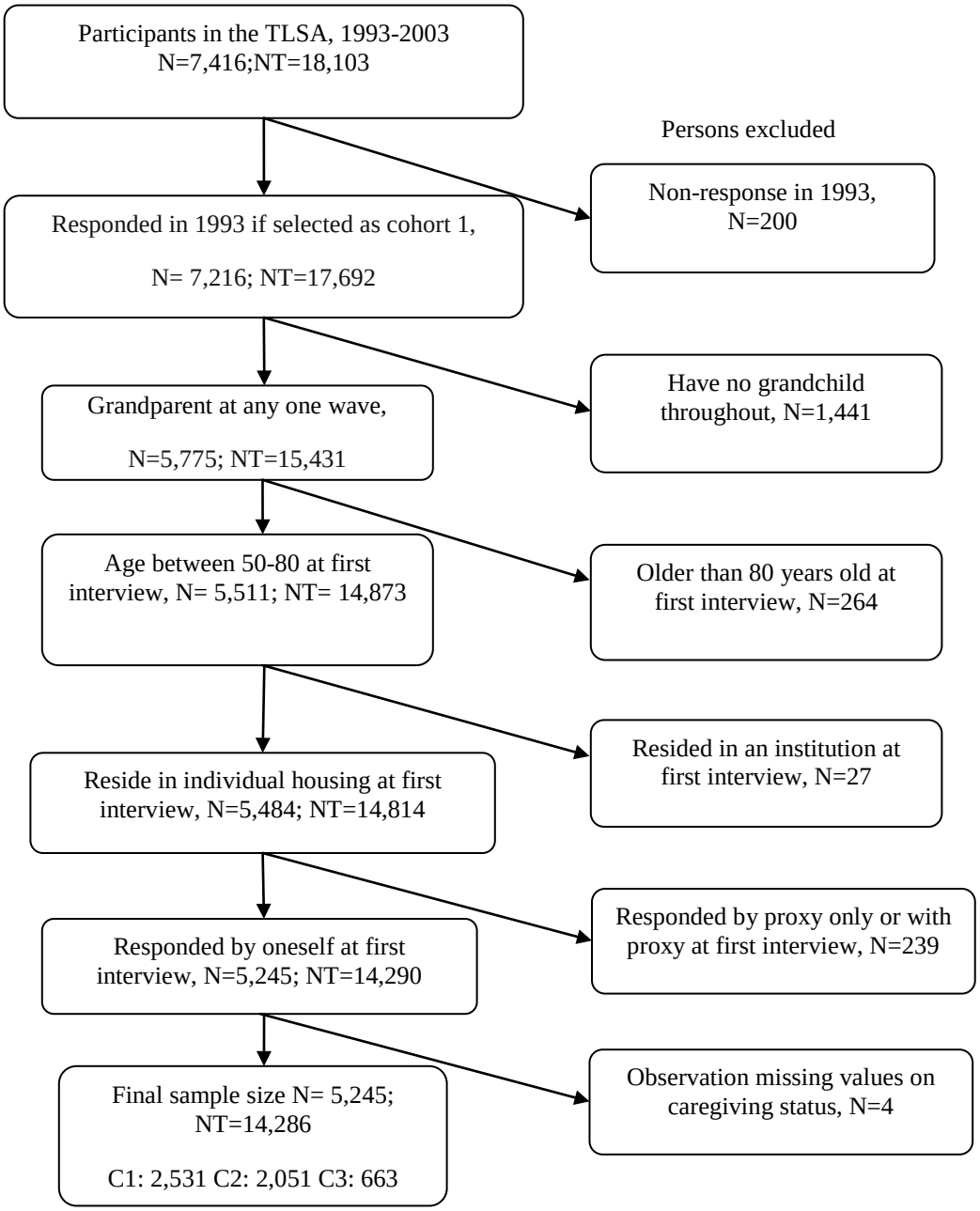


Figure 4.2. Study sample flow chart



N: Number of unique person; NT: Number of person-year observation; C: Cohort

Figure 4.3. Effects of caregiving on elders' physical and mental health based on living arrangement classification (fixed effects estimates)

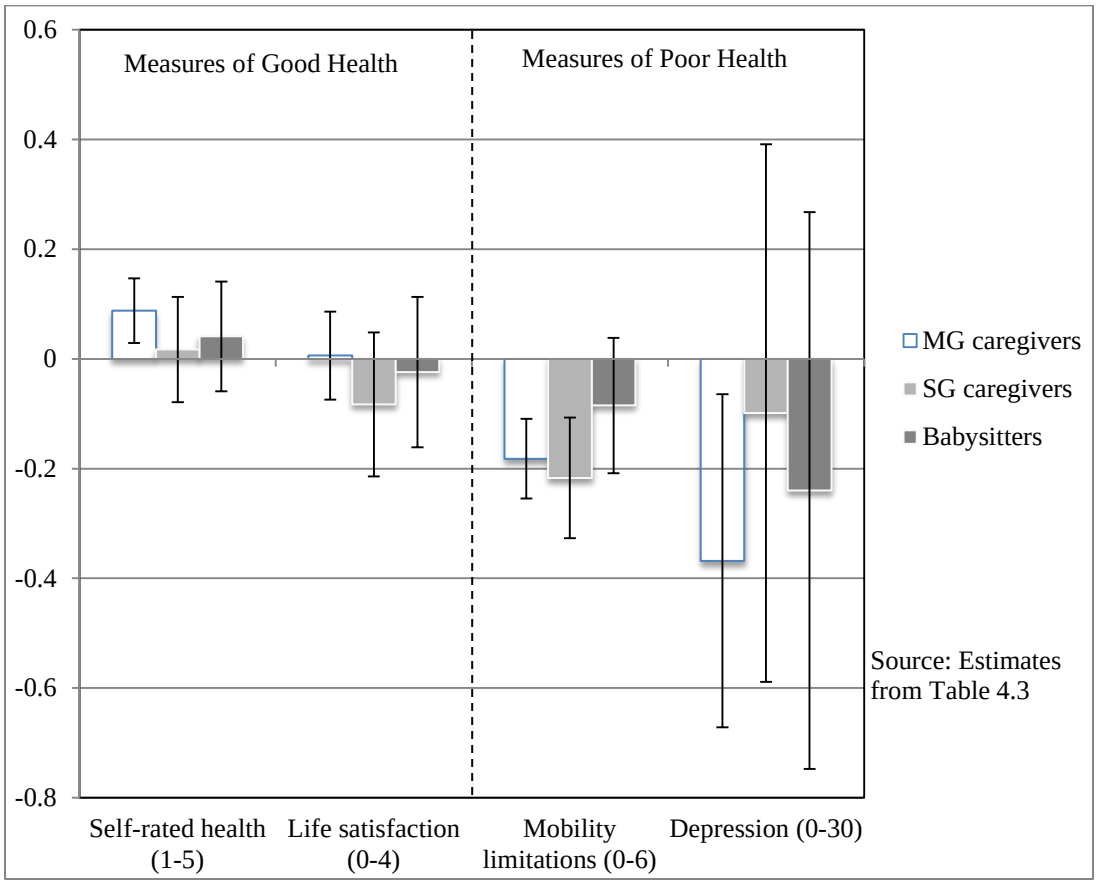


Figure 4.4. Effects of caregiving on elders' physical and mental health based on current caregiver status (fixed effects estimates)

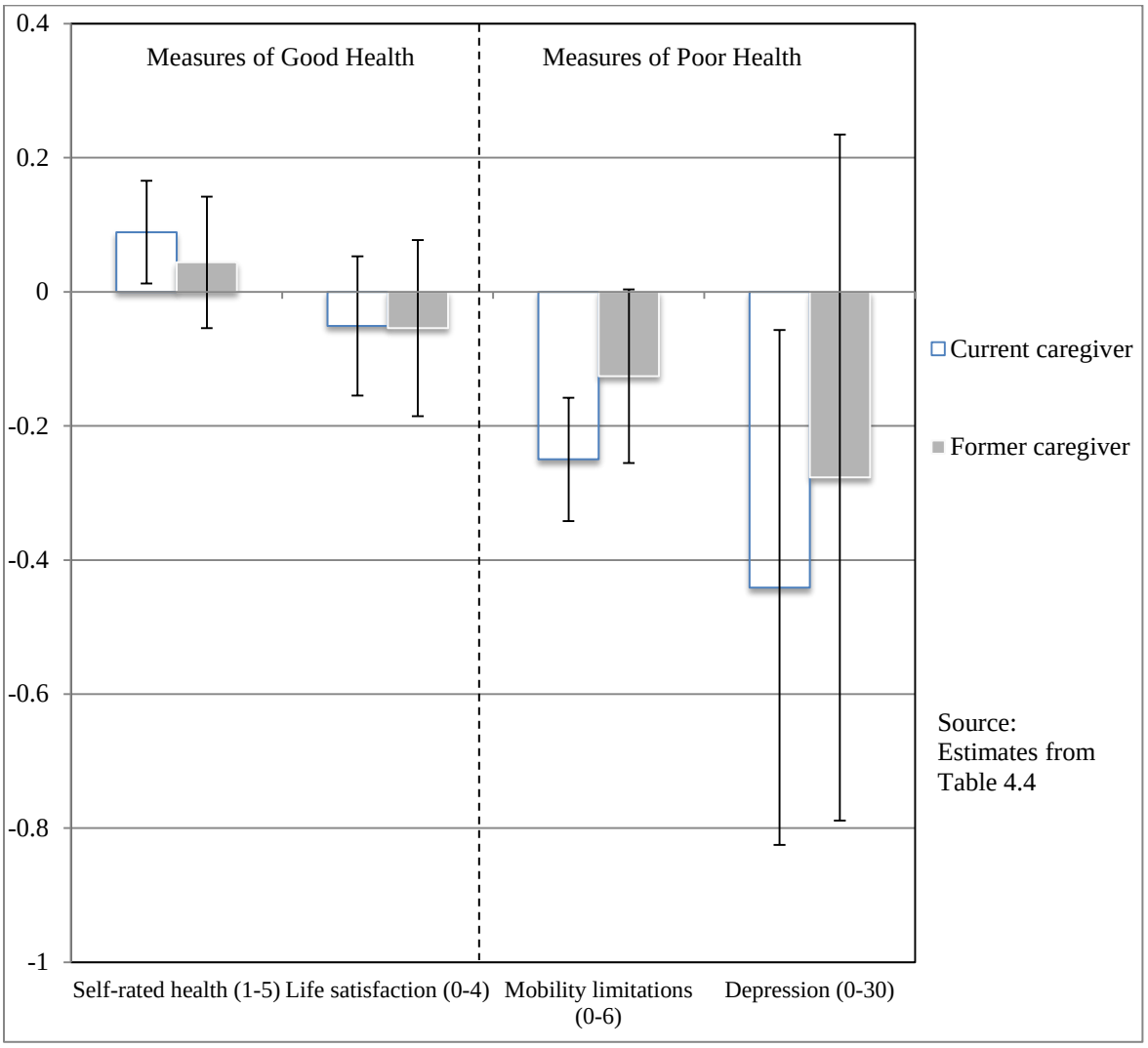


Figure 4.5. Effects of caregiving on elders' health services utilization based on living arrangement classification (fixed effects estimates)

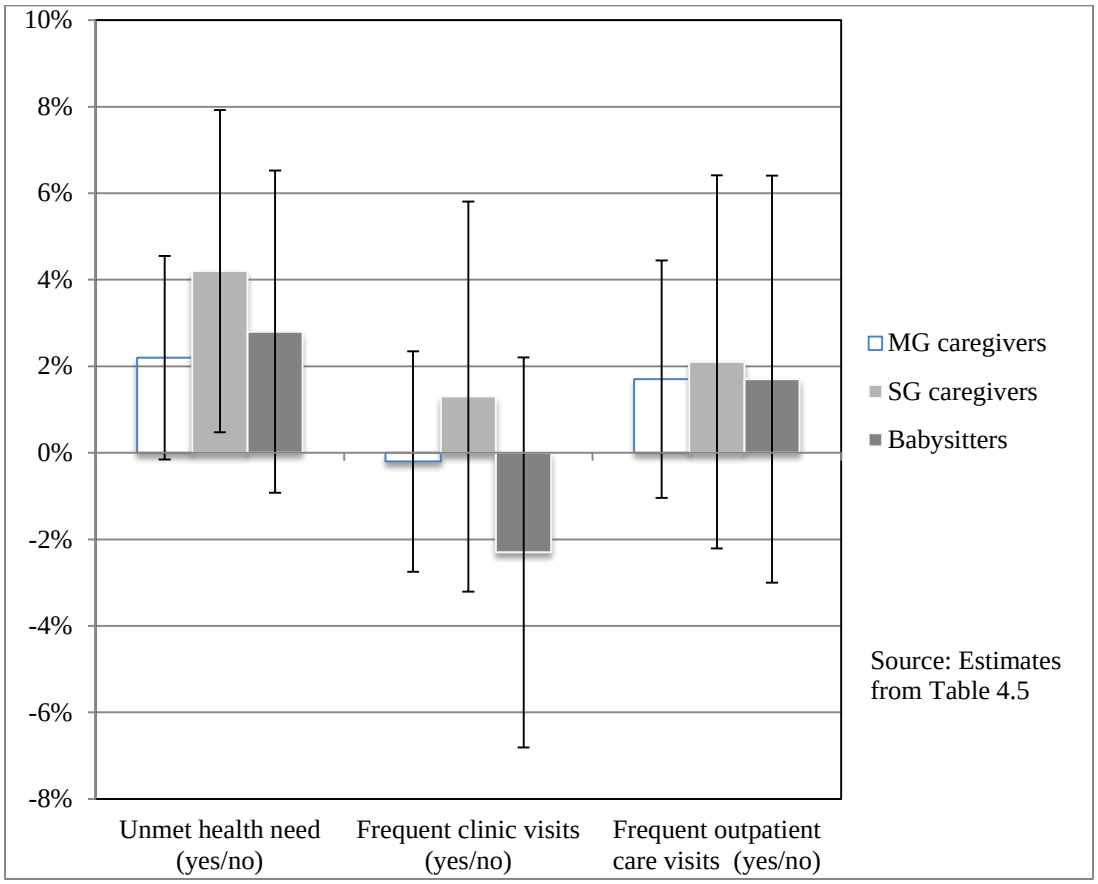


Figure 4.6. Effects of caregiving on elders' health services utilization based on current caregiver status (fixed effects estimates)

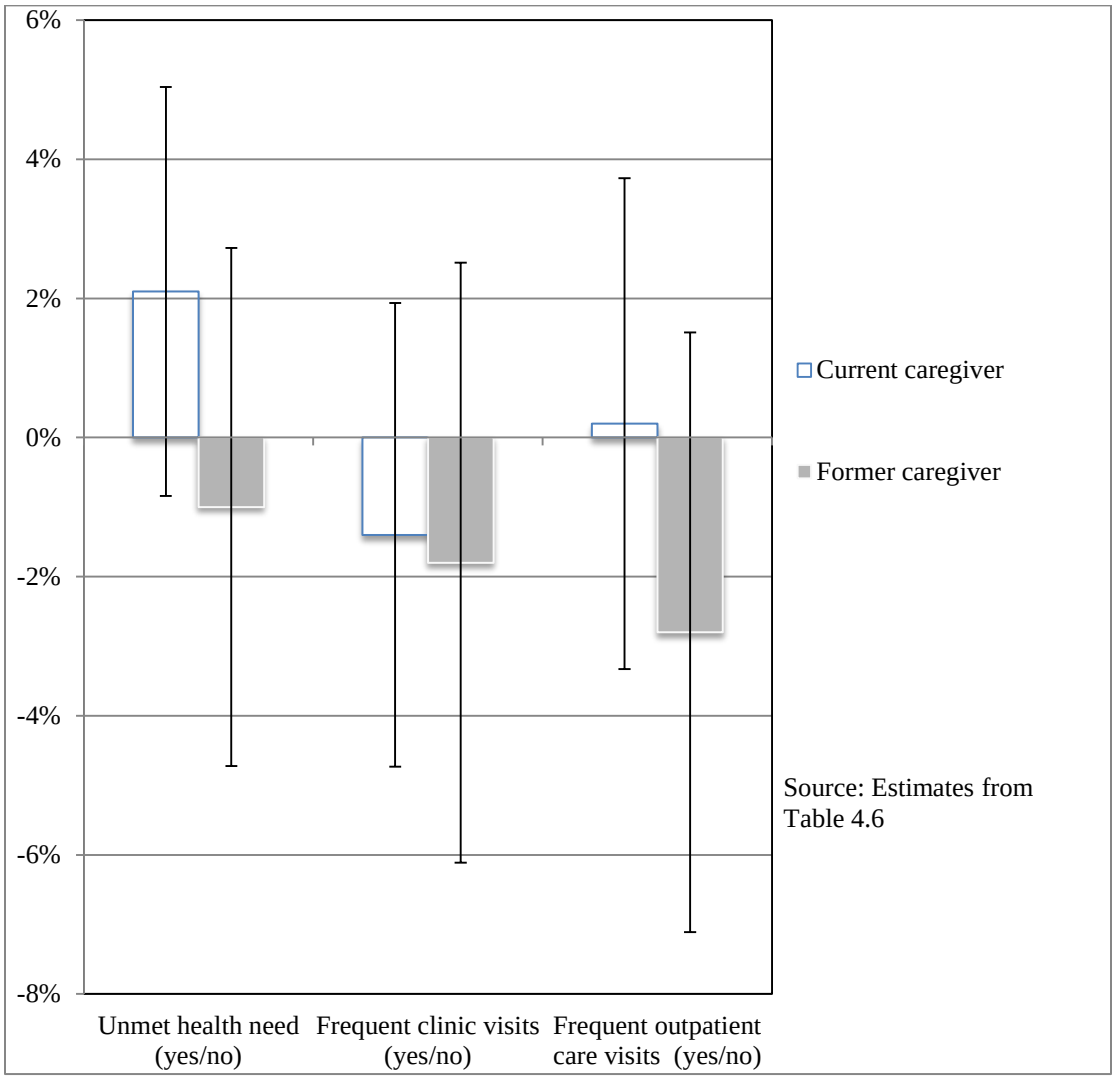


Table 4.1 Living arrangement and grandparent caregiving status

	Types of grandparent caregiving status			
Survey questions	a. MG caregivers	b. SG caregivers	c. Babysitters	d. Non-caregivers
(1) Do you currently provide assistance to babysit your grandchild(ren) of adult child __?	Yes	Yes	Yes	Yes/ No
(2) Do you live with adult child __?	Yes	No	No	No
(3) Do you have a grandchild in the household?	Yes	Yes	No	Yes/ No
Notes: Yes/ No indicates survey responses used to construct the four categories of grandparent caregiving status MG: Multigenerational households SG: Skipped-generation household				

Table 4.2 Taiwanese grandparent characteristics by caregiving status, 2003

Variable ‡	Classification 1: by living arrangement				Classification 2: by caregiver's current status			
	Non-caregivers	**MG**	**SG**	**Babysitters**	**Not yet**	**Current**	**Former**	**Total**
	(74.3%)	(15.9%)	(6.1%)	(3.7%)	(51.1%)	(25.7%)	(23.2%)	n=3866
Female[2]	54.1%	59.9%	53.2%	48.7%	50.6%	56.7%	62.0%	54.8%
Age[12]	66.7 (9.2)	61.1 (6.8)	60.9 (7.0)	61.0 (6.8)	65.4 (9.8)	61.0 (6.8)	69.4 (7.2)	65.2 (9.0)
Marital status[12]								
married	70.5%	81.8%	91.1%	88.0%	70.7%	84.8%	70.1%	74.2%
div/sep/widowed/single	29.5%	18.3%	8.9%	12.0%	29.3%	15.2%	29.9%	25.8%
Ethnicity[2]								
Fuchien	72.4%	76.0%	71.8%	70.6%	73.0%	74.2%	71.0%	72.9%
Hakka	17.3%	16.5%	19.2%	17.7%	16.1%	17.3%	20.0%	17.3%
Mainlander	8.1%	6.1%	7.3%	10.7%	8.2%	7.0%	7.6%	7.8%
Other	2.1%	1.5%	1.7%	0.9%	2.5%	1.4%	1.2%	2.0%
Education years[12]								
0 years	26.4%	20.7%	18.1%	10.8%	22.2%	18.7%	35.6%	24.4%
1-6 years or literate	52.5%	59.2%	54.0%	50.5%	54.0%	56.7%	49.3%	53.6%
>= 7 years	21.1%	20.1%	27.9%	38.7%	23.8%	24.6%	15.1%	22.0%
Location[12]								
Rural	56.3%	48.6%	55.3%	45.6%	55.3%	49.8%	58.9%	54.7%
Urban	43.6%	51.4%	44.7%	54.4%	44.8%	50.2%	41.1%	45.3%
Working currently								
Yes	25.8%	25.8%	24.8%	37.0%	31.6%	27.1%	13.2%	26.2%
No	74.1%	74.3%	75.3%	63.0%	68.4%	72.9%	86.8%	73.8%
Economic status[12]								
Have difficulty	31.1%	33.3%	36.2%	28.7%	31.8%	33.4%	29.8%	31.7%
Have enough money	56.7%	59.6%	61.9%	59.4%	56.6%	60.1%	56.9%	57.6%
Have plenty of money	7.3%	6.1%	1.7%	11.9%	7.3%	5.9%	7.4%	7.0%
Missing	4.9%	1.1%	0.2%	-	4.4%	0.7%	5.9%	3.8%
Social support[12]								
Emotional support								
Unsatisfied-Average	16.3%	15.9%	15.1%	11.7%	17.1%	15.1%	14.4%	16.0%
Satisfied	44.2%	51.3%	47.4%	48.1%	44.4%	49.9%	43.7%	45.6%

