

博士論文

***Psychological impact of rural-to-urban migration  
on those left behind in rural Fujian, China.***

(中国福建省農村部における出稼ぎ労働者家族の心理ストレス)

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**Abstract**

Although there has been research on the health of migrants, little attention has been paid to the health of people left behind in the sending communities. The objectives of this study were to investigate the impact of family members' migration on the psychological health status of people left behind in rural Fujian, China, and examine whether social capital had a buffering effect on psychological stress in this context.

A cross-sectional survey was conducted in seven rural communities in Fujian in 2015. Questionnaire data and dried blood spot samples for the measurement of Epstein-Barr virus (EBV) antibody titer, a biomarker for psychological stress, collected from 734 local residents were used for the analysis in this study. A mixed effects regression analysis with a random effects model to account for multiple individuals in

each community was conducted to investigate the relationship between EBV antibody titer, being left behind and the social capital variables.

Psychological stress was higher among people left behind compared to people who were not left behind (coefficient = 0.14, 95% confidence interval [CI] = 0.01 – 0.27). Although none of the social capital indicators attenuated this association, community-level structural social capital was inversely associated with psychological stress (coefficient = -1.20, 95% CI = -2.40 – -0.00) while individual-level structural social capital was positively associated with it (coefficient = 0.21, 95% CI = 0.06 – 0.36).

In rural Fujian, China, family separation and social capital seemed to be important, but independent determinants of psychological health. While living in a community with active social interaction may benefit the residents psychologically, social interaction in the form of strongly bonded relationships may be a source of psychological stress. As social capital did not buffer the negative psychological impact of family out-migration among people left behind, future research should focus on identifying protective factors against the negative effects of being left behind.

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## **Acknowledgements**

During my Ph.D. program I encountered several problems. For example, just before I was about to start my survey in Hainan Island in July 2014, Typhoon Rammasun prevented me from conducting my fieldwork. Perhaps the greatest problem I faced however was that the permission I had to undertake research in Hainan Island, the place where I had originally intended to conduct this study, was suddenly withdrawn in October 2014 without a specific reason being given. It took me some time before finding a new research location in Fujian Province.

Looking back on the tough journey I had while pursuing my Ph.D., I can recall numerous people who have helped me and enabled me to complete my work. Here, I would like to acknowledge those who particularly helped me.

First of all, I would like to express my deep gratitude to the local residents in Fujian Province for participating in my survey. I also want to thank the many local staff members for providing practical assistance and support during my survey. My special thanks go to Prof. Wenchang Zhang, Prof. Jie Chen and Dr. Fei He of Fujian Medical University and Dr. Meng Huang of Fujian Provincial Center for Disease Control and Prevention.

I would also like to express my deep gratitude to Prof. Chiho Watanabe of the Department of Human Ecology, the University of Tokyo, who provided an environment where I could concentrate on my research. I believe all the comments and suggestions given significantly improved the quality of my dissertation. My special appreciation also goes to Dr. Yosuke Inoue, who is now at the University of North Carolina at Chapel Hill, and who helped me in innumerable ways during the course of my research and without whose generous support it would have been far harder for me to finish this work.

In addition, I would like to mention those who introduced me to their research collaborators in Fujian; my special thanks go to Prof. Taro Yamamoto, Dr. Tomoo Ichikawa and Ms. Raoping Tu of the Department of International Health at Nagasaki University and Dr. Guoxi Cai of Nagasaki Prefectural Institute of Environmental Research and Public Health. Without their help, I might, even now, still have been looking for a new research location.

My special thanks also go to the people in Hainan Island where I conducted the fieldwork for my Master's degree; the research I did there motivated me to undertake my Ph.D. studies. I want to thank the local people in Baoting and Wuzhishan

and the staff members of the Hainan Provincial Center for Disease Control and Prevention, particularly Dr. Jianwei Du, Dr. Shanqing Wang, Dr. Yan Chen and Mr. Dandan Li, who always supported me with warm hearts.

Funding from the Japan Society for the Promotion of Science is gratefully acknowledged.

Lastly, I would like to thank my parents for letting me do what I want to do, believing in me, and always supporting me with their love and encouragement.

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## Abbreviations

ADL	Activity of daily living
AGES	Aichi Gerontological Evaluation Study Project
BMI	Body mass index
CES-D	Center for Epidemiologic Studies–Depression scale
CHAMPSEA	Child Health and Migrant Parents in Southeast Asia
CHARLS	China Health and Retirement Longitudinal Study
CHNS	China Health and Nutrition Survey
CRP	C-reactive protein
CV	Coefficient of variation
DBS	Dried blood spots
EBV	Epstein-Barr virus
ELISA	Enzyme-linked immunosorbent assay
ENADID	Encuesta Nacional de la Dinámica Demográfica
EURO-D	European Depression scale
GDP	Gross domestic product
GDS	Geriatric Depression Scale
GHQ-12	General Health Questionnaire 12-item
HMS	Health and Migration Survey
HPA axis	Hypothalamic-pituitary-adrenal axis
IFLS	Indonesia Family Life Survey
IMHC	Internal Migration and Health in China survey
IQR	Interquartile range
JAGES	Japan Gerontological Evaluation Study Project
LOD	Limit of detection
MMP	Mexican Migration Project
MxFLS	Mexican Family Life Survey
NHANES	National Health and Nutrition Examination Survey
NHIS	National Health Interview Survey
OR	Odds ratio
QOL	Quality of life

RMB	Ren min bi: the Chinese currency
SAMS	The small area for market statistics
SC-IQ	Integrated Questionnaire for the Measurement of Social Capital
SD	Standard deviation
SE	Standard error
SF-12	Short Form-12 Health Survey questionnaire
SF-36	Short Form-36 Health Survey questionnaire
SRH-20	Self-Reporting Questionnaire
VCA	Viral capsid antigen
WHOQOL-BREF	Abbreviated version of the World Health Organization's Quality of Life questionnaire
WHR	Waist-to-hip ratio
95% CI	95% Confidence interval

# Chapter 1 Introduction

## *1.1. Migration and health*

An estimated 244 million people had migrated to another country as of 2015, a 41% increase compared to the number in 2000 (United Nations Department of Economic and Social Affairs, 2016). It was also reported that 740 million people had internally migrated within their own countries as of 2009 (United Nations Development Programme, 2009). Migration occurs on a variety of scales (e.g., in terms of differing destinations and time spans) and is motivated by various factors; in terms of the classical migration framework, some individuals leave their community of origin due to “pull factors” such as the increased opportunity of obtaining stable employment with a higher income, while others move to a new location due to “push factors” such as war, internal conflict, natural disasters, famine or development projects (International Organization for Migration, 2015).

A major mode of migration has been labor migration from rural to urban areas; it has been estimated that approximately three million people in the world move to cities

every week, with this trend being predominantly observed in developing countries (UN-Habitat, 2009). As people believe that urban life will provide more job opportunities with a higher income compared with jobs that can be obtained in rural areas, having family members living and working away from home in urban areas has become a survival strategy for those who live in rural areas in developing countries. Fueled by economic