Table 4.2 Taiwanese grandparent characteristics by caregiving status, 2003

Variable ‡	Classification 1: by living arrangement				Classification 2: by caregiver's current status			
	Non-caregivers	**MG**	**SG**	**Babysitters**	**Not yet**	**Current**	**Former**	**Total**
Very satisfied	34.5%	31.7%	37.3%	40.2%	34.0%	34.3%	35.6%	34.5%
Missing	5.1%	1.1%	0.2%	-	4.5%	0.8%	6.3%	4.0%
Receive support with chores[12]	61.6%	56.5%	51.4%	53.2%	60.5%	54.8%	64.1%	59.9%
Financial support to children[2]	6.0%	7.9%	9.1%	9.2%	7.5%	8.3%	2.9%	6.6%
Financial support from children[12]	49.0%	52.8%	59.5%	49.0%	46.2%	53.9%	55.3%	50.3%
Disease indicators								
High blood pressure[12]	36.4%	28.9%	26.0%	30.1%	34.0%	28.5%	42.0%	34.4%
Diabetes[12]	16.6%	12.7%	14.6%	9.5%	14.8%	12.7%	20.7%	15.6%
Heart disease[12]	18.9%	13.5%	10.0%	13.9%	16.9%	12.7%	23.4%	17.3%
Stroke[12]	6.4%	2.8%	1.3%	3.1%	5.6%	2.5%	8.2%	5.4%
Cancer	3.2%	3.0%	4.9%	2.5%	3.2%	3.4%	3.2%	3.2%
Respiratory ailment	10.4%	8.8%	7.4%	4.9%	10.2%	7.9%	11.0%	9.8%
Arthritis or rheumatism[2]	22.3%	18.2%	19.2%	18.1%	21.6%	18.4%	23.9%	21.3%
Gastric ulcer	20.2%	18.8%	18.8%	23.0%	19.5%	19.4%	21.8%	20.0%
Liver or gall bladder disease	9.6%	9.4%	9.3%	14.7%	9.2%	10.1%	10.5%	9.7%
Health outcomes								
Self-rated health (1-5)[12]								
Poor	6.6%	1.6%	3.0%	-	5.8%	1.7%	8.6%	5.4%
Not so good	26.6%	18.6%	20.2%	20.1%	26.2%	19.2%	27.7%	24.7%
Average	31.2%	36.3%	30.8%	29.1%	30.7%	34.0%	32.2%	31.9%
Good	23.4%	26.8%	32.9%	30.0%	23.9%	28.7%	22.3%	24.7%
Excellent	12.2%	16.8%	13.1%	20.9%	13.5%	16.5%	9.3%	13.3%
Life satisfaction scale[1] (0-4)	2.6 (1.2)	2.8 (1.2)	2.6 (1.3)	2.8 (1.1)	2.6 (1.3)	2.8 (1.2)	2.7 (1.2)	2.7 (1.2)
Mobility limitations[12] (0-6)	1.5 (1.8)	0.8 (1.3)	0.6 (1.1)	0.6 (1.1)	1.4 (1.7)	0.7 (1.2)	1.7 (1.8)	1.3 (1.7)
CES-D[12] (0-30)	5.2 (5.7)	4.2 (5.2)	4.5 (5.2)	4.2 (5.1)	5.0 (5.7)	4.2 (5.1)	5.5 (5.9)	4.9 (5.6)
Unmet health needs[12] (yes/no)	11.5%	17.0%	15.9%	15.0%	12.0%	16.5%	10.3%	12.8%
>=3 clinic visits (yes/no)	17.7%	15.7%	18.9%	19.9%	17.2%	17.1%	18.8%	17.5%
>=4 outpatient visits (yes/no)	18.8%	18.8%	19.9%	27.3%	18.7%	20.3%	19.1%	19.2%

Note: Weighted statistics based on the 2003 grandparent sample;
‡ Bivariate comparisons using X^2 test for categorical variables and Anova test for interval variables;

Table 4.2 Taiwanese grandparent characteristics by caregiving status, 2003

Variable ‡	Classification 1: by living arrangement				Classification 2: by caregiver's current status			
	Non-caregivers	**MG**	**SG**	**Babysitters**	**Not yet**	**Current**	**Former**	**Total**

[1] Significant difference ($p<0.05$) in proportion/ mean by classification 1; [2] Significant difference ($p<0.05$) in proportion/ mean by classification 2
MG: Multigenerational; SG: skipped-generation

Table 4.3 OLS and FE regressions of caregiving on physical and mental health based on living arrangement classification, 1993-2003

	Self-rated health		**Life satisfaction**		**Mobility limitations**		**Depression**	
Explanatory Variables	*OLS*	*FE*	*OLS*	*FE*	*OLS*	*FE*	*OLS*	*FE*
Caregiver classification 1 (ref. Non-caregivers)								
MG caregivers (n= 1485)	0.154***	0.088**	0.072*	0.006	-0.296***	-0.182***	-0.680***	-0.368*
	(0.025)	(0.030)	(0.030)	(0.041)	(0.032)	(0.037)	(0.127)	(0.155)
SG caregivers (n=506)	0.099*	0.017	-0.051	-0.083	-0.329***	-0.217***	-0.292	-0.099
	(0.041)	(0.049)	(0.051)	(0.067)	(0.047)	(0.056)	(0.216)	(0.250)
Babysitters (n=436)	0.103*	0.041	-0.019	-0.024	-0.289***	-0.085	-0.469*	-0.240
	(0.043)	(0.051)	(0.055)	(0.070)	(0.053)	(0.063)	(0.225)	(0.259)
Demographics								
Female	-0.145***		0.034		0.544***		0.991***	
	(0.023)		(0.028)		(0.034)		(0.130)	
Age (ref. 50-60)								
Age 60-69	-0.086**		-0.032		0.200***		0.210	
	(0.030)		(0.037)		(0.036)		(0.146)	
Age 70-79	-0.155***		-0.076		0.558***		0.573**	
	(0.041)		(0.050)		(0.055)		(0.205)	
Age 80+	-0.221***		-0.059		1.143***		0.807**	
	(0.055)		(0.069)		(0.085)		(0.307)	
Married	0.044*	0.031	0.187***	0.164**	-0.114***	-0.080	-0.818***	-0.893***
	(0.022)	(0.041)	(0.028)	(0.059)	(0.034)	(0.057)	(0.129)	(0.256)
Ethnicity (ref. Fuchien)								
Hakka	0.151***		-0.017		-0.045		-0.176	
	(0.026)		(0.031)		(0.038)		(0.136)	
Mainlander or other	0.144***		-0.004		-0.052		-0.201	
	(0.031)		(0.035)		(0.045)		(0.168)	
Education (ref. 0 year)								
1-6 years or literate	0.102***		0.139***		-0.225***		-0.808***	
	(0.024)		(0.030)		(0.037)		(0.141)	
>= 7 years	0.226***		0.258***		-0.350***		-0.920***	
	(0.032)		(0.037)		(0.046)		(0.175)	
Location (ref. Rural)								
Urban	0.136***	0.022	0.094***	-0.040	-0.066*	-0.047	0.049	0.382
	(0.019)	(0.051)	(0.023)	(0.069)	(0.028)	(0.068)	(0.108)	(0.286)
Working	0.115***	0.218***	0.132***	-0.103***	-0.030	-0.418***	-0.143***	-0.583***
	(0.010)	(0.023)	(0.033)	(0.028)	(0.045)	(0.029)	(0.040)	(0.114)
Economic status (ref. Have difficulty)								

Table 4.3 OLS and FE regressions of caregiving on physical and mental health based on living arrangement classification, 1993-2003

	Self-rated health		**Life satisfaction**		**Mobility limitations**		**Depression**	
Explanatory Variables	*OLS*	*FE*	*OLS*	*FE*	*OLS*	*FE*	*OLS*	*FE*
Have enough money	0.337***	0.195***	0.639***	0.326***	-0.347***	-0.220***	-3.112***	-1.752***
	(0.020)	(0.025)	(0.027)	(0.037)	(0.032)	(0.036)	(0.132)	(0.149)
Have plenty of money	0.542***	0.348***	0.961***	0.528***	-0.563***	-0.358***	-3.891***	-2.237***
	(0.032)	(0.040)	(0.039)	(0.054)	(0.044)	(0.052)	(0.176)	(0.208)
Emotional support (ref. Unsatisfied to Average)								
Satisfied	0.235***	0.132***	0.538***	0.335***	-0.201***	-0.066	-2.910***	-1.870***
	(0.022)	(0.025)	(0.031)	(0.038)	(0.034)	(0.037)	(0.148)	(0.161)
Very satisfied	0.425***	0.249***	0.848***	0.540***	-0.283***	-0.105**	-4.022***	-2.685***
	(0.025)	(0.029)	(0.033)	(0.042)	(0.036)	(0.040)	(0.151)	(0.168)
Receive support with chores	-0.137***	-0.079***	0.045	0.016	0.395***	0.210***	0.112	-0.078
	(0.018)	(0.022)	(0.024)	(0.032)	(0.026)	(0.027)	(0.101)	(0.112)
Financial support to children	-0.005	0.004	-0.077	-0.107*	0.019	-0.022	0.073	0.055
	(0.034)	(0.039)	(0.041)	(0.049)	(0.042)	(0.046)	(0.177)	(0.194)
Financial support from children	-0.030	0.007	0.015	-0.005	-0.029	-0.071**	-0.145	-0.052
	(0.018)	(0.021)	(0.023)	(0.028)	(0.024)	(0.027)	(0.099)	(0.116)
Disease indicators								
High blood pressure	-0.178***	-0.103***	-0.020	-0.023	0.105***	-0.023	0.193	0.201
	(0.020)	(0.031)	(0.025)	(0.041)	(0.030)	(0.042)	(0.114)	(0.169)
Diabetes	-0.352***	-0.271***	-0.042	0.068	0.362***	0.150*	0.839***	0.604*
	(0.027)	(0.046)	(0.034)	(0.061)	(0.044)	(0.064)	(0.159)	(0.258)
Heart disease	-0.332***	-0.179***	-0.077**	-0.113**	0.347***	0.175***	1.169***	0.572**
	(0.023)	(0.031)	(0.029)	(0.041)	(0.037)	(0.044)	(0.149)	(0.176)
Stroke	-0.612***	-0.517***	-0.400***	-0.413***	1.515***	0.959***	2.263***	1.691***
	(0.041)	(0.059)	(0.053)	(0.078)	(0.097)	(0.112)	(0.301)	(0.377)
Cancer	-0.467***	-0.337***	-0.214**	-0.117	0.302**	0.284**	1.701***	1.440**
	(0.060)	(0.078)	(0.076)	(0.099)	(0.093)	(0.101)	(0.379)	(0.476)
Respiratory ailment	-0.356***	-0.196***	-0.128***	-0.046	0.305***	0.208***	1.196***	0.391*
	(0.028)	(0.034)	(0.035)	(0.047)	(0.044)	(0.050)	(0.168)	(0.195)
Arthritis or rheumatism	-0.254***	-0.095***	-0.102***	-0.010	0.601***	0.252***	1.283***	0.669***
	(0.021)	(0.026)	(0.027)	(0.035)	(0.034)	(0.038)	(0.132)	(0.154)
Gastric ulcer	-0.270***	-0.157***	-0.012	0.034	0.181***	0.153***	1.410***	0.968***
	(0.022)	(0.029)	(0.028)	(0.040)	(0.034)	(0.039)	(0.142)	(0.172)
Liver or gall bladder disease	-0.310***	-0.204***	-0.087*	-0.078	0.160**	0.143*	1.021***	0.716**
	(0.033)	(0.044)	(0.042)	(0.057)	(0.050)	(0.059)	(0.202)	(0.260)
Cohort and wave dummies								

Table 4.3 OLS and FE regressions of caregiving on physical and mental health based on living arrangement classification, 1993-2003

Explanatory Variables	**Self-rated health**		**Life satisfaction**		**Mobility limitations**		**Depression**	
	OLS	*FE*	*OLS*	*FE*	*OLS*	*FE*	*OLS*	*FE*
Cohort 2	0.013		-0.023		-0.126*		-0.153	
	(0.034)		(0.042)		(0.051)		(0.180)	
Cohort 3	0.002		0.043		-0.221**		0.329	
	(0.062)		(0.074)		(0.079)		(0.316)	
1996	-0.138***	-0.281***	0.392***	0.261***	-0.166***	0.229***	-1.302***	-0.480***
	(0.026)	(0.026)	(0.036)	(0.036)	(0.037)	(0.034)	(0.147)	(0.145)
1999	-0.086**	-0.308***	0.417***	0.252***	-0.076	0.538***	-2.168***	-0.967***
	(0.029)	(0.030)	(0.039)	(0.040)	(0.042)	(0.038)	(0.162)	(0.158)
2003	-0.035	-0.360***	0.486***	0.284***	-0.012	0.887***	-2.560***	-0.903***
	(0.033)	(0.033)	(0.043)	(0.044)	(0.049)	(0.043)	(0.184)	(0.172)
Constant (Cohort 1 in 1993)	3.019***	3.295***	0.977***	1.703***	1.074***	0.924***	11.935***	9.415***
	(0.058)	(0.060)	(0.072)	(0.084)	(0.083)	(0.081)	(0.324)	(0.334)
Persons	5215	5227	5174	5186	5215	5227	5213	5223
Person-waves	13429	13462	12954	12985	13429	13462	13331	13364
R-squared	0.281	0.132	0.189	0.050	0.359	0.206	0.280	0.086
F-test of FE intercepts	F(5226, 8210) =1.80 ***		F(5185, 7774) = 1.41***		F(5226, 8210) = 2.65 ***		F(5224, 8114) = 1.94***	

Note: OLS: Ordinary least squares models; FE: Fixed effects models; MG: Multigenerational; SG: skipped-generation
Robust standard errors in parentheses
* p<0.05 ** p<0.01 *** p<0.001

Table 4.4 OLS and FE regressions of caregiving on physical and mental health based on current caregiver status, 1993-2003

	Self-rated health		**Life satisfaction**		**Mobility limitations**		**Depression**	
Explanatory Variables	*OLS*	*FE*	*OLS*	*FE*	*OLS*	*FE*	*OLS*	*FE*
Caregiver classification 2 (ref. Never-caregivers)								
Current caregiver	0.135***	0.089*	0.034	-0.051	-0.335***	-0.250***	-0.592***	-0.441*
	(0.022)	(0.039)	(0.027)	(0.053)	(0.029)	(0.047)	(0.117)	(0.196)
Former caregiver	0.065*	0.044	0.066	-0.054	-0.161***	-0.126*	-0.371*	-0.277
	(0.028)	(0.050)	(0.034)	(0.067)	(0.044)	(0.066)	(0.164)	(0.261)
Have any adult children coresident	0.071***	0.054	0.069**	0.057	0.048	0.118**	-0.274*	-0.317*
	(0.020)	(0.031)	(0.025)	(0.041)	(0.029)	(0.039)	(0.114)	(0.163)
Demographics								
Female	-0.149***		0.030		0.553***		1.014***	
	(0.023)		(0.028)		(0.034)		(0.131)	
Age (ref. 50-60)								
Age 60-69	-0.080**		-0.025		0.209***		0.186	
	(0.030)		(0.037)		(0.037)		(0.146)	
Age 70-79	-0.146***		-0.067		0.566***		0.537**	
	(0.041)		(0.050)		(0.055)		(0.205)	
Age 80+	-0.205***		-0.044		1.134***		0.735*	
	(0.056)		(0.069)		(0.085)		(0.307)	
Married	0.049*	0.036	0.191***	0.171**	-0.105**	-0.066	-0.831***	-0.922***
	(0.022)	(0.041)	(0.028)	(0.059)	(0.034)	(0.057)	(0.129)	(0.257)
Ethnicity (ref. Fuchien)								
Hakka	0.148***		-0.020		-0.042		-0.162	
	(0.026)		(0.031)		(0.038)		(0.136)	
Mainlander or other	0.150***		0.001		-0.050		-0.222	
	(0.031)		(0.035)		(0.045)		(0.168)	
Education (ref. 0 year)								
1-6 years or literate	0.104***		0.141***		-0.224***		-0.817***	
	(0.024)		(0.030)		(0.037)		(0.141)	
>= 7 years	0.234***		0.264***		-0.350***		-0.952***	
	(0.032)		(0.037)		(0.046)		(0.175)	
Location (ref. Rural)								
Urban	0.131***	0.020	0.089***	-0.044	-0.070*	-0.055	0.068	0.393
	(0.019)	(0.051)	(0.023)	(0.069)	(0.028)	(0.068)	(0.108)	(0.286)
Working	0.115***	0.222***	0.134***	-0.100***	-0.030	-0.423***	-0.143***	-0.599***
	(0.023)	(0.033)	(0.028)	(0.045)	(0.029)	(0.040)	(0.114)	(0.168)
Economic status (ref. Have difficulty)								

Table 4.4 OLS and FE regressions of caregiving on physical and mental health based on current caregiver status, 1993-2003

	Self-rated health		**Life satisfaction**		**Mobility limitations**		**Depression**	
Explanatory Variables	*OLS*	*FE*	*OLS*	*FE*	*OLS*	*FE*	*OLS*	*FE*
Have enough money	0.336***	0.195***	0.638***	0.325***	-0.348***	-0.222***	-3.107***	-1.751***
	(0.020)	(0.025)	(0.027)	(0.037)	(0.032)	(0.036)	(0.132)	(0.149)
Have plenty of money	0.539***	0.347***	0.959***	0.525***	-0.563***	-0.360***	-3.883***	-2.233***
	(0.032)	(0.040)	(0.039)	(0.054)	(0.044)	(0.052)	(0.176)	(0.208)
Emotional support (ref. Unsatisfied to Average)								
Satisfied	0.234***	0.132***	0.536***	0.335***	-0.199***	-0.066	-2.903***	-1.871***
	(0.022)	(0.025)	(0.031)	(0.038)	(0.034)	(0.037)	(0.148)	(0.161)
Very satisfied	0.422***	0.248***	0.846***	0.540***	-0.281***	-0.107**	-4.010***	-2.685***
	(0.025)	(0.029)	(0.033)	(0.042)	(0.036)	(0.040)	(0.151)	(0.168)
Receive support with chores	-0.137***	-0.153***	-0.083***	0.031	0.012	0.387***	0.200***	0.172
	(0.018)	(0.022)	(0.025)	(0.032)	(0.026)	(0.027)	(0.102)	(0.112)
Financial support to children	-0.005	-0.008	0.003	-0.079	-0.110*	0.012	-0.029	0.080
	(0.034)	(0.039)	(0.042)	(0.049)	(0.042)	(0.046)	(0.178)	(0.194)
Financial support from children	-0.030	-0.031	0.007	0.014	-0.006	-0.029	-0.073**	-0.142
	(0.018)	(0.021)	(0.023)	(0.028)	(0.024)	(0.027)	(0.099)	(0.116)
Disease indicators								
High blood pressure	-0.178***	-0.103***	-0.020	-0.023	0.106***	-0.023	0.197	0.201
	(0.020)	(0.031)	(0.025)	(0.041)	(0.030)	(0.042)	(0.114)	(0.169)
Diabetes	-0.353***	-0.273***	-0.044	0.066	0.360***	0.146*	0.847***	0.616*
	(0.027)	(0.046)	(0.034)	(0.061)	(0.044)	(0.064)	(0.159)	(0.258)
Heart disease	-0.331***	-0.178***	-0.076**	-0.113**	0.347***	0.176***	1.167***	0.568**
	(0.023)	(0.031)	(0.029)	(0.041)	(0.037)	(0.044)	(0.148)	(0.176)
Stroke	-0.610***	-0.517***	-0.398***	-0.412***	1.517***	0.963***	2.255***	1.687***
	(0.041)	(0.059)	(0.053)	(0.078)	(0.096)	(0.112)	(0.301)	(0.377)
Cancer	-0.467***	-0.337***	-0.215**	-0.118	0.302**	0.286**	1.701***	1.437**
	(0.060)	(0.078)	(0.076)	(0.099)	(0.093)	(0.101)	(0.378)	(0.475)
Respiratory ailment	-0.354***	-0.196***	-0.126***	-0.045	0.305***	0.209***	1.188***	0.392*
	(0.028)	(0.034)	(0.035)	(0.047)	(0.044)	(0.050)	(0.168)	(0.195)
Arthritis or rheumatism	-0.253***	-0.096***	-0.101***	-0.011	0.599***	0.250***	1.281***	0.673***
	(0.021)	(0.026)	(0.027)	(0.035)	(0.034)	(0.038)	(0.132)	(0.154)
Gastric ulcer	-0.271***	-0.159***	-0.014	0.034	0.182***	0.153***	1.416***	0.974***
	(0.022)	(0.029)	(0.028)	(0.040)	(0.034)	(0.039)	(0.142)	(0.172)
Liver or gall bladder disease	-0.310***	-0.203***	-0.086*	-0.076	0.161**	0.146*	1.019***	0.710**
	(0.033)	(0.044)	(0.042)	(0.057)	(0.050)	(0.059)	(0.202)	(0.260)
Cohort and wave dummies								

Table 4.4 OLS and FE regressions of caregiving on physical and mental health based on current caregiver status, 1993-2003

	Self-rated health		**Life satisfaction**		**Mobility limitations**		**Depression**	
Explanatory Variables	*OLS*	*FE*	*OLS*	*FE*	*OLS*	*FE*	*OLS*	*FE*
Cohort 2	0.016		-0.019		-0.145**		-0.176	
	(0.034)		(0.042)		(0.051)		(0.180)	
Cohort 3	0.019		0.060		-0.278***		0.224	
	(0.063)		(0.074)		(0.080)		(0.319)	
1996	-0.145***	-0.284***	0.385***	0.265***	-0.146***	0.243***	-1.262***	-0.460**
	(0.026)	(0.027)	(0.036)	(0.037)	(0.037)	(0.035)	(0.148)	(0.146)
1999	-0.099**	-0.314***	0.402***	0.266***	-0.029	0.577***	-2.081***	-0.934***
	(0.030)	(0.031)	(0.041)	(0.042)	(0.044)	(0.041)	(0.167)	(0.167)
2003	-0.052	-0.367***	0.466***	0.306***	0.055	0.941***	-2.443***	-0.862***
	(0.034)	(0.036)	(0.046)	(0.049)	(0.051)	(0.048)	(0.193)	(0.190)
Constant (Cohort 1 in 1993)	2.972***	3.251***	0.932***	1.669***	1.034***	0.851***	12.111***	9.681***
	(0.060)	(0.065)	(0.074)	(0.090)	(0.086)	(0.086)	(0.340)	(0.359)
Persons	5215	5227	5174	5186	5215	5227	5213	5223
Person-waves	13429	13462	12954	12985	13429	13462	13331	13364
R-squared	0.282	0.132	0.189	0.050	0.360	0.207	0.281	0.086
F-test of FE intercepts	F(5226, 8210) =1.80 ***		F(5185, 7774) = 1.41***		F(5226, 8210) = 2.66 ***		F(5224, 8114) = 1.94***	

Note: OLS: Ordinary least squares models; FE: Fixed effects models;
Robust standard errors in parentheses
* p<0.05 ** p<0.01 *** p<0.001

Table 4.5 LPM and FE regressions of caregiving on health services utilization based on current caregiver status, 1993-2003

	Unmet health needs		**At least 3 clinic visits**		**At least 4 outpatient visits**	
Explanatory Variables	*LPM*	*FE*	*LPM*	*FE*	*LPM*	*FE*
Caregiver classification 1 (ref. Non-caregivers)						
MG caregivers (n= 1485)	0.019*	0.022	-0.011	-0.002	-0.008	0.017
	(0.009)	(0.012)	(0.010)	(0.013)	(0.011)	(0.014)
SG caregivers (n=506)	0.031*	0.042*	0.003	0.013	-0.008	0.021
	(0.016)	(0.019)	(0.018)	(0.023)	(0.018)	(0.022)
Babysitters (n=436)	0.015	0.028	-0.014	-0.023	0.014	0.017
	(0.016)	(0.019)	(0.018)	(0.023)	(0.019)	(0.024)
Demographics						
Female	0.038***		0.017		0.016	
	(0.008)		(0.009)		(0.010)	
Age (ref. 50-60)						
Age 60-69	-0.021*		0.002		-0.000	
	(0.011)		(0.012)		(0.013)	
Age 70-79	-0.033*		0.022		-0.001	
	(0.014)		(0.016)		(0.017)	
Age 80+	-0.008		-0.005		-0.040	
	(0.019)		(0.023)		(0.023)	
Married	0.001	0.035*	-0.001	-0.011	-0.003	-0.011
	(0.007)	(0.017)	(0.009)	(0.020)	(0.010)	(0.021)
Ethnicity (ref. Fuchien)						
Hakka	-0.028***		-0.002		-0.014	
	(0.008)		(0.010)		(0.011)	
Mainlander or other	-0.010		-0.034**		-0.085***	
	(0.009)		(0.011)		(0.011)	
Education (ref. 0 year)						
1-6 years or literate	-0.001		-0.009		-0.014	
	(0.008)		(0.010)		(0.010)	
>= 7 years	-0.019		-0.039**		-0.042**	
	(0.010)		(0.012)		(0.013)	
Location (ref. Rural)						
Urban	0.017**	-0.033	-0.044***	0.010	-0.027**	0.027
	(0.006)	(0.019)	(0.008)	(0.024)	(0.008)	(0.025)
Working	0.017*	0.033**	-0.029**	-0.029*	-0.029**	-0.034*
	(0.008)	(0.012)	(0.009)	(0.014)	(0.009)	(0.014)
Economic status (ref. Have difficulty)						

Table 4.5 LPM and FE regressions of caregiving on health services utilization based on current caregiver status, 1993-2003

	Unmet health needs		**At least 3 clinic visits**		**At least 4 outpatient visits**	
Explanatory Variables	*LPM*	*FE*	*LPM*	*FE*	*LPM*	*FE*
Have enough money	-0.062***	-0.044***	-0.071***	-0.045***	-0.086***	-0.059***
	(0.008)	(0.010)	(0.009)	(0.012)	(0.009)	(0.012)
Have plenty of money	-0.079***	-0.039**	-0.104***	-0.065***	-0.129***	-0.081***
	(0.011)	(0.015)	(0.012)	(0.017)	(0.013)	(0.018)
Emotional support (ref. Unsatisfied to Average)						
Satisfied	-0.033***	-0.014	0.007	0.026*	0.008	0.018
	(0.009)	(0.011)	(0.010)	(0.013)	(0.010)	(0.013)
Very satisfied	-0.046***	-0.013	0.007	0.036**	0.000	0.032*
	(0.009)	(0.012)	(0.010)	(0.013)	(0.011)	(0.014)
Receive support with chores	0.001	0.008	0.022**	0.024*	0.019*	0.022*
(0.006)	(0.008)	(0.008)	(0.010)	(0.008)	(0.010)	(0.010)
Financial support to children	0.022	0.013	0.023	0.022	0.025	0.012
(0.013)	(0.015)	(0.014)	(0.017)	(0.014)	(0.017)	(0.017)
Financial support from children	0.021***	0.022**	0.019*	0.005	0.025**	0.015
(0.006)	(0.008)	(0.007)	(0.010)	(0.008)	(0.010)	(0.010)
Disease indicators						
High blood pressure	-0.011	-0.010	0.060***	0.062***	0.047***	0.044**
	(0.007)	(0.012)	(0.009)	(0.014)	(0.009)	(0.015)
Diabetes	-0.022**	-0.019	0.010	0.036	0.023	0.042
	(0.009)	(0.017)	(0.012)	(0.022)	(0.012)	(0.022)
Heart disease	-0.002	0.001	0.086***	0.071***	0.078***	0.052**
	(0.008)	(0.012)	(0.011)	(0.016)	(0.011)	(0.016)
Stroke	0.010	-0.013	0.025	0.004	0.026	-0.005
	(0.014)	(0.021)	(0.020)	(0.030)	(0.020)	(0.030)
Cancer	-0.018	-0.064*	0.095***	0.114**	0.082**	0.066
	(0.020)	(0.026)	(0.028)	(0.037)	(0.028)	(0.039)
Respiratory ailment	0.010	0.008	0.117***	0.080***	0.138***	0.105***
	(0.010)	(0.014)	(0.014)	(0.018)	(0.014)	(0.018)
Arthritis or rheumatism	0.034***	0.023*	0.064***	0.039**	0.094***	0.057***
	(0.008)	(0.010)	(0.010)	(0.013)	(0.011)	(0.014)
Gastric ulcer	0.022**	0.017	0.086***	0.057***	0.100***	0.052***
	(0.008)	(0.011)	(0.011)	(0.014)	(0.011)	(0.015)
Liver or gall bladder disease	0.032*	0.033	0.042**	-0.017	0.062***	0.017
	(0.012)	(0.017)	(0.015)	(0.022)	(0.016)	(0.022)
Cohort and wave dummies						

Table 4.5 LPM and FE regressions of caregiving on health services utilization based on current caregiver status, 1993-2003

Explanatory Variables		**Unmet health needs**		**At least 3 clinic visits**		**At least 4 outpatient visits**	
		LPM	*FE*	*LPM*	*FE*	*LPM*	*FE*
	Cohort 2	0.009		-0.003		-0.008	
		(0.011)		(0.014)		(0.014)	
	Cohort 3	-0.016		0.009		0.027	
		(0.022)		(0.024)		(0.025)	
	1996	0.025*	0.037***	0.067***	0.083***	0.088***	0.094***
		(0.010)	(0.010)	(0.012)	(0.012)	(0.012)	(0.012)
	1999	-0.013	0.003	0.039**	0.060***	0.011	0.024
		(0.010)	(0.011)	(0.013)	(0.013)	(0.013)	(0.013)
	2003	-0.003	0.018	-0.030*	0.003	-0.062***	-0.042**
		(0.012)	(0.012)	(0.014)	(0.014)	(0.014)	(0.015)
	Constant (Cohort 1 in 1993)	0.175***	0.109***	0.166***	0.113***	0.233***	0.166***
		(0.019)	(0.023)	(0.023)	(0.027)	(0.024)	(0.028)
Persons		5215	5227	5208	5220	5215	5227
Person-waves		13428	13461	13379	13412	13429	13462
R-squared		0.032	0.013	0.078	0.035	0.094	0.041
F-test of FE intercepts		F(5226, 8212) = 1.25 ***		F(5219, 8170) = 1.30***		F(5226, 8213) = 1.36 ***	

Note: LPM: Linear probability models; FE: Fixed effects models; MG: Multigenerational; SG: skipped-generation
Robust standard errors in parentheses
* p<0.05 ** p<0.01 *** p<0.001

Table 4.6 LPM and FE regressions of caregiving on health services utilization based on caregivers' current status, 1993-2003

	Unmet health needs		**At least 3 clinic visits**		**At least 4 outpatient visits**	
Explanatory Variables	*LPM*	*FE*	*LPM*	*FE*	*LPM*	*FE*
Caregiver classification 2 (ref. Never-caregivers)						
Current caregiver	0.019*	0.021	-0.012	-0.014	-0.007	0.002
	(0.008)	(0.015)	(0.009)	(0.017)	(0.010)	(0.018)
Former caregiver	-0.018*	-0.010	-0.024*	-0.018	-0.035**	-0.028
	(0.009)	(0.019)	(0.012)	(0.022)	(0.012)	(0.022)
Have any adult children coresident	-0.006	0.006	-0.008	0.014	-0.019*	-0.006
	(0.007)	(0.011)	(0.008)	(0.013)	(0.009)	(0.014)
Demographics						
Female	0.040***		0.019*		0.018	
	(0.008)		(0.009)		(0.010)	
Age (ref. 50-60)						
Age 60-69	-0.022*		0.002		-0.002	
	(0.011)		(0.012)		(0.013)	
Age 70-79	-0.034*		0.021		-0.003	
	(0.014)		(0.016)		(0.017)	
Age 80+	-0.011		-0.009		-0.045*	
	(0.019)		(0.023)		(0.023)	
Married	0.001	0.036*	-0.001	-0.009	-0.004	-0.011
	(0.007)	(0.017)	(0.009)	(0.020)	(0.010)	(0.021)
Ethnicity (ref. Fuchien)						
Hakka	-0.028***		-0.001		-0.013	
	(0.008)		(0.010)		(0.011)	
Mainlander or other	-0.011		-0.035**		-0.087***	
	(0.009)		(0.011)		(0.011)	
Education (ref. 0 year)						
1-6 years or literate	-0.001		-0.010		-0.015	
	(0.008)		(0.010)		(0.010)	
>= 7 years	-0.020		-0.041**		-0.045***	
	(0.010)		(0.012)		(0.013)	
Location (ref. Rural)						
Urban	0.018**	-0.034	-0.043***	0.009	-0.025**	0.027
	(0.006)	(0.019)	(0.008)	(0.024)	(0.008)	(0.025)
Working	0.017*	0.033**	-0.030***	-0.030*	-0.031***	-0.035*
	(0.008)	(0.012)	(0.009)	(0.014)	(0.009)	(0.014)
Economic status (ref. Have difficulty)						

Table 4.6 LPM and FE regressions of caregiving on health services utilization based on caregivers' current status, 1993-2003

	Unmet health needs		**At least 3 clinic visits**		**At least 4 outpatient visits**	
Explanatory Variables	*LPM*	*FE*	*LPM*	*FE*	*LPM*	*FE*
Have enough money	-0.062***	-0.044***	-0.070***	-0.045***	-0.086***	-0.059***
	(0.008)	(0.010)	(0.009)	(0.012)	(0.009)	(0.012)
Have plenty of money	-0.079***	-0.039**	-0.104***	-0.065***	-0.128***	-0.081***
	(0.011)	(0.015)	(0.012)	(0.017)	(0.013)	(0.018)
Emotional support (ref. Unsatisfied to Average)						
Satisfied	-0.033***	-0.014	0.008	0.026*	0.009	0.018
	(0.009)	(0.011)	(0.010)	(0.012)	(0.010)	(0.013)
Very satisfied	-0.046***	-0.014	0.008	0.035**	0.001	0.031*
	(0.009)	(0.012)	(0.010)	(0.013)	(0.011)	(0.014)
Receive support with chores	0.001	0.003	0.008	0.025**	0.023*	0.024**
	(0.007)	(0.009)	(0.008)	(0.010)	(0.008)	(0.010)
Financial support to children	0.022	0.022	0.012	0.023	0.021	0.025
	(0.013)	(0.015)	(0.014)	(0.017)	(0.014)	(0.017)
Financial support from children	0.021***	0.021***	0.022**	0.019**	0.005	0.025**
	(0.006)	(0.008)	(0.007)	(0.010)	(0.008)	(0.010)
Disease indicators						
High blood pressure	-0.011	-0.010	0.060***	0.063***	0.047***	0.045**
	(0.007)	(0.012)	(0.009)	(0.014)	(0.009)	(0.015)
Diabetes	-0.022*	-0.018	0.011	0.036	0.023	0.043
	(0.009)	(0.017)	(0.012)	(0.022)	(0.012)	(0.022)
Heart disease	-0.002	0.001	0.085***	0.071***	0.078***	0.052**
	(0.008)	(0.012)	(0.011)	(0.016)	(0.011)	(0.016)
Stroke	0.010	-0.013	0.024	0.004	0.025	-0.005
	(0.014)	(0.021)	(0.020)	(0.031)	(0.020)	(0.030)
Cancer	-0.018	-0.063*	0.095***	0.115**	0.081**	0.066
	(0.020)	(0.026)	(0.028)	(0.037)	(0.028)	(0.039)
Respiratory ailment	0.010	0.008	0.117***	0.080***	0.138***	0.106***
	(0.010)	(0.014)	(0.014)	(0.018)	(0.014)	(0.018)
Arthritis or rheumatism	0.034***	0.023*	0.063***	0.039**	0.094***	0.057***
	(0.008)	(0.010)	(0.010)	(0.013)	(0.011)	(0.014)
Gastric ulcer	0.023**	0.017	0.086***	0.057***	0.100***	0.052***
	(0.008)	(0.011)	(0.011)	(0.014)	(0.011)	(0.015)
Liver or gall bladder disease	0.032*	0.033	0.042**	-0.016	0.062***	0.017
	(0.012)	(0.017)	(0.015)	(0.022)	(0.016)	(0.022)
Cohort and wave dummies						

Table 4.6 LPM and FE regressions of caregiving on health services utilization based on caregivers' current status, 1993-2003

Explanatory Variables		**Unmet health needs**		**At least 3 clinic visits**		**At least 4 outpatient visits**	
		LPM	*FE*	*LPM*	*FE*	*LPM*	*FE*
	Cohort 2	0.008		-0.005		-0.010	
		(0.011)		(0.014)		(0.014)	
	Cohort 3	-0.021		0.002		0.017	
		(0.022)		(0.024)		(0.025)	
	1996	0.027**	0.038***	0.070***	0.084***	0.093***	0.097***
		(0.010)	(0.010)	(0.012)	(0.012)	(0.012)	(0.013)
	1999	-0.008	0.006	0.045***	0.065***	0.020	0.029*
		(0.010)	(0.011)	(0.013)	(0.014)	(0.014)	(0.014)
	2003	0.004	0.021	-0.022	0.011	-0.051***	-0.034*
		(0.012)	(0.013)	(0.015)	(0.016)	(0.015)	(0.016)
	Constant (Cohort 1 in 1993)	0.179***	0.106***	0.171***	0.105***	0.245***	0.174***
		(0.020)	(0.024)	(0.024)	(0.030)	(0.025)	(0.030)
Persons		5215	5227	5208	5220	5215	5227
Person-waves		13428	13461	13379	13412	13429	13462
R-squared		0.032	0.013	0.078	0.035	0.094	0.041
F-test of FE intercepts		F(5226, 8212) = 1.25 ***		F(5219, 8170) = 1.30***		F(5226, 8213) = 1.36 ***	

Note: LPM: Linear probability models; FE: Fixed effects models
Robust standard errors in parentheses
* p<0.05 ** p<0.01 *** p<0.001

CHAPTER 5. THE HEALTH EFFECTS OF GRANDPARENT CAREGIVING IN TAIWAN: AN INSTRUMENTAL VARIABLE ESTIMATION

[Target journal: Review of Economics of the Household]

5.1 Abstract

The objective of this paper is to determine whether selection into caregiving biases the health effect of grandparent caregiving in Taiwan, using instrumental variable (IV) methods. Data came from 5,245 grandparent respondents in four waves (1993-2003) of the Survey of Health and Living Status of the Elderly in Taiwan (TLSA). We use time-varying instruments with and without person fixed effects to estimate the health impact of grandparent caregiving and find that ever being a caregiver for grandchildren was endogenous in grandparents' life satisfaction and mobility limitations. For the marginal caregivers who would not have likely to be a caregiver but ended up providing care because they had more grandchildren or more adult children getting married over time, a significant reduction in the number of mobility limitations supports our hypothesis of positive health impacts among grandparent caregivers in Taiwan.

5.2 Introduction

Grandparenthood is experienced by people in all cultures, but grandparenting may have different health consequences in different cultural contexts [Goodman and Silverstein, 2002]. The objective of this paper is to determine whether caring for grandchildren has positive impacts on the health and health services use of grandparents in Taiwan, after controlling for

biased selection into caregiving using instrumental variable (IV) methods. Grandparent caregiving in practice could have both positive and negative effects on the health of grandparents, such as increased social engagement and caregiver burden. Yet it is the net of those two opposing effects that can be estimated empirically since we could only observe the sum of those two effects on any health outcome. The current literature on grandparent caregiving has largely shown negative health impacts on the caregivers, but most of these studies are based in the U.S. and grandparents in other countries and cultures have not been well-represented [Grinstead et al., 2003; Hayslip and Kaminski, 2005; Kolomer, 2008]. Goodman and Silverstein, in their study comparing White, African American, and Latino grandmothers in the US, found that cultural norms and traditions can shape expectations about grandparent roles and subsequently affect grandparent well-being [Goodman and Silverstein, 2002].

Chinese society emphasizes collective goals over individual goals, and the contributions of grandparents to the welfare of their extended families enable them to achieve intergenerational reciprocity [Sheng and Settles, 2006]. For the purpose of this study, the term “Chinese” is used as a term for the shared ethnicity/ culture between Taiwan and China while our study sample came from Taiwanese grandparent population. A national survey in Taiwan in 2006 showed that among married women between ages 15 and 64 with kids, 25% reported having the grandparents as primary caregivers for a grandchild under age three, and this figure has increased seven percentage points in the past 20 years following increased female labor force participation [Directorate General of Budget, 2006].

In addition to the cultural factor, the reasons for Taiwanese grandparents’ participation in care of grandchildren may also play a role in affecting caregivers’ health outcomes. Since

grandparents in Taiwan most often reported that their adult children work full-time as their main reasons to providing grandchild care [Chang, 2007; Lo and Liu, 2009], the caregivers appear to be under less stressful conditions than custodial grandparents in the US who are required to step in with their adult children having problems such as substance abuse or incarceration [Roe et al., 1996; Emick and Hayslip, 1999; Goodman and Silverstein, 2002]. Therefore, considering both the cultural context and the reasons for caregiving, we expect to observe positive health impact as a result of caring for grandchildren among Taiwanese grandparents which differs from the literature based in the US.

Previous research

Despite the rise of grandparent caregiving in Taiwan, little is known about the health impact on grandparents caring for grandchildren [Lo and Liu, 2009]. Our review of the literature identified only three previous studies that looked at Taiwanese grandparents' health in association with caring for grandchildren [Liu, 2001; Chi, 2004; Lo and Liu, 2009]. Liu's study (2001) focused on the quality of life of 318 grandmothers caring for grandchildren six years old or younger and concluded that the sample reported above average quality of life scores. Chi's study (2004), which included only grandparent caregivers in skipped-generation household (SG) households using purposive sampling(n=321), found that caregivers reported poor health status as measured by the SF-36 scale[Ware and Sherbourne, 1992][Ware and Sherbourne, 1992]. Finally, the study by Lo and Liu, which was the only study to include a control group of non-caregivers, reported no statistically significant differences in measures of quality of life or depression between the caregiver (n=45) and non-caregiver groups (n=48) [Lo and Liu, 2009]. In addition to varied findings, prior studies were limited in terms

of the rigor of their study designs due to the use of cross-sectional data from a specific locality in Taiwan.

An analysis using a nationally representative sample from the Taiwan Longitudinal Study on Aging (TLSA) found that caring for grandchildren was beneficial for grandparents' health in a Chinese society (see Chapter 4). Comparing the physical health and psychological well-being of 5,245 grandparents by caregiving status, caregivers reported higher self-rated health, fewer mobility limitations, and fewer depressive symptoms after controlling for selection into caregiving by baseline health. That longitudinal study used person fixed effects (FE) to correct for bias from self-selection by healthier elders into caregiving; this bias likely affects results from single-group or cross-sectional study designs often used in earlier studies of grandparent caregivers [Grinstead et al., 2003].

Although panel data analysis can be effective in addressing endogeneity from unobserved time-constant variables, a remaining threat to obtaining unbiased estimates of the effects of caregiving on grandparents is the joint determination of caregiving and health, implying that a grandparent's decision to provide childcare is also likely to be affected by the individual's health status. The joint causation makes it difficult to determine whether the health advantage observed among caregivers was a selection effect or a true benefit of caregiving. For example, a grandparent may decide to stop caregiving for grandchildren as he or she experiences a decline in health status. However, to our knowledge no existing literature investigated this joint determination of grandparent caregiving and health except for one study which examined the effect of intergenerational co-residence on the well-being of elderly in China [Silverstein et al., 2006]. Siverstein and colleagues reported that they did not find living arrangements of the elderly to be endogenous with well-being after comparing

estimates between ordinary least squares and two-stage least squares model. Nevertheless, considering the lack of other evidence on this caregiver selection effect in the grandparent population, this paper seeks to make a new contribution by using an IV approach with time-varying instruments with and without person fixed effects to address the simultaneous determination of caregiving and health in observational data. We used four waves of the Taiwan Longitudinal Study on Aging (TLSA) from 1993-2003 to obtain the causal effect of grandparent caregiving while controlling for unobserved individual heterogeneity.

5.3 Methods

Data

The Survey of Health and Living Status of the Elderly in Taiwan, also known as the Taiwan Longitudinal Study on Aging (TLSA), included a nationally represent sample of the Taiwanese population aged ≥60 in 1989 [Bureau of Health Promotion, 2003]. Follow-up interviews with the same respondents were done in 1993, 1996, 1999, and 2003. In addition to the first birth cohort selected in 1989, a second birth cohort of the population aged 50-66 was added in 1996 and a third birth cohort aged 50-56 was added in 2003 [Bureau of Health Promotion, 2003].

The selection of the initial TLSA panel was conducted in 1989 using a three-stage equal probability sampling design. Although there was no explicit rule of selecting one respondent per household in TLSA sampling [Hermalin et al., 1989]. However, sample weights are available for different selection probability of different birth cohorts. Since two individuals were randomly selected from each residential block (lin), it was highly unlikely to have more than one person selected from the same household, and the TLSA has always been used

without further adjustment for household clusters. [Bureau of Health Promotion, 2007].

Sample

The analytical sample selected for this study included three cohorts of grandparents aged 50 and above from four waves (1993-2003) of the TLSA panel that included the survey questions on grandparent caregiving. Inclusion criteria for this analysis were that the sample person must be:

1) a respondent in 1993 if they were in Cohort 1 of the survey;
2) a grandparent in at least one of the four survey waves;
3) between 50 and 80 years old at the initial survey;
4) living in a non-institutional setting at the initial survey; and
5) a respondent (i.e., no proxy response) at the initial survey.

Figure 5.1 shows the selection of our study sample from the pooled TLSA sample of 7,416 people to the final analysis sample of 5,245 people. Since the 1993 survey was used as the baseline for cohort 1 in our study, we excluded 200 non-respondents in 1993 even though they may have responded in later waves. The second and main inclusion criterion was to limit our sample to those who had at least one grandchild in any wave of the survey; 5,775 people were identified as grandparents. We excluded 264 people in the oldest cohort (cohort 1) due to exceeding the age limit of 80 in 1993. The upper age limit was applied since the oldest old are much less likely to have young grandchildren who need to be cared for, and also are more likely to have health problems not attributed to caregiving [Hughes et al., 2007; Lin, 2009]. Persons who resided in an institution or those who responded by proxy at their initial interview during the study period (e.g., 1993 for cohort 1, 1996 for cohort 2, and 2003

for cohort 3) were excluded for reasons similar to the age restriction. However, those who lived in the community at their initial survey but subsequently moved into institutions or responded by proxy during follow-ups remained in the sample. After excluding observations with missing values on caregiving status, our final study sample contained a total of 5,245 grandparents from three cohort groups with a total of 14,286 person-wave observations.

Measures

Grandparent caregiving. The main explanatory variable in this study in this study is a binary indicator of whether the respondent reported ever being a caregiver for any of his or her grandchildren. A grandparent is considered a caregiver once he or she responded "Yes" to the question "Do you currently provide assistance to babysit your grandchild(ren)?" in relation to each adult child. This dichotomous measure of caregiver equals zero for a person for each wave until he or she reported caregiving and then equal to one for all subsequent waves. Those grandparents who reported "No" throughout the entire study period for all of their adult children's children were the never-caregiver comparison group.

In addition to the key survey question listed above, we used additional conditions to ascertain a respondent's self-reported caregiver status. A caregiver must have responded positively to the following three criteria: (1) is a grandparent in the same wave he or she self-identified as a caregiver; (2) has the youngest coresident grandchild at age 18 or younger if only caring for any coresident grandchild; and (3) reports the frequency of his or her caregiving activity as either often or occasionally rather than not responding to the frequency question (9% of the sample). Thus, we overrode a respondent's caregiving status to being a never-caregiver if one did not meet the above criteria. We selected a more conservative

definition for grandparent caregiver to improve validity, since the survey did not use an objective measure of grandchild care (e.g. caregiving hours).

Health Outcomes. We examined four measures of the physical and mental health of grandparents as well as three health services use outcomes. *Self-rated health* was measured using a 1-5 ordinal scale on the following question: “Regarding your state of health, do you feel it is: excellent, good, average, not so good, or poor?” The measure of *satisfaction with life* in the TLSA was adopted from the Life Satisfaction Index A (LSIA) [Neugarten et al., 1961]. We selected the common four items used in 1993 to be the basis for measuring life satisfaction in this study. The respondent was asked about whether he or she agreed or disagreed with four statements on feeling about life (e.g., better life than most other people, satisfied with life, life meets expectations), adding up to a summary score ranging from 0 (not satisfied) to 4 (most satisfied).

The number of *mobility limitations* counted the following six activities: standing continuously for 15 minutes, lifting or carrying 11–12 kg, squatting, reaching over one’s head, grasping with one’s fingers, and running or jogging a short distance (20–30 meters). A mobility limitation was defined as having some or more difficulty performing the specific functional task. *Depressive symptoms* were measured using a 10-item Chinese version of the original 20-item Center for Epidemiological Studies Depression (CES-D) Scale [Radloff, 1977]. For each of the ten CES-D items, respondents were asked to rate the frequency of their experience on a four-point scale (0-3), and then all items were summed up to a total score ranging from 0 (not depressed) to 30 (most depressed) [Andersen et al., 1994].

Among the three health services utilization measures included in our study, we measured whether a person had any unmet need in healthcare based on the response to the following

question: “In the past three months, have you been in discomfort and thought about seeing a doctor but didn’t go?” *Frequent clinic visits* was a dichotomous measure of whether the respondent had at least *three* visits to Western clinics (excluding hospitalization or emergency unit) in the past month. *Frequent outpatient care visits* was defined as whether the respondent had at least *four* visits to any of the following three outpatient care setting in the past month: (1) a Western medical clinic; (2) a Chinese medical clinic; or (3) a pharmacy. We chose to dichotomize these measures instead using them as continuous variables due to a response category of “too many to recall” that was coded for 8% of all responses in 1996, which was the only wave that this response category was included. Because our research interest was to determine whether caregiving leads to excessive health services utilization rather than any utilization, we dichotomized these two measures to identify frequent use of health care services.

Other covariates included the respondents’ socio-demographic, social support, and health-related variables. Socio-demographic variables included gender, age, marital status, ethnicity, education level, geographic location, work status, and economic status. The four types of social support representing measures of intergenerational transfers were emotional support, instrumental support (received help with household chores), financial support received from as well as provided by any adult child to the elderly respondent. We included nine chronic disease indicators available in the TLSA during the entire study period as health-related control variables because chronic disease onset could have either predated or occurred after the start of caregiving. Finally, a set of wave and cohort dummy variables accounted for unobserved time-invariant characteristics including baseline differences in health status among birth cohorts and any time trend effects.

Statistical analyses

We provide descriptive statistics in 2003 that compare grandparents who were caregivers of their grandchildren to those who had never been caregivers since the 2003 wave included all three birth cohorts of the study sample. To examine the differences in the distribution of the health and health services utilization of our grandparent sample by caregiving status, we used chi-squared tests for categorical variables and t-tests for continuous variables.

The general structure of multivariate regression model used to estimate the health impact of grandparent caregiving is specified as follow:

$$HO_{it} = \alpha + \beta_1 GC_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (1)$$

where *HO* represents one of the four health outcomes for grandparent *i* at time *t*, *GC* is a dichotomous indicator caregiving, *X* is a vector of other covariates including sociodemographic and social support of the grandparents, and ε is the error term. The coefficient β_1 is of main interest as it represents the effect of grandparent caregiving. While grandparents may experience both the positive and negative aspects of caregiving, what we are able to estimate empirically is the net of those two opposing effects. We expect the net effect estimate β_1 to be positive for favorable health outcomes such as self-rated health and negative for unfavorable health outcomes such as mobility limitations because we hypothesize that on average, health improvement will be found among Chinese grandparent caregivers.

Our hypotheses related to caregivers' health services use are somewhat different from the rest of the physical and mental health outcomes discussed above. Caregiving may allow the grandparents less time to go the doctor, which in turn reduces health services utilization and possibly increases unmet health needs. However, if caring for grandchildren leads to health

improvement for the caregivers, then they will have both less outpatient use and lower unmet health needs. Once again, the effects of grandparent caregiving on health services use which have been estimated in this study are the net effects. We hypothesize that β_1 is negative since caregiving is likely to lower grandparents' health services use but is positive for unmet health needs since caregiving is likely to reduce an elder's time for self-care.

The main challenge in estimating the effect of caregiving is that grandparent caregiving (*GC)* may be endogenously determined. While including person fixed effects can reduce bias by controlling for unobserved time-constant factors, FE methods cannot address selection on unobserved time-varying factors, or endogeneity associated with reverse causality. Therefore, in addition to FE methods, we employed an IV estimation approach. If the instruments are valid, IV estimation produces consistent estimates of the effect of caregiving on health by correcting for the endogeneity from joint determination.

The first stage equation used in our IV estimation is specified as follow:

$$GC_{it} = \gamma_1 IV_{it} + \gamma_2 X_{it} + \varepsilon_{it} \quad (2)$$

The likelihood of grandparent caregiving (*GC*) is a function of IVs and other covariates (*X*). Grandparent sociodemographic and social support variables are also included in equation (1) shown earlier.

Obtaining consistent estimates of the effect of caregiving by IV estimation requires good IVs. The two requirements for good IVs are: (1) they are highly correlated with grandparent caregiving; and (2) have no direct effect on health outcomes but only an indirect effect through their association with caregiving. We considered several characteristics of the adult children generation to predict grandparent caregiving including the percent of adult children who are males and whether the eldest adult child is a son. Family structure variables have

been used successfully in IV models predicting elder parent caregiving [Van Houtven and Norton, 2004; Bolin et al., 2008; Coe and Van Houtven, 2009]. However, as we wanted to combine IV estimation with control of fixed effects, the analysis required IVs that vary over time. Since the elders were much beyond their childbearing age, variable such as the percent of male adult children were not time-varying unless the death of adult children occurred. Therefore, our final choice of IVs included two time-varying variables: (1) the number of ever-married adult children, and (2) the number of grandchildren in the family. We chose the definition of ever-married (including those who are currently divorced or separated) in defining the marital status of adult children because the likelihood of having any grandchildren will be higher if the adult generation has ever been married. Subsequently, having more grandchildren is likely to increase a grandparent's likelihood of being a caregiver.

The estimation technique for equation (1) depends on the type of dependent variables examined and whether the method controlled for endogeneity (Table 5.1). We began by estimating ordinary least squares (OLS) regressions for all outcomes. These models are also known as linear probability models (LPM) for dichotomous measures of health services use. For the dichotomous measures, we also estimated non-linear probit models. The FE models were either OLS plus person fixed effects or LPM plus person fixed effects, depending on the nature of the dependent variable.

Two types of IV models (Table 5.1, Col 3 and 4) were estimated to compare with results from the OLS and the FE models. The first type of our IV models was the IV only model estimated without person fixed effects while the second type was the IV-FE model including fixed effects. In the IV only model, we used maximum likelihood (ML) treatment-effects

estimation which included a first-stage probit model and a second-stage linear model [StataCorp, 2009]. This model was chosen since a probit first-stage equation seemed more appropriate than a linear model for our binary endogenous regressor (ever a caregiver). The IV-FE model was implemented in Stata's panel IV program which fitted two-stage least squares (2SLS) regression on mean-differenced data [StataCorp, 2009].

Table 5.1 Analysis models and estimation methods

Control for endogeneity?	**Models**	**Estimation methods**	**Stata program**
No	(1) OLS/ LPM/ Probit	OLS for continuous dependent variables (DVs); LPM and Probit for dichotomous DVs.	regress probit
Yes	(2) FE	Person fixed -effects regression on panel data	xtreg, fe
	(3) IV only	Maximum likelihood (ML) estimates of 1st stage probit model and 2nd stage linear model; ML two-equation bivariate probit models for dichotomous DVs	treatreg biprobit
	(4) IV-FE	Two-stage least squares (2SLS) regression on mean-differenced data	xtivreg, fe

For all models listed in Table 5.1 we performed complete case analyses on observations with no missing data, so the analysis sample size varied for each model since missingness varied across the dependent variables. We also reported robust standard errors in all models to adjust for heteroskedasticity.

We conducted three specification tests to examine the empirical strength and validity of the instruments. First, we reported *F-test* statistics from the first-stage regression in the IV-FE models (or Wald-test in the IV only models) to evaluate the strength of our IVs. A significant F-test with value greater than 10 suggests that the IVs are significantly associated with the likelihood of caregiving. Secondly, we conducted over-identification test to determine whether our IVs were validly excluded from the outcome equation. In the IV-only models, we conducted a likelihood ratio (LR) test of an over-identified model (restricted) vs. an

unrestricted model that was identified only by function form; in the IV-FE models, Hansen's J statistic was reported for over-identification tests [Baum et al., 2010].

Finally, we tested for the endogeneity of a grandparent caregiving by testing the null hypothesis that ever being a caregiver was not jointly determined with one's current health status. In the IV only models, this test was equivalent to a Wald-test of the independence of the two error terms from the first- and second-stage equations (H_0: $\rho=0$); in the IV-FE models, it became a test of the difference of two Sargan-Hansen statistics [Baum et al., 2010]. Rejecting the null hypothesis suggests that IV estimation was needed to obtain consistent estimates on the health impact of grandparent caregiving. Results from these three specification tests of our IVs are reported in the results section.

5.4 Results

Descriptive results

Table 5.2, which presents the descriptive statistics of our study sample by grandparent caregiver status, shows that about 49% were ever-caregivers as of the 2003 wave. The descriptive statistics were weighted based upon the cross section of grandparents sample who represented the Taiwanese population aged 50 or above in 2003. Having almost half of the grandparent population identified as caregivers may seem high, but many elders helped to care for grandchildren at some point during the decade from 1993 to 2003. Table 5.2 shows that compared to non-caregivers, ever-caregivers had on average higher satisfaction with life and fewer mobility limitations. They were also more likely to be female, currently married, and much more likely to receive financial support from adult children. However, the prevalence of selected disease indicators did not differ significantly by caregiving status.

Specification test results and preferred model selection

This section provides a technical assessment of the choice of preferred models based on three specification tests. Readers interested in the main results on the effect of caregiving may wish to skip to the next section.

Results from two first-stage regressions in which the IVs are included to predict the likelihood of ever-caregiving can be found in Table 5.3. As we estimated two types of IV model for each outcome, we present one set of results from the first-stage probit regression and another from the first-stage linear probability model. Although each of our two IVs (the number of adult children ever-married and the number of grandchildren) was a significant predictor in only either the probit or the linear first-stage regression, the two IVs together passed the joint significance test (an *F-test* in the IV-FE models or a Wald-test in the IV only models) in all models estimated.

Although we conducted two sets of IV estimation (IV only model and IV-FE), we focused on the specification test results from the IV-FE model (Table 5.4) due to the following reasons. First, the specification tests results from the IV only model were mostly inconclusive as the IVs often did not pass the test of validity of exclusion restriction (Appendix 1 Table A1.1). Furthermore, we believe the IV-FE estimates were more robust than the IV only estimates since the IV-FE model included further control of fixed effects in addition to the IV estimation.

For all IV-FE models, our IVs had good predictive power for caregiving, with a highly significant F-test statistic and a value > 10 which passes the test of the strength of the IVs for all outcomes (Table 5.4, Col 2). We also found our IVs to be validly excluded in the models

including fixed effects. With IVs that passed the two tests of strength and validity, we proceeded with the test of exogeneity and rejected the null hypothesis that ever caregiving was exogenous for the outcome of life satisfaction and mobility limitation (Table 5.4, Col 4). Those results suggest that the IV-FE model was preferred for those two outcomes while the FE model was supported for the other five dependent variables.

Results in Table 5.5 show that the IVs in our bivariate probit model were jointly significant using Wald tests. Tests of exclusion restriction followed the methods by Holmes [Holmes, 2004] showed that the IVs could be validly excluded from the outcome equation of unmet health needs and ≥4 outpatient visits. However, the IVs did not pass the over-identification test for the outcome of ≥3 clinic visits. Finally, the test of exogeneity indicated that caregiving was only found to be endogenous for the outcome of unmet health needs at the 5% significance level. Therefore, we concluded that the bivariate probit model was our preferred model for unmet health needs while the probit model was supported for ≥4 outpatient visits. We found no support for the bivariate probit model for the outcome of having ≥3 clinic visits since the IVs were not validly excluded.

Main results

Table 5.6 compares estimates of the health impact of grandparent caregiving from four models. The four columns of estimates displayed include OLS, FE only, IV only, and IV-FE models. The results highlight the importance of controlling for endogeneity in estimating caregivers' health impact by outcome. This table only presents the coefficient of caregiving from the estimation model; full regression results on other covariates can be found in the Appendix 1 Table A1.2). Our preferred estimate for the effect of grandparent caregiving for

each health outcome is shaded in gray.

Comparing the four columns of estimates in Table 5.6, we found the estimated effect of caregiving to vary by estimation method. The estimates from the FE models (Col 2) confirmed the importance of controlling for unobserved differences that were time-invariant as we observed a reduction in the magnitude of the health impact of caregiving relative to the OLS or LPM estimates (Col 1). The IV estimation results (Col 3 and 4) showed a relatively large effect of caregiving on grandparents' health compared to the FE only estimates (Col 2). One important reason for the difference in the magnitude of the coefficients is that the effect estimated by an IV approach is for a "marginal" caregiver, meaning someone who would not have been highly likely to be a grandparent caregiver but ended up providing care because they had more grandchildren or more adult children getting married over time. In contrast, the FE models provide estimates of the average effect of grandparent caregiving for the full sample, though these effects may still be biased due to unobserved time-varying characteristics.

For self-rated heath, the preferred FE estimate of 0.09 implies that ever being a caregiver was associated with a small positive change in health status rated by the elders on a scale of 1-5. While our test result supported the IV-FE model for life satisfaction so the preferred estimate was not statistically significant, it is worth noting that the IV only estimate of 0.77 was similar to the IV-FE estimate, but with a much smaller standard error so it was statistically significant. For mobility, the preferred IV-FE estimate of a 2.15 reduction in the number of limitations (scaled from 0-6) was a significant effect for the marginal caregivers. As for depression, our preferred FE estimate shows a protective effect (-0.46) of grandparent caregiving in depression measured on the CES-D scale which ranges from 0 to 30 (with a

mean of 5.65 in the analysis sample).

Unlike the significant effect observed for the four physical and mental health measures, the effects of ever being a grandparent caregiver on health services use measures were not significantly different from zero. The FE only estimates were preferred for all models. Thus, no net effect of caregiving was detected in the probability of having either unmet health needs, having ≥3 clinic visits, or ≥4 outpatient visits between grandparent caregivers and those who had never been caregivers before.

Table 5.7 shows results from the probit and bivariate probit models of health services use. Once again, the preferred estimates are shaded in gray based on specification test results shown in Table 5.5. Contrary to our hypothesis that caregiving would increase the elders' unmet heath needs, the bivariate probit estimate of the effect of caregiving on unmet health needs was negative and statistically significant, suggesting that the marginal caregivers were less likely to report having any unmet health need after having ever provided grandchild care. This result was different from the FE only estimate in which we found no net effect of caregiving on unmet health needs on average for the full sample (Table 5.6, Row 9). While the estimates from our probit models suggested that ever caregivers were less likely to have frequent clinic visits or outpatient visits, those significant reductions in utilization could be overstated since the probit models were equivalent to the OLS models which did not control for endogeneity. Therefore, we did not choose our preferred estimates of the effect of caregiving on clinic or outpatient utilization from the probit models but from the FE only estimates which we discussed earlier (Table 5.6, Row 11 and 13).

5.5 Discussion

In this study we seek to determine whether selection into caregiving biases the health effect of caregiving among Taiwanese grandparents who were ever-caregivers for their grandchildren during the decade between 1993 to 2003. Findings from our study showed beneficial effects of caregiving were found after testing for potential bias from both unobserved time-invariant variables and underlying selection into caregiving based on unobserved time-varying variables. We explored both the FE and the IV estimation methods to address these two kinds of endogeneity that could lead to biased estimates of the effect of grandparent caregiving.

We concluded from our IV analysis that caring for grandchildren was endogenous in the model of life satisfaction, mobility limitations, and unmet health needs. Moreover, our findings suggested that grandparent caregiving reduced mobility limitations and unmet health needs of grandparents, and the effects were underestimated in the FE estimation. Although our preferred estimate for the effect of caregiving on life satisfaction was non-significant, given the similarity between the IV only and the IV-FE estimates, one explanation that the IV-FE estimate was not significant could be due to the loss of statistical power as the FE absorbed a large number of the degrees of freedom.

The IV estimates should be interpreted in the context of the Local Average Treatment Effect (LATE) [McClellan et al., 1994] which applies to a subgroup of caregivers whose caregiving decision was affected by having more grandchildren. Thus, our IV estimates were not directly comparable to either the FE or the OLS estimates in its generalizability to all grandparent population. The substantially larger IV estimate than non-IV estimate on mobility limitation may be explained by the fact that the estimated reduction is not an

estimate of the population average, but was identified for a subgroup of grandparent caregivers whose physical activity may have increased mainly due to interacting with grandchildren.

Our results showing improved mobility from grandparent caregiving are similar to the findings by Hughes and colleagues which also measured functional limitations with forms of ambulation (e.g., walking a block and climbing a flight of stairs)[Hughes et al., 2007]. In their study, grandmothers who began providing 200 to 500 hour of care per year were more likely to exercise and reported fewer functional limitations. Grandmothers in skipped-generation households whose grandchildren move out also developed more functional limitations[Hughes et al., 2007]. While the authors discussed their findings of better health among babysitting grandmothers in the US as somewhat unexpected, we believe that recent research on the negative health consequence of prolonged sitting may explain the beneficial health effects of grandparent caregiving. A recent study examining the relationship between sedentary behaviors (e.g. riding in a car and watching TV) and cardiovascular disease (CVD) mortality found that men who reported more than 23 hours a week of sedentary activity had a 6 percent greater risk of dying from heart disease than those who reported less than 11 hours a week of sedentary activity [Warren et al., 2010]. Another study by Australian researchers also provides evidence of the importance of avoiding prolonged uninterrupted periods of sedentary time [Healy et al., 2008]. Against this backdrop, our finding of reduced mobility limitations among grandparent caregivers is of little surprise since the presence of a grandchild in the household presumably significantly reduces the chance of a grandparent could sit all day long.

In addition to the health improvement found on mobility, we also found that marginal

caregivers had a lower likelihood of having any unmet health need. Given that this effect was only observed in LATE and not in the general population, this result implied that for those whose caregiving decision was affected by the number of grandchildren or married adult children, the positive impact of caregiving on health also significantly reduced their unmet needs for healthcare services.

Our study found that grandparent caregiving had a bigger effect in reducing mobility limitation and unmet health needs after controlling for the endogeneity of caregiving. Nevertheless, the findings from the IV model need to be interpreted with caution for the following reasons. First, while our IVs passed the over-identification test in the IV-FE models, there can still be explanations of why these two IVs may be directly correlated with the health outcome of interest and thus could not be validly excluded from the outcome equation. For example, one could argue that having more grandchildren leads to better psychological well-being of the grandparents, regardless of their caregiving status. If our assumption of IV validity fails, then the significant and positive IV estimates may not reflect the true effect of caregiving but the effect of family size. Secondly, in this study we used one single endogenous treatment variable of ever-caregiving, but in reality the effect of caregiving could vary for grandparents who were not currently caring for grandchildren but provided caregiving in the previous survey; our IV estimates for the marginal caregivers do not represent the effects of grandparent caregiving for those former caregivers who have stopped to provide caregiving. While a novel contribution of this study is to test for endogeneity of grandparent caregiving, future research may consider distinguish the effect of caregiving on current from former caregivers or use other groupings of caregivers to investigate heterogeneity in the effect of caregiving.

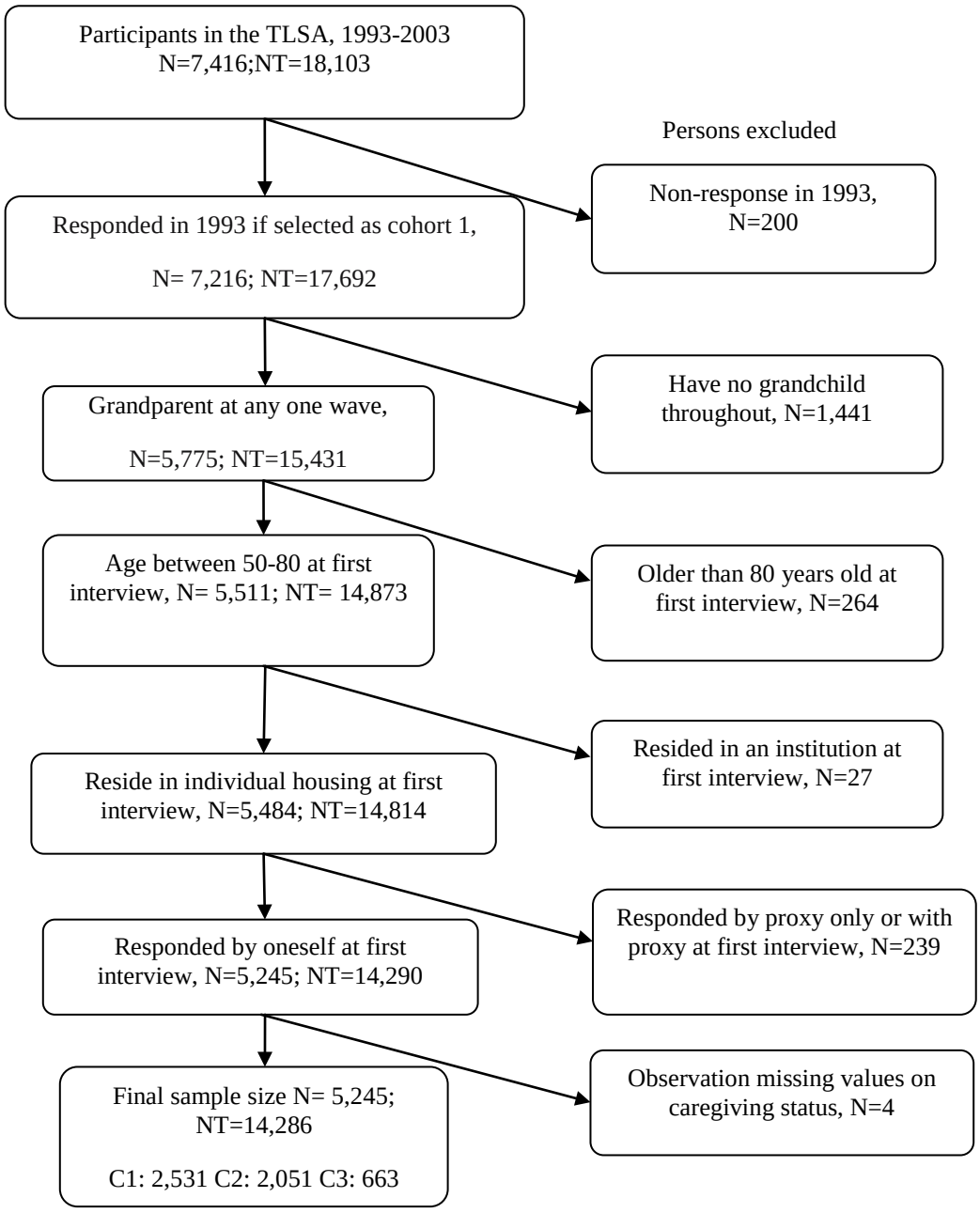
Because the TLSA is not a survey about caregiving or grandparenting, the data are limited in providing context-specific variables that were available in other qualitative studies. For example, we did not have direct measures of the burden or stress reported by the grandparent caregivers. We also lacked a precise measure of caregiving since the TLSA did not record the amount of caregiving by hours. Although the survey asked the caregivers to report the frequency of their caregiving activity as either often or occasionally, we could not use that measure of care intensity in our final analysis for it was highly correlated with the measure of ever being a caregiver ($\rho>0.85$). Thus, our measure of caregiving status based on the grandparent's answer to whether he or she helped caring for a grandchild may be subjective.

Other important context-specific variables that were unavailable in our data are related to the grandchildren. First, the age of a grandchild cared by the grandparent was unknown: the survey questions only referred to grandchildren as 18 years old or younger when asking grandparents about their caregiving activity. Given that caring for a grandchild who is a toddler versus a teenager involves quite different demands on the grandparents, we recommend for an additional question on the age of the care recipient to be added to the TLSA questionnaire. Secondly, using a survey of the elderly, we did not have information on either the grandchildren's health or behavior. Since previous literature has found that the special health needs of grandchildren had significant impact on the health of grandparents [Bowers and Myers, 1999; Burnette, 1999; Sands and Goldberg-Glen, 2000], future studies should investigate how these other contextual factors may affect the health and well-being for some sub-population of grandparent caregivers.

While the literature on grandparent caregiving has established negative health impact of

caregiving based on studies of grandparents in the US [Marx and Solomon, 2000; Grinstead et al., 2003; Baker and Silverstein, 2008], a unique contribution of this study is that after adopting rigorous econometric methods to address the effect of caregiver selection, we still found evidence of positive health effects among grandparent caregivers in Taiwan. We suspect that both the cultural context and the reasons for grandparent caregiving may explain the observed health improvement among caregivers in Taiwan. Moreover, our finding that grandparents become more physically active after caring for their grandchildren counters the stereotype that the elderly are either too frail to assume the role of grandparent caregivers or the job is too demanding on their health. Since our study was done in the Chinese grandparent population, further research using sample from different cultures is needed. Future comparative studies will not only help assess the generalizability of our findings to grandparents in other countries, but also determine if there is a common factor (i.e. less sedentary time) by which caregiving could be beneficial for grandparents across cultures.

Figure 5.1 Study sample flow chart



N: Number of unique persons; NT: Number of person-year observations; C: Cohort

Table 5.2 Summary statistics of study variables, overall and by grandparent caregiver status

Variable	Caregivers	Never-caregivers	Total	t/X^2 test‡
Dependent variable				
Self-rated health (1-5)	3.2 (1.1)	3.1 (1.1)	3.2 (1.1)	
Life satisfaction scale (0-4)	2.7 (1.2)	2.6 (1.3)	2.7 (1.2)	*
Mobility limitations (0-6)	1.2 (1.6)	1.4 (1.7)	1.3 (1.7)	**
CES-D (0-30)	4.8 (5.5)	5.0 (5.7)	4.9 (5.6)	
Unmet health needs (yes/no)	13.5%	12.0%	12.8%	
>=3 clinic visits (yes/no)	17.9%	17.2%	17.5%	
>=4 outpatient visits (yes/no)	19.7%	18.7%	19.2%	
Grandparent caregiver status	100.0%	0.0%	48.9%	—
Instrumental variables				
No. of grandchildren	8.0 (5.4)	8.2 (6.5)	7.6 (5.5)	
No. of married adult children	3.7 (1.7)	3.6 (2.0)	3.5 (1.8)	
Socio-demographic				
Female	59.2%	50.6%	54.8%	***
Age	65.0 (8.2)	65.4 (9.8)	65.2 (9.0)	
Marital status				***
Married	77.8%	70.7%	74.2%	
Div/sep/widowed/single	22.2%	29.3%	25.8%	
Ethnicity				*
Fuchien	72.7%	73.0%	72.9%	
Hakka	18.6%	16.1%	17.3%	
Mainlander	7.3%	8.2%	7.8%	
Other	1.3%	2.5%	1.9%	
Education years				**
0 years	26.7%	22.2%	24.4%	
1-6 years or literate	53.2%	54.0%	53.6%	
>= 7 years	20.1%	23.8%	22.0%	
Location				
Rural	54.1%	55.3%	54.7%	
Urban	45.9%	44.8%	45.3%	
Working currently				***
Yes	20.5%	31.6%	26.2%	
No	79.5%	68.4%	73.8%	
Economic status				
Have difficulty	31.7%	31.8%	31.7%	
Have enough money	58.6%	56.6%	57.6%	
Have plenty of money	6.6%	7.3%	7.0%	
Missing	3.2%	4.4%	3.8%	
Social support				
Emotional support				
Very unsatisfied- Average	14.8%	17.1%	16.0%	
Satisfied	47.0%	44.4%	45.6%	
Very satisfied	34.9%	34.0%	34.5%	
Missing	3.4%	4.5%	4.0%	

Table 5.2 Summary statistics of study variables, overall and by grandparent caregiver status

Variable	Caregivers	Never-caregivers	Total	t/X^2 test‡
Receive support with chores	59.2%	60.5%	59.9%	
Financial support to children	5.8%	7.5%	6.6%	
Financial support from children	54.5%	46.2%	50.3%	***
Disease indicators				
High blood pressure	34.9%	34.0%	34.4%	
Diabetes	16.5%	14.8%	15.6%	
Heart disease	17.8%	16.9%	17.3%	
Stroke	5.2%	5.6%	5.4%	
Cancer	3.3%	3.2%	3.2%	
Respiratory ailment	9.4%	10.2%	9.8%	
Arthritis or rheumatism	21.0%	21.6%	21.3%	
Gastric ulcer	20.5%	19.5%	20.0%	
Liver or gall bladder disease	10.3%	9.2%	9.7%	

Notes: Weighted statistics based on the 2003 grandparent sample (n=3866)

‡X^2-test for categorical variables and t-test for interval variables by caregiving status.

* p<0.05 ** p<0.01 *** p<0.001

CES-D: Center for Epidemiological Studies Depression scores

Table 5.3 First-stage probit/ linear probability model of ever being a caregiver

Characteristics	Caregiving	
	Probit	LMP-FE
Instrumental variables		
No. of adult children married	0.059***	-0.002
	(0.012)	(0.005)
No. of grandchildren	0.005	0.015***
	(0.004)	(0.002)
Socio-demographics		
Female	0.273***	
	(0.029)	
Age groups (ref: 50-59)		
60-69	-0.080*	
	(0.040)	
70-79	-0.426***	
	(0.056)	
80+	-0.913***	
	(0.077)	
Marital status (ref: div/sep/widowed/single)		
currently married	0.161***	0.029*
	(0.029)	(0.012)
Ethnicity (ref: Fuchien)		
Hakka	0.069*	
	(0.031)	
Mainlander or other	0.114**	
	(0.039)	
Education years (ref: 0 year)		
1-6 years or literate	-0.024	
	(0.030)	
>= 7 years	-0.066	
	(0.041)	
Location (ref. Rural)		
Urban	0.082***	-0.014
	(0.025)	(0.015)
Working	-0.326***	-0.049***
	(0.031)	(0.010)
Economic status (ref. Have difficulty)		
Have enough money	0.008	-0.008
	(0.028)	(0.007)
Have plenty of money	-0.001	-0.013
	(0.045)	(0.012)
Social support		
Emotional support (ref. Unsatisfied to Average)		
Satisfied	0.096**	0.004
	(0.033)	(0.008)
Very satisfied	0.117***	-0.005

Table 5.3 First-stage probit/ linear probability model of ever being a caregiver

Characteristics	Caregiving	
	Probit	LMP-FE
	(0.034)	(0.008)
Receive support with chores	0.154***	0.016*
	(0.026)	(0.007)
Financial support to children	-0.041	-0.015
	(0.049)	(0.012)
Financial support from children	0.188***	0.020***
	(0.025)	(0.006)
Disease indicators		
High blood pressure	0.014	-0.002
	(0.026)	(0.009)
Diabetes	-0.085*	0.001
	(0.035)	(0.013)
Heart disease	-0.056	-0.009
	(0.032)	(0.009)
Stroke	-0.183**	-0.021
	(0.061)	(0.018)
Cancer	-0.056	-0.008
	(0.081)	(0.021)
Respiratory ailment	0.010	0.010
	(0.038)	(0.010)
Arthritis or rheumatism	-0.006	0.013
	(0.030)	(0.007)
Gastric ulcer	0.008	0.013
	(0.031)	(0.009)
Liver or gall bladder disease	0.013	0.003
	(0.046)	(0.013)
Cohort and wave dummies		
Cohort 2	-0.117**	
	(0.044)	
Cohort 3	-0.482***	
	(0.082)	
1996	0.489***	0.067***
	(0.043)	(0.008)
1999	0.927***	0.162***
	(0.046)	(0.009)
2003	1.191***	0.227***
	(0.051)	(0.010)
Constant	-1.531***	
	(0.080)	
Lambda	-0.114	
	(0.103)	
N	13412	12246
R-squared		0.168

Table 5.3 First-stage probit/ linear probability model of ever being a caregiver

Characteristics	Caregiving	
	Probit	LMP-FE

Notes: [a]Result from the first-stage probit regression of the IV only model of self-rated health
[b]Result from the first-stage linear probability model of the IV-FE estimation self-rated health
* p<0.05 ** p<0.01 *** p<0.001

Table 5.4 Specification tests for IVs for "ever a caregiver" variable in IV- FE models

(1) Dependent Variable	(2) Strength of IV	(3) Test of exclusion restrictions [a] (null: validly excluded)	(4) Exogeneity test[b] (null: exogenous)	(5) Conclusion on preferred estimation
	F-test (d.f.=2) [p-value]	χ^2(d.f.=1) [p-value]	χ^2(d.f.=1) [p-value]	
Self-rated health	32.67 [<0.001]	0.01 [0.917]	2.40 [0.121]	FE
Life satisfaction	31.89 [<0.001]	2.12 [0.145]	4.28 [0.039]	IV-FE
Mobility limitation	32.67 [<0.001]	0.71 [0.401]	13.42 [<0.001]	IV-FE
Depression	30.61 [<0.001]	0.62 [0.430]	0.63 [0.427]	FE
Unmet health needs	32.67 [<0.001]	0.65[0.420]	0.76 [0.382]	FE
>=3 clinic visits	32.98 [<0.001]	0.26 [0.613]	2.41 [0.120]	FE
>=4 outpatient visits	32.67 [<0.001]	0.03 [0.866]	1.90 [0.168]	FE

[a]Hansen J over-identification test; [b]This is a test of the difference of two Sargan-Hansen statistics

Table 5.5 Specification tests for IVs for "ever a caregiver" variable in bivariate probit models of health services use

(1) Dependent Variable	(2) Wald-test of IV strength	(3) Test of exclusion restrictions (ER)[a] (null: validly excluded)	(4) Exogeneity test[b] (null: exogenous)	(5) Conclusion on preferred estimation
	χ^2 (d.f.=2) [p-value]	χ^2(d.f.=1) [p-value]	χ^2(d.f.=1) [p-value]	
Unmet needs	44.11 [<0.001]	4.42 [0.101]	6.97 [0.008]	bivariate probit
>=3 clinic visits	42.31 [<0.001]	6.50 [0.039]	3.34 [0.068]	ER not valid Exogeneous
>=4 outpatient visits	41.32 [<0.001]	4.85 [0.087]	1.00 [0.753]	probit

[a] Method follows Holmes (2004); [b] LR test of ρ=0

Table 5.6 Effect of grandparent caregiving on elders' health and health services use, highlighting the caregiving coefficient by estimation model, other output suppressed

Dependent Variable	(1) OLS	(2) FE only	(3) IV only[a]	(4) IV-FE[b]
Self-rated health	0.121***	0.088*	0.495*	0.677
	(0.020)	(0.039)	(0.195)	(0.392)
Life satisfaction	0.052*	-0.053	0.766***	0.972
	(0.024)	(0.053)	(0.118)	(0.526)
Mobility limitations	-0.265***	-0.234***	-0.453*	-2.153***
	(0.029)	(0.047)	(0.182)	(0.595)
Depression	-0.540***	-0.457*	-2.169***	-2.281
	(0.110)	(0.195)	(0.520)	(2.306)
Unmet health needs	0.004	0.020	-0.039	0.148
	(0.007)	(0.015)	(0.030)	(0.153)
>=3 clinic visits	-0.019*	-0.015	0.537***	0.252
	(0.008)	(0.016)	(0.020)	(0.176)
>=4 outpatient visits	-0.021*	-0.002	-0.039	0.259
	(0.008)	(0.018)	(0.055)	(0.193)

Notes: All models controlled for covariates and robust standard errors in parentheses; [a]IV model estimated by treatment effects (maximum likelihood) estimates; [b]IV-FE model estimated by 2SLS regression; Preferred estimates are shaded
* p<0.05 ** p<0.01 *** p<0.001

Table 5.7 Effect of grandparent caregiving on elders' health services use, highlighting the caregiving coefficient by estimation model, other output suppressed

Dependent Variable	(1) Probit	(2) Bivariate probit
Unmet health needs	0.020	-0.742**
	(0.032)	(0.241)
>=3 clinic visits	-0.061*	0.318
	(0.029)	(0.205)
>=4 outpatient visits	-0.071*	-0.169
	(0.029)	(0.307)

Notes: All models controlled for covariates and robust standard errors in parentheses; Preferred estimates are shaded except for >=3 clinic visits since tests were inconclusive.
* p<0.05 ** p<0.01 *** p<0.001

CHAPTER 6. THE EFFECTS OF TRANSITIONS IN CAREGIVING ON THE HEALTH AND HEALTH SERVICES UTILIZATION OF GRANDPARENTS IN TAIWAN

[Target journal: The Gerontologist]

6.1 Abstract

Purpose: To examine the effects of continuity and transition in caregiving for grandchildren on the health and health services use of grandparents in Taiwan.

Design and Methods: Data came from 4,016 grandparents who responded in at least two consecutive waves of the Survey of Health and Living Status of the Elderly in Taiwan (1993-2003). Grandparent caregiving transition status was a series of dichotomous variables: started care, stopped care, and continued care, with no care in both survey waves as the reference category. Multivariate regression analyses were used to estimate the effects of caregiving transition on outcomes of health and health services use including self-rated health and unmet health needs.

Results: Compared to the reference group of non-caregivers, grandparents who either started care or continued care both reported better health in higher self-rated health and fewer mobility limitations. However, grandparents who continued to provide care were also more likely to report having unmet health needs (OR=1.41) as compared to the non-caregivers. Grandparents who stopped caregiving were less likely to have unmet health needs.

Implications: The fact that the greatest health impact was found among continuous caregivers in Taiwan suggests that the effects of caregiving increase with the duration of

caregiving rather than following caregiving transitions. While caring for grandchildren is associated with positive changes in grandparents' physical and mental health, the increase in unmet health needs among the continuous caregivers deserves attention from healthcare providers working with this population.

6.2 Introduction

Although grandparenthood is a universal experience shared by people of different cultures, the act of grandparent caregiving does not have a single definition. In fact, the role of grandparents has been largely defined by racial and cultural differences [Mcgreal, 1994]. Several studies on grandparent caregiving have concluded that cultural norms and traditions can shape expectations about grandparent roles and subsequently affect grandparent well-being [Hermalin et al., 1998; Burnette, 1999; Goodman and Silverstein, 2002]. According to the theories that were used to describe this life stage for the elderly, there seems to be a huge divide between how grandparents in different countries view their responsibility in relation to grandchildren [Selzer, 1976; Kivett, 1991]. For example, previous studies of grandparents in the US have described grandparents' assumption of caregiving as an atypical event and a "time-disordered role" which may lead to feelings of entrapment [Minkler et al., 1997]. On the other hand, Chinese grandparents typically do not share the American norm in considering their participation in grandchild care as interfering with their adult children [Kamo, 1998]. With a societal emphasis on collective goals over individual goals, the contributions of Chinese grandparents to the welfare of their extended families enable them to achieve intergenerational reciprocity [Sheng and Settles, 2006]. This difference speaks to the need to re-visit the current debate on the effect of caregiving transitions on grandparent

caregivers, which until now have been based mostly on the evidence from the US.

The research interest behind caregiving transitions is built upon two different hypotheses: (1) long-term caregivers may show worsening health over time [Solomon and Marx, 1999]; (2) caregivers who recently assumed responsibility in caring for a grandchild may experience the greatest change in health [Minkler et al., 1997]. The majority of evidence from previous longitudinal studies of grandparent caregivers seemed to support the second hypothesis. Transition into grandchild care in the US has been shown to be highly correlated with elevated levels of depression [Minkler et al., 1997; Szinovacz et al., 1999]. Adaptation to the caregiver role among grandparents over an extended period, however, has manifested in a return to prior levels of well-being [Szinovacz et al., 1999; Hughes et al., 2007]. For instance, in a study of the transition in surrogate parenting and its effect on grandparents' psychological well-being, grandmothers reported worse depressive symptoms after grandchildren moved in [Szinovacz et al., 1999]. However, the study also found that grandchildren's continued stay in the household did not significantly increase grandmothers' depression, and grandchildren's moving out also did not lead to further reduction in grandparents' depression.

In a study on preventive health behaviors among grandmothers, Baker and Silverstein argued that two opposing factors influence the utilization of health services by the caregivers: raising a grandchild will increase the perceived barriers to preventive health behaviors due to the demand of caregiving but also increase the grandparents' motivation to stay healthy [Baker and Silverstein, 2008]. Drawing on the family adjustment and adaptation response theory [Patterson, 1988], the authors proposed that grandmothers would first reduce but subsequently increase preventive health behaviors as they adapt to the caregiver role [Baker

and Silverstein, 2008]. They tested those two hypotheses and found that long-term caregivers were more likely to report influenza vaccination than non-caregivers, while grandmothers who recently began caregiving showed suppression of preventive behavior during the transition into caregiving. This finding on the effect for those new to caregiving seemed to echo the Minkler et al (1997) study showing that caregivers who recently assumed grandchild care responsibility would experience the most change in health.

Few existing studies had longitudinal data to study the health effects of the transition into and out of caregiving for elderly grandparents. A recent article examining the pattern and transitions in grandparent caregiving reviewed seven publications on this topic [Musil et al., 2011]. Despite the limited number of previous studies, the authors concluded that the direction (type) of transition has different effects on grandparents health outcomes [Musil et al., 2011]. They also found that transition to higher levels of caregiving led to a decline in physical health and an increase in the stress level among the grandparents, although no effect was found on depressive symptoms. Given that none of the published studies of caregiving transition used samples from populations outside the US, it is important to examine the health effects of transitions in caregiving for grandparents living in different cultural contexts.

Hypotheses

While our study of Chinese grandparent caregivers identified positive health effects for the grandparents [see Chapter 4], it remains unclear whether the improvement in health was a temporary effect during the period of transition or whether the effect would build up over time for continuous caregivers. Since findings from the literature have indicated that

transition into grandchild care has a bigger impact than the duration of caregiving [Minkler et al., 1997; Szinovacz et al., 1999; Hughes et al., 2007; Musil et al., 2011], our study hypothesizes that among grandparent caregivers, those who started caregiving are expected to experience more pronounced health changes than those who continued to provide care to grandchildren. Since our underlying hypothesis is that caregiving brings positive health impacts for grandparents in the Chinese cultural context, we hypothesize that transition into caregiving is associated with positive changes in their physical and mental health. However, we hypothesize that transition into caregiving is associated with a decline in health services utilization due to the time constraint faced by a new grandparent caregiver. For grandparents who stopped caring for grandchildren, we expect to see no significant health effect as those former caregivers are likely to experience the counter-effect of whatever changes had occurred after the first transition.

The purpose of the current study is to examine the health effects of continuity and transition in caregiving status among grandparent caregivers in Taiwan. Drawing upon the Taiwan Longitudinal Study on Aging (TLSA), 1993-2003, this study provides a longitudinal analysis of whether the transitions into and out of caregiving have impacts on caregivers' health and health services use among Taiwanese grandparents.

6.3 Methods

Data

We analyzed data from the TLSA, which began in 1989 using a three-stage equal probability sampling design of the Taiwanese population aged 60 and above [Hermalin et al., 1989]. Follow-up interviews with the same respondents were done in 1993, 1996, 1999, and

2003. In addition to the first birth cohort selected in 1989, a second birth cohort of the population aged 50-66 was added in 1996, and a third birth cohort aged 50-56 was added in 2003. The analytical sample selected for this study included the first two cohorts of grandparents aged 50 and above from four waves (1993-2003) of the TLSA panel since the survey questions on grandparent caregiving first appeared in 1993. We did not include the third cohort of grandparents who were only surveyed in 2003 due to a lack of data to study caregiving transition after 2003.

The selection of the initial TLSA panel was conducted in 1989 using a three-stage equal probability random sampling design [Hermalin et al., 1989]. Since two individuals were randomly selected from each residential block (*lin*), it was highly unlikely to have more than one person selected from the same household, and the TLSA has always been used without further adjustment for household clusters [Bureau of Health Promotion, 2007].

Sample

Table 6.1illustrates the selection process from the pooled TLSA sample of 7,416 persons to the final study sample of 4,016 persons. Since 1993 was the year in which the survey questions on grandparent caregiving first appeared, we excluded 200 persons who were interviewed in 1989 but were missing in the 1993 survey. The second and the main inclusion criteria was to limit our sample to those who had at least one grandchild in any wave of the survey: 5,775 people were identified as grandparents during the study period. Grandparents who were older than 80, resided in an institution, or responded by proxy at their initial interview were excluded from our analysis since they were less likely to be caregivers due to health problems [Hughes et al., 2007; Lin, 2009]. However, those who lived in the

community at the baseline but subsequently moved into institutions or responded by proxy during follow-ups remained in our sample.

In order to measure transitions in grandparent caregiving status, which is the variable of interest in our study, we limited our sample to those who responded in at least two consecutive waves of the TLSA. Therefore, our analysis did not include those who only responded in 2003 or those who were lost to follow-up in successive waves. After excluding observations with missing values in caregiving transitions, our final study sample consisted of 4,016 grandparents from two cohort groups with a total of 8,758 person-intervals.

Measures

Grandparent caregiving transition status was grouped into four categories focusing on the type of change in caregiving status. First, a respondent's caregiver status was ascertained at the baseline wave in each consecutive person-interval. A grandparent was considered a caregiver once he or she responded "Yes" to the question "Do you currently provide assistance to babysit your grandchild(ren)?" in relation to each adult child. In addition to that main question about caregiving activity, we used three additional criteria including grandchildren's age to confirm a respondent's self-reported caregiver status. (See Section 3.5.3 in Chapter 3 for those criteria described earlier). We then compared the caregiver status at follow-up to define caregiving transition as follows: (1) those who did not care for grandchildren at one wave but started caregiving by the next wave; (2) those who cared for grandchildren continuously across two waves; (3) those who cared for grandchildren at one wave but stopped by the next wave; and (4) those who provided no care at two consecutive waves. This variable is operationalized as a series of dichotomous variables: started care,

stopped care, and continued care, with no care as the reference category.

While a grandparent caregiver could be living in a household with the presence or absence of either adult children or grandchildren, in our analysis we controlled for co-residence with adult children as previous studies have shown that grandparents in a skipped-generational household have been most likely to report negative health impacts from caregiving [Jendrek, 1993; Bowers and Myers, 1999; Blustein et al., 2004].

The four health outcome measures examined as our study outcomes were s*elf-rated health status, satisfaction with life, mobility limitations,* and *depressive symptoms.* Self-rated health was measured using a 1-5 ordinal scale on the following question: “Regarding your state of health, do you feel it is: excellent, good, average, not so good, or poor?” The measure of satisfaction with life in the TLSA was adopted from the Life Satisfaction Index A (LSIA) [Neugarten et al., 1961]. We selected the four items used in 1993 to be the common basis for measuring life satisfaction in this study using four waves of the TLSA. The respondent was asked “whether you agree or disagree with the sentence on feeling about life: (1) Have your life been better than most people’s lives? (2) Have these last few years been the best in your life? (3) Do you expect that in the future happy things will occur? (4) Are you satisfied with your life?” Each “yes” response was counted as a 1 and a “no” was a 0; points were added up to a summary score ranging from 0 (least satisfied) to 4 (most satisfied).

The mobility limitation measure in the TLSA contained items adapted from the Nagi scale [Nagi, 1976]. Due to variations in the number of scale items surveyed across waves, we chose the common six tasks that were available from 1993 to 2003. The number of mobility limitations counted the following six activities: standing continuously for 15 minutes, lifting or carrying 11–12 kg, squatting, reaching over one’s head, grasping with one’s fingers, and

running or jogging a short distance (20–30 meters). We considered it a mobility limitation if a respondent had some or more difficulty performing the specific functional task.

Depressive symptoms were measured using a 10-item Chinese version of the original 20-item Center for Epidemiological Studies Depression (CES-D) Scale [Radloff, 1977], which has been validated in cross-cultural studies including Chinese populations [Krause and Liang, 1992; Ofstedal et al., 1999]. For each of the ten CES-D items, respondents were asked to rate the frequency of their experience on a four-point scale (0-3), and then all items were summed up to a total score ranging from 0 (not depressed) to 30 (most depressed) [Andersen et al., 1994].

In addition to the four measures of the grandparents' physical and mental health, we also examined three outcome variables related to their health services utilization. Whether a person has any *unmet health needs* was constructed from the following question: "In the past three months, have you been in discomfort and thought about seeing a doctor but didn't go?" *Frequent* c*linic visits* was a dichotomous measure of whether the respondent had at least three visits to Western medical clinics (excluding hospitalization or emergency unit) in the past month. *Frequent outpatient care visits* was defined as whether the respondent had at least four visits to any of the following three outpatient care setting in the past month: (1) a Western medical clinic; (2) a Chinese medical clinic; or (3) a pharmacy. We could not use these measures as continuous variables due to a response category of "too many to recall" that was coded for 8% of all responses in 1996. Due to changes in the survey questionnaires, 1996 was the only wave that this response category was included and therefore could be compared with other waves. Because our research interest was to determine whether caregiving leads to excessive health services utilization rather than any utilization, we chose

having at least three visits to Western medical clinics or at least four outpatient visits per month to identify frequent use of health care services.

Control variables are as follows: (1) socio-demographic characteristics: gender, age groups, marital status, ethnicity, education level, geographic location, work status, and economic status; (2) exchanges of social support: emotional support, instrumental support (received help with household chores), financial support (received from or provided by any adult children); (3) disease indicators of nine common chronic conditions available in the TLSA from 1993 to 2003: high blood pressure, diabetes, heart disease, stroke, cancer, respiratory ailment, arthritis or rheumatism, gastric ulcer, and liver or gall bladder disease; and (4) wave dummies for each survey that were included to account for general time trends. We did not control for health insurance status because all citizens living in Taiwan are covered by the mandatory national health insurance system since 1995 [Bureau of National Health Insurance, 2010].

Analysis

Since our key explanatory variable was a measure of transitions in grandparent caregiving (GC) status, we regressed each outcome at Time 2 of the consecutive person-interval on our four-category caregiving transition measure (started care, stopped care, and continued care, with no care as the reference category) while controlling for other covariates *X* that were measured at Time 1 using the following equation:

$$HO_{i2} = \alpha + \beta_d (GC_{i2} - GC_{i1}) + \delta X_{i1} + \varepsilon_{it} \quad (1)$$

We estimated ordinary least squares regression (OLS) for the four continuous measures of health and logistic models for the three dichotomous outcomes of health services

utilization. Because each respondent may have contributed from one up to three person-intervals in the data, the observations are not stochastically independent and thus clustering by individual was used in all models to adjust for correlated standard errors. Finally, we chose not to weight our multivariate analysis since our analysis had controlled for age; sampling weights were primarily needed to correct for age distribution of different cohorts [Bureau of Health Promotion, 2007].

In addition to our main analyses, we estimated two additional models to examine the impact of caregiving transition on grandparents' health. The first method used was a lagged dependent variable approach widely used in the literature on caregiving transitions [Hughes et al., 2007; Baker and Silverstein, 2008; Baker and Silverstein, 2008]. The second method was a change score approach which differenced all variables in the model including both the outcome and the explanatory variables. Details on the equations estimated and the results of these two alternative models are presented in Appendix 2, while the rest of the discussion will be based on results from estimation of equation (1).

6.4 Results

Table 6.1 shows the descriptive statistics for the analysis sample. Here we use individuals as the unit of analysis rather than person-intervals and therefore present baseline characteristics of 4,016 elders who responded in at least two consecutive survey waves. In this sample of grandparents, 64.2% had not provided caregiving to grandchildren in two consecutive periods, while about an equal percentage of grandparents (11%) either started caregiving or continued with caregiving by follow-up. Regarding the pattern of living arrangement at baseline, we found that the majority of grandparents were living with adult

children; 46.5% reported living in a multigenerational household with both adult children and grandchildren and 27.7% lived with only adult children. Only 3% of the elders lived in a skipped-generational household with grandchildren only.

We provide transition matrices for grandparent caregiving status in Table 6.2 to show the distribution of different types of transitions. Because the unit of analysis is person-intervals, the distribution of transition status is not the same as Table 6.1. The first two rows showed that for all sample reporting caregiving status in two consecutive waves, that status is rather stable with 66.6% not caring for grandchildren at all. Transition into caregiving occurred among 10.9% of our observations, and 14.1% transitioned out of caregiving during follow-up. The remaining 8.4% of the sample stayed as grandparent caregivers in both time periods. A comparison of caregiving transition status by grandparents' co-residence with adult children revealed that the percentage of intervals spent in continued caregiving (3.2%) is much lower than the number found among grandparents living with at least one adult child (10.4%). In other words, caregiving transition status varied by type of co-residence.

Table 6.3 shows the effects of three types of caregiving transition on the four health measures estimated by OLS regression, after controlling for adult children co-residence, grandparents' socio-demographic and disease indicators, as well as exchanges of social support in the household. The results showed that grandparents who started caregiving between the waves reported significantly higher self-rated health, as well as fewer mobility limitations and fewer depressive symptom relative to the non-caregivers in both waves. Those who continued to provide care to grandchildren over time also reported significant differences in all outcomes, with positive effects found for favorable health outcomes such as self-rated health and negative effects found for unfavorable health outcomes such as mobility

limitations. Comparing the effect size between those who started caregiving to those continued with caregiving showed that the estimate of the effect of caregiving on all health outcomes were smaller for the new caregivers, e.g., the coefficient on self-rated health was 0.21 for those who continued caregivers but 0.09 for those who started caregiving. Those who provided care initially but then stopped caregiving also reported better health outcomes compared to those who were non-caregivers in both waves. In addition, we also found evidence that co-residence with at least one adult children was significantly associated with fewer depressive symptoms but more mobility limitations.

Since our measures of health services utilization were dichotomous variables, the results of the effects of caregiving transition from logistic regressions are shown in Table 6.4. Grandparents who continued to provide care to grandchildren were more likely to report having unmet health needs (OR=1.41) as compared to the non-caregivers. In contrast, grandparents who stopped caregiving recently were less likely to have unmet health needs. They also reported fewer visits to either a clinic (OR=0.78) or any outpatient setting (OR=0.75). This result suggests that for the former caregivers, both actual and needed health services use seemed to fall after they stopped caregiving. On the other hand, no significant difference in any of the three utilization measures was found for those who started caregiving compared to the non-caregivers.

Figure 6.2 displays the predicted probabilities of each health services use measure by grandparent caregiving transition status. The calculation of these predicted probabilities is based on the logic regression results in Table 6.4. These are the average predicted probabilities in which every person in the data were treated as if they had one type of caregiving transition status before switched to the other. Therefore, the differences in the

probabilities shown in the figure reflect only the marginal difference of caregiving status while holding all other variables constant. The predicted probability of having unmet health needs among those continued caregiving was 16%, a number significantly higher than the 12% of the referent group of non-caregivers who did not care for grandchildren in both waves. Our model also predicted that only 10% of those who stopped caregiving would have unmet health needs, which is significantly lower when compared to the non-caregivers (p= 0.03). Looking at health care visits, non-caregivers were found to have the highest predicted probability (24%) of having frequent clinic visits, whereas those who stopped caregiving had a lower probability (20%) of frequent clinic visits. Finally, we observed a similar pattern of decrease in outpatient care visits among caregivers who stopped providing care compared to those who never participated in caregiving. The predicted probability among the stopped caregivers was 21% that was significantly lower than 26% predicted for the non-caregivers.

6.5 Discussion

In this study we examined the effects of transitions in grandparent caregiving on the health and health services use among grandparents in Taiwan. While the existing debate on the effects of grandparent caregiving has focused on comparing the effects of transition versus duration, the literature is based on the premise that caring for grandchildren has negative health impact on grandparents since all studies were conducted on grandparents in the US. However, given our earlier finding that caregiving appeared to be beneficial for grandparents (see Chapter 4), we were interested in whether the observed health improvement came from an abrupt transition or an accumulation of continuous engagement in grandchild care. Results from our analysis show a quite different picture from previous

studies and offer new insights into the existing debate on the effects of transitions in caregiving.

Our descriptive analysis on the pattern of caregiving transition showed that transitions actually occurred somewhat infrequently; 75% of the observations remained in the same caregiving status in a span of 3 to 4 years between two TLSA waves. Still, more than one-third of our sample helped care for a grandchild at some point during that observation period. In our regression analysis, we found support of our hypothesis that transition into caregiving was associated with positive changes in measures of physical and mental health of Taiwanese grandparents. But we did not expect the effects among those who continued to provide care to be more pronounced than those new caregivers. This finding deserves special attention since it is not consistent with the adaption perspective [Lawton et al., 2000]. According to the adaption theory, we would expect that the changes in health experienced by a caregiver during transition, regardless of its directional effect, should decrease for continuous caregivers as they adapt to the situation over time. However, our finding of the greatest health impact being observed among continuous caregivers in Taiwan may be explained by the cultural context. If caring for grandchildren is welcomed by the grandparents rather than viewed a time-disordered role, we would not expect such a drastic impact during the role transition period as found in the US literature of grandparent caregivers. Instead, the gradual effects of caregiving would accumulate over time and increase with the duration of caregiving for the continuous caregivers.

Although we hypothesized that grandparents who transitioned out of caregiving would see insignificant health effects as they experienced an opposite change of their first transition into caregiving, our main results did not support that hypothesis since grandparent caregivers

reported fewer mobility limitations compared to those non-caregivers. To further explore this issue, we compared the finding from alternative model specifications in which we controlled for health status at baseline to address for possible selection effect of healthier caregivers (see Appendix 2 Table A2.2). We concluded that the positive effect of caregiving did not last after grandparents stopped caregiving, since significant change in health was found for those who stopped caregiving after controlling for selection by time-invariant unobserved characteristics.

Regarding our hypothesis that those who started caregiving would suppress health services use while those continued to care for grandchildren would increase utilization, our results on the measures of unmet health needs and outpatient visits did not fully support that hypothesis and need to be interpreted with caution. Once again we found little evidence to support the adaptation theory predicting increased in healthcare utilization, since grandparents who continued to provide care were more likely to report unmet health needs than non-caregivers. More importantly, having unmet needs was the only negative impact we have identified for grandparent caregivers in this study, as the effect was reversed for those who stopped caregiving.

Although we did not find a significant effect on health services use for those who transitioned into caregiving, the absence of a significant effect may be due to the two opposing effects at work. On the one hand, transition into caregiving gives the grandparents less time to go the doctor, which in turn reduces health services utilization and possibly increases unmet health needs. On the other hand, based on our finding that those who started caregiving also reported better health status and fewer limitations, they may also have fewer outpatient visits and fewer unmet health needs. Another possible explanation for the lack of

significant effect during transition into caregiving could be that the adaptation theory is originally used to explain to health maintenance behavior and thus less applicable to office visits.

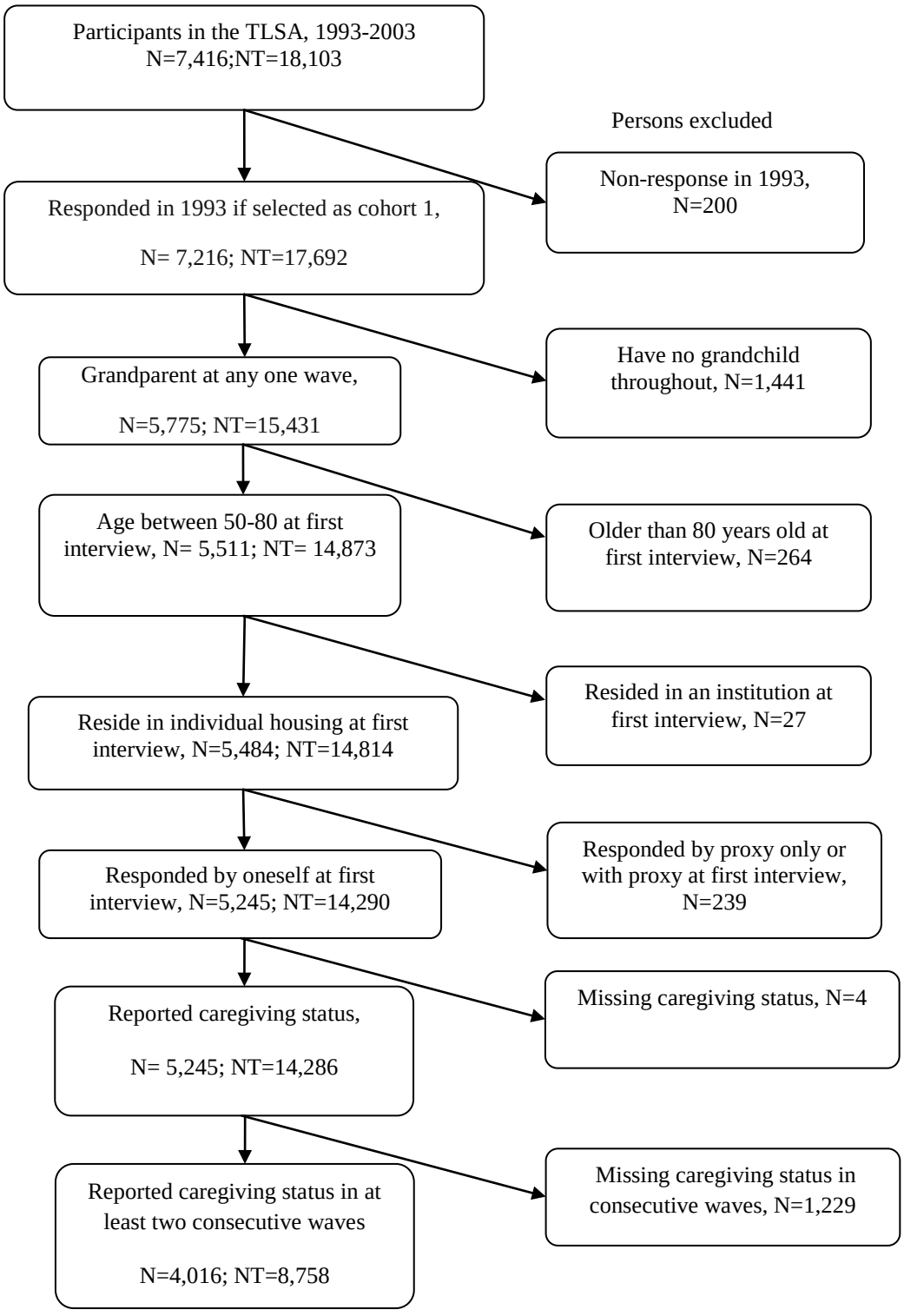
While we used a panel dataset to study the effects of transitions in grandparent caregiving, in our main analysis we treated the data as pooled cross-sectional analyses adjusting for individual-level clustering. We did not analyze our data using panel data methods mainly because we have chosen a logistic specification for dichotomous outcomes such as unmet health needs, but fixed effects methods for non-linear models such as conditional logit models could not be estimated for those whose caregiving status remained unchanged (e.g. who continued with caregiving). Therefore, our findings of positive changes in grandparents' health among the caregivers could have been overstated due to potential selection bias unadjusted in our main models. However, after performing additional analyses that better controlled for unobserved selection, we confirm that a small but significant health improvement was found in mobility limitations and depression among those who started or continued with caregiving.

The TLSA is not a survey about caregiving or grandparenting, and several data limitations should be noted for this analysis. First, there was no standard definition of caring for grandchildren since no exact measure of caregiving by hours was reported in the dataset. The caregiving status variable based on the grandparent's answer to whether he or she helped care for a grandchild is thus subjective. The data are also limited in context-specific variables that were available in other qualitative studies of grandparent caregiving. For example, we did not have direct measures of the burden or stress reported by the grandparent caregivers. We also lacked information on the age of a grandchild cared by the grandparent: the survey

questions only refer to grandchildren as 18 years old or younger when asking grandparents about their caregiving activity. Furthermore, the tradeoff of using a nationally representative sample of the TLSA is that the small percentage of caregivers identified in our study limited our ability to further investigate the heterogeneity in caregiving transition. Future analysis focusing on the sub-population of grandparent caregivers should consider how the transitions in caregiving and its effect on caregivers' health may differ by the type of living arrangement.

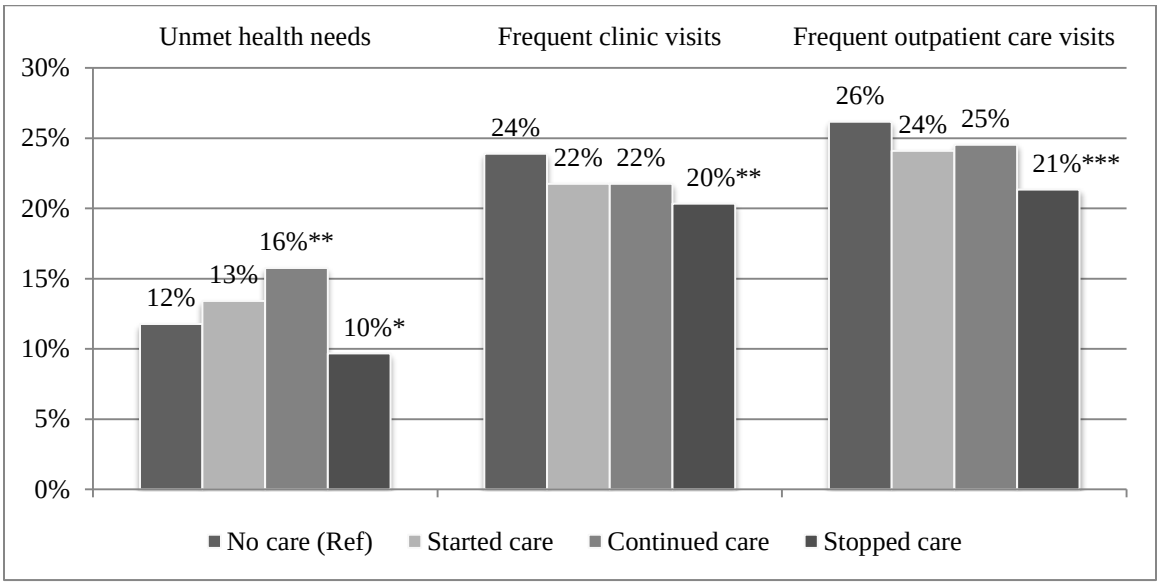
Despite these limitations, a unique contribution of this study on the health impact of transition in grandparent caregiving is to provide evidence from a culture in which caregiving appears to be beneficial for grandparents. Our findings from Taiwanese grandparents suggest that the health improvement experienced by caregivers come from the duration of caregiving rather than the effects of transitions. While caring for grandchildren is associated with positive changes in grandparents' physical and mental health, the increase in unmet health needs among the continuous caregivers should not be overlooked. The health needs of these grandparents with long-term commitment to care for grandchildren may require special attention from healthcare providers to ensure that they are not negatively affected by the caregiving responsibility.

Figure 6.1 Study sample flow chart



N: Number of unique persons; NT: Number of person-year observations

Figure 6.2 Predicted probabilities of health services utilization by grandparent caregiving transition status



Source: predicted probabilities based on results from Table 6.4

* p<0.05 ** p<0.01 *** p<0.001

Table 6.1 Descriptive statistics at first wave for grandparent sample in at least two consecutive waves (n=4,016)

Characteristics	Mean or %	SD
Grandparent caregiving transition status		
Started care	11.3%	
Continued care	11.1%	
Stopped care	13.3%	
No care	64.2%	
Living arrangement		
With adult children and grandchildren	46.5%	
With adult children only	28.2%	
With grandchildren only	3.0%	
With spouse only	16.7%	
Living alone	4.9%	
Missing	0.8%	
Health outcomes		
Self-rated health (1-5)	3.36	1.10
Life satisfaction scale (0-4)	2.53	1.33
Mobility limitations (0-6)	0.91	1.42
CES-D (0-30)	5.68	5.62
Unmet health need (yes/no)	13.5%	
>=3 clinic visits (yes/no)	19.0%	
>=4 outpatient visits (yes/no)	24.5%	
Covariates		
Female	51.2%	
Age	64.54	7.39
Marital status		
married	77.0%	
div/sep/widowed/single	23.0%	
Ethnicity		
Fuchien	68.8%	
Hakka	17.3%	
Mainlander	12.5%	
Other	1.4%	
Education years		
0 years	34.0%	
1-6 years or literate	46.2%	
>= 7 years	19.8%	
Location		
Rural	57.4%	
Urban	42.6%	
Working currently		
Yes	34.5%	

Table 6.1 Descriptive statistics at first wave for grandparent sample in at least two consecutive waves (n=4,016)

Characteristics	Mean or %	SD
No	65.5%	
Economic status		
Have difficulty	16.5%	
Have enough money	62.2%	
Have plenty of money	21.3%	
Social support		
Emotional support		
Very unsatisfied- Average	17.4%	
Satisfied	45.8%	
Very satisfied	36.8%	
Receive support with chores (yes/no)	56.5%	
Financial support to children (yes/no)	7.4%	
Financial support from children (yes/no)	70.7%	
Disease indicators		
High blood pressure	25.6%	
Diabetes	9.3%	
Heart disease	14.1%	
Stroke	3.2%	
Cancer	1.0%	
Respiratory ailment	9.0%	
Arthritis or rheumatism	16.6%	
Gastric ulcer	13.2%	
Liver or gall bladder disease	5.3%	

Note: Unweighted baseline data from 1993-1999; respondents in 2003 only are excluded. SD=standard deviation

Table 6.2 Grandparent caregiving transition status by co-residence with adult children

		Caregiving status at:		
		Second wave		
	First wave	Caregiving	Not caregiving	N
Total	Caregiving	8.4% (continued)	14.1% (stopped)	8,759[a]
	Not caregiving	10.9% (started)	66.6% (no care)	
1+ co-resident adult child				
	Caregiving	10.4%	16.3%	5,878
	Not caregiving	12.0%	61.2%	
No co-resident adult child				
	Caregiving	3.2%	8.7%	2,880
	Not caregiving	7.9%	80.3%	

[a] Person-interval data from 1993-2003

Table 6.3 OLS Regressions of health measures on grandparent caregiving transition status

Explanatory Variables	Dependent variables Self-rated health	Life satisfaction	Mobility limitations	Depression
Grandparent caregiving transition status (ref. no care)				
Started care	0.09*	0.02	-0.29***	-0.37
	(0.04)	(0.04)	(0.05)	(0.20)
Continued care	0.21***	0.11*	-0.42***	-1.06***
	(0.04)	(0.05)	(0.06)	(0.22)
Stopped care	0.09**	0.09*	-0.18***	-0.45*
	(0.03)	(0.04)	(0.05)	(0.19)
Have 1+coresident adult children	0.04	0.05	0.13***	-0.33*
	(0.03)	(0.03)	(0.04)	(0.15)
Demographics				
Female	-0.13***	0.03	0.51***	1.17***
	(0.03)	(0.04)	(0.05)	(0.17)
Age group (ref. 50-60)	-0.14***	-0.05	0.40***	0.39*
Age 60-69	(0.03)	(0.04)	(0.05)	(0.18)
	-0.21***	-0.02	0.93***	0.70***
Age 70-79	(0.04)	(0.05)	(0.06)	(0.21)
	-0.36***	-0.05	1.82***	1.21**
Age 80+	(0.07)	(0.09)	(0.11)	(0.45)
Married (ref. Div/sep/widowed/single)	0.04	0.17***	-0.08	-0.64***
	(0.03)	(0.04)	(0.05)	(0.19)
Ethnicity (ref. Fuchien)				
Hakka	0.16***	0.01	-0.09	-0.20
	(0.03)	(0.04)	(0.05)	(0.19)
Mainlander or other	0.06	-0.03	-0.04	0.07
	(0.04)	(0.05)	(0.06)	(0.23)
Education (ref. 0 year)				
1-6 years or literate	0.12***	0.21***	-0.28***	-1.14***
	(0.03)	(0.04)	(0.05)	(0.19)
>= 7 years	0.30***	0.41***	-0.51***	-1.71***
	(0.04)	(0.05)	(0.06)	(0.24)
Location (ref. Rural)				
Urban	0.15***	0.07*	-0.08*	0.15
	(0.03)	(0.03)	(0.04)	(0.15)
Working	0.17***	-0.04	-0.42***	-0.37*
	(0.03)	(0.04)	(0.04)	(0.16)
Economic status (ref. Have difficulty)	0.22***	0.60***	-0.27***	-2.55***
Have enough money	(0.03)	(0.04)	(0.05)	(0.19)
	0.35***	0.81***	-0.34***	-3.22***
Have plenty of money	(0.04)	(0.05)	(0.06)	(0.24)
Emotional support (ref. Unsatisfied to Average)				
Satisfied	0.21***	0.29***	-0.13**	-1.60***
	(0.03)	(0.04)	(0.05)	(0.21)

Table 6.3 OLS Regressions of health measures on grandparent caregiving transition status

	Dependent variables			
Explanatory Variables	Self-rated health	Life satisfaction	Mobility limitations	Depression
Very satisfied	0.31***	0.52***	-0.21***	-2.31***
	(0.03)	(0.04)	(0.05)	(0.21)
Receive support with chores	-0.07**	0.06	0.17***	0.07
	(0.02)	(0.03)	(0.03)	(0.14)
Financial support to children	0.05	0.01	0.01	0.11
	(0.05)	(0.05)	(0.07)	(0.26)
Financial support from children	-0.06**	0.00	0.04	-0.05
	(0.02)	(0.03)	(0.04)	(0.14)
Disease indicators				
High blood pressure	-0.19***	-0.04	0.21***	0.36*
	(0.03)	(0.03)	(0.04)	(0.16)
Diabetes	-0.33***	-0.05	0.49***	0.83***
	(0.04)	(0.05)	(0.07)	(0.24)
Heart disease	-0.22***	-0.01	0.30***	0.97***
	(0.03)	(0.04)	(0.05)	(0.21)
Stroke	-0.44***	-0.36***	1.43***	1.35**
	(0.06)	(0.08)	(0.13)	(0.49)
Cancer	-0.02	0.09	-0.06	-0.24
	(0.09)	(0.10)	(0.14)	(0.50)
Respiratory ailment	-0.26***	-0.11*	0.22***	1.13***
	(0.04)	(0.05)	(0.06)	(0.25)
Arthritis or rheumatism	-0.17***	-0.10**	0.46***	0.65***
	(0.03)	(0.04)	(0.05)	(0.18)
Gastric ulcer	-0.15***	-0.02	0.07	0.80***
	(0.03)	(0.04)	(0.05)	(0.19)
Liver or gall bladder disease	-0.14**	-0.11*	0.08	0.92**
	(0.05)	(0.06)	(0.07)	(0.29)
Wave dummies				
1999	0.04	0.15***	0.10*	-1.37***
	(0.03)	(0.04)	(0.04)	(0.17)
2003	0.02	0.22***	0.25***	-1.84***
	(0.03)	(0.04)	(0.05)	(0.18)
Constant (1996)	2.79***	1.31***	0.94***	10.39***
	(0.07)	(0.09)	(0.11)	(0.45)
Person-intervals	8,249	7,850	8,366	7,903
R-squared	0.181	0.134	0.298	0.173

Notes: * p<0.05 ** p<0.01 *** p<0.001; Robust standard errors in parentheses
Ordinary least squares (OLS) models on person-interval data of grandparents in at least two consecutive TLSA waves (1993-2003)

Table 6.4 Logistic regressions of health services use on grandparent caregiving transition status

Explanatory Variables	Dependent variable								
	Unmet health needs			Frequent clinic visits			Frequent outpatient visits		
Grandparent caregiving and transition status									
Started care	1.16	(0.94	1.44)	0.89	(0.75	1.07)	0.89	(0.75	1.07)
Continued care	1.41**	(1.12	1.78)	0.87	(0.71	1.07)	0.89	(0.73	1.09)
Stopped care	0.80*	(0.65	0.99)	0.78**	(0.67	0.92)	0.75***	(0.64	0.88)
Have 1+coresident adult children	0.89	(0.76	1.03)	0.97	(0.86	1.09)	0.94	(0.83	1.06)
Demographics									
Female	1.40***	(1.17	1.68)	1.11	(0.97	1.28)	1.12	(0.98	1.28)
Age group (ref. 50-60)									
Age 60-69	0.68***	(0.55	0.83)	1.19*	(1.01	1.40)	1.00	(0.85	1.18)
Age 70-79	0.60***	(0.48	0.75)	1.22*	(1.02	1.47)	0.95	(0.80	1.14)
Age 80+	0.68*	(0.46	0.99)	0.85	(0.61	1.19)	0.54***	(0.39	0.77)
Married (ref. div/sep/widowed/single)	0.92	(0.78	1.09)	0.99	(0.87	1.13)	0.94	(0.82	1.07)
Ethnicity (ref. Fuchien)									
Hakka	0.81	(0.66	1.00)	0.99	(0.85	1.15)	0.93	(0.80	1.08)
Mainlander or other	0.90	(0.71	1.14)	0.88	(0.74	1.06)	0.68***	(0.56	0.82)
Education (ref. 0 year)									
1-6 years or literate	0.90	(0.76	1.07)	0.95	(0.83	1.09)	0.91	(0.80	1.04)
>= 7 years	0.72*	(0.55	0.94)	0.69***	(0.57	0.84)	0.65***	(0.53	0.79)
Location (ref. Rural)									
Urban	1.33***	(1.15	1.54)	0.71***	(0.63	0.80)	0.80***	(0.71	0.90)
Working	1.01	(0.84	1.20)	0.85*	(0.74	0.98)	0.85*	(0.74	0.98)
Economic status (ref. Have difficulty)									
Have enough money	0.69***	(0.60	0.81)	0.70***	(0.62	0.80)	0.67***	(0.59	0.75)
Have plenty of money	0.52***	(0.38	0.71)	0.51***	(0.40	0.64)	0.44***	(0.35	0.57)
Social support									
Emotional support (ref. Unsatisfied to Average)									
Satisfied	0.74***	(0.63	0.88)	1.07	(0.92	1.24)	1.01	(0.87	1.16)
Very satisfied	0.68***	(0.57	0.83)	0.98	(0.84	1.15)	0.94	(0.81	1.10)
Receive support with chores	1.01	(0.85	1.19)	1.10	(0.95	1.26)	1.19*	(1.04	1.36)

Table 6.4 Logistic regressions of health services use on grandparent caregiving transition status

Explanatory Variables		Dependent variable: Unmet health needs			Frequent clinic visits			Frequent outpatient visits		
	Financial support to children	1.13	(0.84	1.53)	1.23	(0.97	1.57)	1.12	(0.88	1.41)
	Financial support from children	1.15	(1.00	1.34)	1.17**	(1.04	1.32)	1.17**	(1.04	1.31)
Disease indicators										
	High blood pressure	0.89	(0.76	1.04)	1.36***	(1.20	1.53)	1.25***	(1.10	1.41)
	Diabetes	0.74**	(0.60	0.91)	1.03	(0.88	1.21)	1.09	(0.93	1.27)
	Heart disease	0.98	(0.82	1.18)	1.62***	(1.42	1.86)	1.61***	(1.40	1.84)
	Stroke	1.21	(0.87	1.70)	1.08	(0.83	1.41)	1.11	(0.85	1.44)
	Cancer	0.77	(0.48	1.24)	1.92***	(1.40	2.64)	1.60**	(1.15	2.22)
	Respiratory ailment	1.18	(0.96	1.45)	1.80***	(1.53	2.12)	1.93***	(1.64	2.27)
	Arthritis or rheumatism	1.24**	(1.06	1.47)	1.42***	(1.24	1.62)	1.56***	(1.37	1.77)
	Gastric ulcer	1.15	(0.97	1.36)	1.44***	(1.26	1.66)	1.60***	(1.40	1.83)
	Liver or gall bladder disease	1.16	(0.90	1.48)	1.17	(0.95	1.44)	1.29*	(1.05	1.59)
Wave dummies										
	1999	0.67***	(0.56	0.79)	0.87	(0.76	1.00)	0.69***	(0.60	0.79)
	2003	0.77**	(0.65	0.92)	0.58***	(0.50	0.67)	0.43***	(0.37	0.50)
	Constant (1996)	0.32***	(0.21	0.49)	0.31***	(0.22	0.44)	0.49***	(0.35	0.69)
Person-intervals		8071			8038			8072		
R-squared		0.040			0.070			0.086		

Notes: Coefficients are odds ratios (95% confidence intervals in parentheses); * p<0.05 ** p<0.01 *** p<0.001
Logistic regressions on person-interval data of grandparents who are in at least two consecutive TLSA waves (1993-2003)

CHAPTER 7. CONCLUSIONS

7.1 Summary of findings

This dissertation seeks to estimate the health impact of caring for grandchildren on grandparent caregivers using a longitudinal sample from the Survey of Health and Living Status of the Elderly in Taiwan. The main objective of this dissertation is to determine whether Taiwanese grandparents experience effects of caregiving on their physical health, mental health, and health care utilization compared to grandparents not caring for grandchildren. This dissertation includes three empirical studies which used different methods to examine different aspects of grandparent caregiving. The first paper uses panel data analyses to estimate the impact of caring for grandchildren on the physical health, psychological well-being, and health services utilization of Taiwanese grandparents. The second paper explores instrumental variable estimation to determine the marginal effect of caregiving on the health and health services use for those grandparents whose caregiving decision was affected by having more adult children married or more grandchildren. The third paper examines the effects of continuity and transition in caregiving for grandchildren on the health and health services use of grandparents in Taiwan. This concluding chapter briefly reviews the main findings from the three papers, discusses overall policy implications and limitations and provides recommendations for future research.

Paper 1 (Chapter 4): The impact of caring for grandchildren on the health and health services utilization of grandparents in Taiwan

This study compared the physical health and psychological well-being of Taiwanese grandparents by caregiving status and found that the effect of caregiving varied by the health outcome examined. We found support of our hypothesis that caregiving can be beneficial for grandparents who were currently providing care to grandchildren as they reported higher self-rated health, fewer mobility limitations, and fewer depressive symptoms. Our finding suggests that even though healthier Taiwanese grandparents were more likely to care for grandchildren, after controlling for selection into caregiving affected by baseline health, caregiving still had a beneficial health effect for the grandparents in reducing mobility limitations and depression.

Among the three types of caregivers in different living arrangement, caregivers in multigenerational families experienced the most health improvement, while babysitters reported no statistically significant change in health. This supports our hypothesis that the effect of grandparent caregiving varies by co-residence with adult children, since caregivers in multigenerational household presumably have more support in caregiving from the parents of the children.

Since we found mainly positive effects of caregiving on the health of Taiwanese grandparents, one could speculate that the demand for healthcare services would also go down; however, no significant difference was found in outpatient utilization by caregiving status, except that skipped-generation caregivers were more likely to have unmet health needs. A higher likelihood of having unmet health need was also the only negative consequence associated with caregiving identified in our study.

Paper 2 (Chapter 5): The health effects of grandparent caregiving in Taiwan: an

instrumental variable estimation

In this study we seek to determine whether selection into caregiving biases the health effect of caregiving among Taiwanese grandparents who were ever-caregivers for their grandchildren during the decade from 1993 to 2003. We explored both FE and IV estimation methods to address these two kinds of endogeneity that could lead to biased OLS estimates of the effect of grandparent caregiving. We concluded from our IV analysis that caring for grandchildren was endogenous in the model of life satisfaction, mobility limitations, and unmet health needs. Our findings suggested that grandparent caregiving has a large impact on reducing mobility limitations and unmet health needs, though these effects are the Local Average Treatment Effect pertaining to marginal caregivers. For the measures of self-rated health and depression, our preferred FE estimates implied that caregiving had a small but significant positive effect on those outcomes. While grandparent caregivers were less likely to have unmet health needs, no significant change was found on having excessive outpatient care use.

Grandparent caregiving was found to significantly reduce mobility limitations and unmet health needs after controlling for the endogeneity of caregiving; yet the findings from the IV model need to be interpreted with caution. First, the estimated effect applies not to the general grandparent population but to a subgroup of caregivers whose caregiving decision was affected by having more grandchildren. Secondly, it does not represent the effects of grandparent caregiving for those former caregivers who have stopped caregiving. In conclusion, the beneficial effects of caregiving for the marginal caregivers were identified after controlling for potential selection bias and support our hypothesis of positive health impacts among grandparent caregivers in Taiwan.

Paper 3 (Chapter 6): The effects of transitions in caregiving on the health and health services utilization of grandparents in Taiwan

In this study we examined the effects of transitions in grandparent caregiving on the health and health services use among grandparents in Taiwan. Since we have found positive health impact associated with grandparent caregiving in the previous two studies of this dissertation, the subsequent research question was whether the observed health improvement came from an abrupt transition or an accumulation of continuous engagement in grandchild care. We found support of our hypothesis that transition into caregiving was associated with better outcomes in measures of self-rated health and mobility limitations. But the fact that the greatest health impact was found among continuous caregivers and not those new caregivers suggests that the effects of caregiving increase with the duration of caregiving rather than following caregiving transitions.

Although no significant effect was found on either clinic visits or outpatient use following caregiving transitions, we found those who continued to provide care were more likely to report unmet health needs than non-caregivers. More importantly, having unmet needs was the only negative impact we have identified for grandparent caregivers in this study, as the effect was reversed for those who stopped caregiving. While caring for grandchildren is associated with positive changes in grandparents' physical and mental health, the increase in unmet health needs among the continuous caregivers deserves attention from healthcare providers working with this population.

7.2 Policy implications

Considering the lack of previous research on grandparent caregiving in Taiwan, findings from this nationally representative sample address an important question affecting a growing proportion of the Taiwanese population. In our study we found that more than 25% of all Taiwanese grandparents reported caring for grandchildren in 2003. With a growing population of elderly currently making up more than 10% of the entire population of Taiwan, this study fills an important gap in how participation by grandparents may impact their health.

Given that we have found evidence of positive health impact for grandparent caregivers, this may be viewed as support for the influence of Chinese familism culture and reassuring for grandparents. Not only can grandparents help both their adult children and grandchildren simultaneously through caregiving, but they can derive health benefit from this role. Specifically, our finding that grandparents enjoy improvement in both self-rated health and mobility after caring for their grandchildren counters the stereotype that the elderly are either too frail to assume the role of grandparent caregivers or that such responsibility is too demanding on their health.

In addition to the direct effect on grandparents, caregiving also has a broader impact on the entire family. For instance, our findings should be welcomed by the adult child generation as they may be more willing to ask the grandparents for childcare assistance if they see caregiving is beneficial and not creating a burden. In light of the growing need of childcare support following a steady increase in female labor force participation over the years [Directorate General of Budget, 2006], policymakers in Taiwan may want to consider social policies that encourage family co-residence and intergenerational support as an alternative to

formal childcare supply.

While this study highlights the positive aspect of grandparent caregiving, it is important to note that we have also identified one negative effect. Caregivers in skipped-generation household and those who continued to provide caregiving over a span of three to four years were more likely to report having unmet health needs. This finding serves as a good reminder that caregiving could still compromise the health of those grandparents with little support. Grandparents who cared for grandchild alone or provided care over an extended period may be most in need of additional help from social welfare agencies to avoid negative health consequences of caregiving.

7.3 Limitations and future research

This section identifies several limitations for studies conducted in this dissertation and suggests areas in need of future research. Since all studies used the same data (TLSA), we begin by discussing data-related limitations common to all three studies and next to limitations that are unique to a specific study. Finally, we propose three directions for further research on grandparent caregivers.

Although the TLSA is a dataset that contains rich information on the health and health care utilization of the elderly respondent, the lack of full comparability of survey questions across waves presents a challenge to its use in longitudinal analysis. For example, we had to comprise our choice of some key dependent variables in in our analysis due to changes in survey design. The measure of life satisfaction was limited to four common items across survey waves and a change in response item prevented us from using the measures of clinic visits and outpatient care use as continuous variables. While we tried to minimize these

differences in variable construction, changes in measurement across waves could limit the reliability of these variables.

Because the TLSA is not a survey specific to the study of caregiving or grandparenting, there was no standard definition of grandparent caregiving, and no exact measure of caregiving hours was reported in the dataset. The caregiving status variable constructed in our study was based on the grandparents' self-report of to whether he or she helped caring for a grandchild. The data are limited in providing other context-specific variables that were available in other qualitative studies. In order to obtain a more objective measure of caregiving, future data collections would need to record the amount of grandparent caregiving by hours. Researchers interested in the psychological well-being of caregivers would also benefit from additional measures of the burden or stress associated with caregiving.

Although the scope of this dissertation was defined to study the health impact on grandparents, lacking information on either the grandchildren's health or behavior could have limited our findings' generalizability. Since previous literature has found that the special health needs of grandchildren had significant impact on the health of grandparents [Bowers and Myers, 1999; Burnette, 1999; Sands and Goldberg-Glen, 2000], future studies should investigate how these other grandchild factors may affect the health and well-being for grandparent caregivers.

In the TLSA, grandparent caregiving is only defined for grandchildren who are 18 years old or younger but without further distinction in age. Given that caring for a grandchild who is a toddler versus a teenager involves quite different demands on the grandparents, we recommend adding an additional question on the age of the care recipient to the TLSA

survey.

In addition to those data limitations that are inherent to this secondary data analysis, we also acknowledge limitations related to our analytical methods. In our first paper we regarded both living arrangement and social support as exogenous variables to focus on our main research question. Nevertheless, future studies should consider the relationship between these three variables and test for possible endogeneity. In our second paper which used the IV estimation approach, the concern about the validity of our IVs remains even though they passed the over-identification test as one could argue that having more grandchildren may lead to better psychological well-being of the grandparents, regardless of their caregiving status. If our assumption of IV validity fails, then the significant and positive IV estimates may not reflect the true effect of caregiving but the effect of family size. In our third paper, our findings of significant reduction in health care utilization among those who stopped caregiving could have been overstated due to potential selection bias in pooled cross-sectional analyses.

In conclusion, we would like to propose the following three areas of future research considering the findings of this dissertation:

First, while results from our studies have suggested a beneficial effect of caregiving found in Chinese culture, it is important to conduct a comparative study using additional data from other countries to formally test the hypothesis about cross-culture differences.

Secondly, it is important to acknowledge that the health improvement found for Taiwan grandparent caregivers is at the population level, and the tradeoff of using a nationally representative sample of the TLSA is that the small percentage of caregivers in our sample prevents further investigation on the heterogeneity in the effect of caregiving. Further

research is needed to identify those grandparents who are most at risk to negative health impacts.

Finally, moving beyond the question about the direction of the health impact, researchers interested in grandparent caregiving should seek the next step to determine the specific mechanism by which caregiving is found to be beneficial for grandparents. The answers to that question will be useful to design future interventional studies to help the study population.

Appendix 1

Appendix to Chapter 5

Table A1.1 Specification tests for IVs for "ever a caregiver" variable in IV only models

(1) Dependent Variable	(2) Wald-test of IV[a] strength χ^2 (d.f.=2) [p-value]	(3) Test of exclusion restrictions (ER)[b] (null: validly excluded) χ^2(d.f.=2) [p-value]	(4) Exogeneity test[c] (null: exogenous) χ^2(d.f.=1) [p-value]	(5) Conclusion on preferred estimation
Self-rated health	84.85 [<0.001]	5.13 [0.077]	2.72 [0.099]	OLS
Life satisfaction	116.54 [<0.001]	54.64 [<0.001]	20.10 [<0.001]	ER not valid Endogeneous
Mobility limitation	95.74 [<0.001]	120.59 [<0.001]	0.80 [0.372]	ER not valid Exogeneous
Depression	104.61 [<0.001]	138.46 [<0.001]	6.72 [0.010]	ER not valid Endogeneous
Unmet health needs	97.24 [<0.001]	239.27 [<0.001]	1.80 [0.179]	ER not valid Exogeneous
>=3 clinic visits	69.02 [<0.001]	15.36 [<0.001]	95.52 [<0.001]	ER not valid Endogeneous
>=4 outpatient visits	94.78 [<0.001]	5.03 [0.081]	0.11 [0.744]	OLS

[a.] IV only model estimated by treatment effects maximum likelihood estimates; [b] The test is a LR test of an over-identified model (restricted) vs. an unrestricted model that was identified only by function form; [c] Wald-test of $\rho=0$

Table A1.2 Full set of coefficients from IV-FE models of grandparent caregiving on elders' health and health services use

	Health outcome				Health services use	
Explanatory Variables	Self-rated health	Life satisfaction	Mobility limitations	Depression	Unmet health needs	>=3 clinic visits	>=4 outpatient visits
Ever caregivers	0.677	0.972	-2.153***	-2.281	0.148	0.252	0.259
(ref. Non-caregivers)	(0.392)	(0.526)	(0.595)	(2.306)	(0.153)	(0.176)	(0.193)
Demographics (only time-varying variables in IV-FE models)							
Married	0.008	0.123	-0.019	-0.833**	0.030	-0.018	-0.019
	(0.044)	(0.064)	(0.067)	(0.266)	(0.018)	(0.021)	(0.022)
Location (ref. Rural)							
Urban	0.030	-0.023	-0.083	0.360	-0.031	0.013	0.029
	(0.052)	(0.072)	(0.075)	(0.291)	(0.019)	(0.025)	(0.026)
Working	0.161***	0.022	-0.237***	-0.452*	0.038**	-0.016	-0.022
	(0.038)	(0.052)	(0.052)	(0.202)	(0.014)	(0.017)	(0.017)
Economic status (ref. Have difficulty)							
Have enough money	0.197***	0.336***	-0.237***	-1.761***	-0.042***	-0.042***	-0.056***
	(0.026)	(0.038)	(0.039)	(0.149)	(0.011)	(0.012)	(0.013)
Have plenty of money	0.352***	0.542***	-0.383***	-2.250***	-0.038*	-0.059***	-0.076***
	(0.041)	(0.056)	(0.057)	(0.211)	(0.015)	(0.018)	(0.019)
Social support							
Emotional support (ref. Unsatisfied to Average)							
Satisfied	0.130***	0.332***	-0.056	-1.840***	-0.013	0.025	0.018
	(0.027)	(0.039)	(0.040)	(0.159)	(0.011)	(0.013)	(0.013)
Very satisfied	0.252***	0.544***	-0.111*	-2.675***	-0.012	0.036**	0.033*
	(0.030)	(0.042)	(0.043)	(0.168)	(0.012)	(0.014)	(0.014)
Receive support with chores	-0.086***	-0.001	0.237***	-0.049	0.007	0.020*	0.019
	(0.023)	(0.033)	(0.032)	(0.121)	(0.009)	(0.010)	(0.011)
Financial support to children	0.014	-0.100*	-0.062	0.015	0.016	0.027	0.016
	(0.040)	(0.051)	(0.054)	(0.203)	(0.015)	(0.018)	(0.018)
Financial support from children	-0.005	-0.026	-0.037	-0.012	0.021*	-0.000	0.011
	(0.023)	(0.031)	(0.032)	(0.125)	(0.009)	(0.010)	(0.011)
Disease indicators							
High blood pressure	-0.103***	-0.020	-0.027	0.193	-0.010	0.063***	0.044**

Table A1.2 Full set of coefficients from IV-FE models of grandparent caregiving on elders' health and health services use

	Health outcome					Health services use	
Explanatory Variables	Self-rated health	Life satisfaction	Mobility limitations	Depression	Unmet health needs	>=3 clinic visits	>=4 outpatient visits
	(0.031)	(0.042)	(0.045)	(0.169)	(0.012)	(0.015)	(0.015)
Diabetes	-0.273***	0.066	0.144*	0.587*	-0.018	0.035	0.042
	(0.048)	(0.063)	(0.069)	(0.257)	(0.016)	(0.022)	(0.023)
Heart disease	-0.173***	-0.107*	0.158***	0.550**	0.002	0.072***	0.054***
	(0.031)	(0.043)	(0.048)	(0.180)	(0.012)	(0.016)	(0.016)
Stroke	-0.504***	-0.388***	0.938***	1.663***	-0.010	0.014	0.004
	(0.062)	(0.083)	(0.113)	(0.374)	(0.022)	(0.031)	(0.030)
Cancer	-0.335***	-0.107	0.270*	1.435**	-0.062*	0.116**	0.068
	(0.079)	(0.101)	(0.105)	(0.463)	(0.028)	(0.038)	(0.039)
Respiratory ailment	-0.204***	-0.052	0.229***	0.407*	0.006	0.077***	0.102***
	(0.035)	(0.049)	(0.053)	(0.196)	(0.014)	(0.018)	(0.018)
Arthritis or rheumatism	-0.101***	-0.025	0.273***	0.675***	0.022*	0.036**	0.054***
	(0.027)	(0.037)	(0.041)	(0.155)	(0.011)	(0.014)	(0.014)
Gastric ulcer	-0.165***	0.026	0.177***	0.984***	0.016	0.053***	0.049**
	(0.030)	(0.041)	(0.043)	(0.170)	(0.012)	(0.015)	(0.015)
Liver or gall bladder disease	-0.204***	-0.082	0.155*	0.719**	0.033	-0.020	0.014
	(0.044)	(0.059)	(0.062)	(0.254)	(0.017)	(0.022)	(0.022)
Cohort and wave dummies							
1996	-0.333***	0.191***	0.394***	-0.299	0.025	0.065***	0.075***
	(0.039)	(0.054)	(0.058)	(0.227)	(0.015)	(0.018)	(0.019)
1999	-0.435***	0.080	0.931***	-0.539	-0.025	0.017	-0.022
	(0.076)	(0.101)	(0.113)	(0.442)	(0.029)	(0.034)	(0.037)
2003	-0.540***	0.040	1.444***	-0.279	-0.023	-0.057	-0.107*
	(0.104)	(0.138)	(0.157)	(0.609)	(0.040)	(0.047)	(0.051)
Persons	5227	5185	5227	5225	5227	5220	5227
Person-waves	12246	11730	12246	12134	12244	12200	12246
R-squared	0.105	0.001	0.056	0.075	0.003	0.007	0.015

Note: * p<0.05 ** p<0.01 *** p<0.001; Robust standard errors in parentheses

Appendix 2

Appendix to Chapter 6

In addition to model (1) shown in Section 6.3, the first of the two additional models we estimated use a lagged dependent variable approach in which the health outcomes measured at Time 1 (HO_{i1}) was included in the equation as follows:

$$HO_{i2} = \alpha + \beta_d (GC_{i2} - GC_{i1}) + \delta X_{i1} + HO_{i1} + \varepsilon_{it} \qquad (2)$$

The main advantage of this model is to control for baseline health status which is essential to determine whether the observed differences in grandparent health are results of caregiving. Results from regressions with the lagged dependent variable (LDV) are presented in Table A2.1 and the coefficient on the LDV was significant in all models. However, we found little difference when comparing results on the caregiving transition variables with findings from our main analytical model shown in Table 6.3, since the only changes were found for the stopped caregivers. That is, after controlling for baseline health with a LDV, the effect of transition out of caregiving was no longer significant associated with either self-rated health or mobility limitations of the grandparents.

The second of the two additional models was a first-difference regression in which we subtract each observation at the first of the two consecutive waves from the same person's second observation except for the caregiving transitional variable which was already a dummy indicator of change. The only difference between this specification and the FE regression models used in Chapter 4 was that instead of including measures of grandparent caregiving status from two time periods, equation (3) modeled the transition status as a single indicator which allows for testing of meaningful hypotheses. We estimate the following equation in which time invariant effects are differenced out of the regression and only time-

variant error ν_{it} remains:

$$HO_{i2} - HO_{i1} = \alpha + \beta_d (GC_{i2} - GC_{i1}) + \delta (X_{i2} - X_{i1}) + \nu_{it} \quad (3)$$

The main advantage of the differencing method is that we could control for selection effect from time-invariant variables such as unobserved health endowment. From our estimation results (See Table A2.2), we observe a reduction in the effect sizes of many coefficients in comparison with results from either the OLS main model or the LDV model. While we found no significant change in health for those who stopped caregiving after controlling for confounding from time-invariant factors, significant health improvement in mobility limitations and depression was still reported by caregivers who either started or continued with caregiving.

Table A2.1 OLS regressions of grandparent caregiving transition on elders' health measures including the lagged dependent variable (LDV), highlighting the transition variables, other output suppressed

Caregiving transition variables	Self-rated health	Life satisfaction	Mobility limitations	Depression
Started care	0.07*	0.02	-0.26***	-0.36
	(0.03)	(0.05)	(0.05)	(0.19)
Continued care	0.18***	0.12*	-0.27***	-0.94***
	(0.04)	(0.05)	(0.05)	(0.20)
Stopped care	0.05	0.11**	-0.05	-0.25
	(0.03)	(0.04)	(0.05)	(0.18)
LDV	0.26***	0.17***	0.45***	0.33***
	(0.01)	(0.01)	(0.01)	(0.02)

Notes: * p<0.05 ** p<0.01 *** p<0.001; Robust standard errors in parentheses

Table A2.2 First-difference regressions of grandparent caregiving transition on elders' health measures, highlighting the transition variables, other output suppressed

Caregiving transition variables	Self-rated health	Life satisfaction	Mobility limitations	Depression
Started care	0.07	-0.00	-0.28***	-0.50*
	(0.04)	(0.06)	(0.05)	(0.21)
Continued care	0.11**	0.07	-0.09*	-0.67***
	(0.04)	(0.06)	(0.05)	(0.19)
Stopped care	-0.04	0.07	0.07	0.06
	(0.04)	(0.05)	(0.05)	(0.21)

Notes: * p<0.05 ** p<0.01 *** p<0.001; Robust standard errors in parentheses

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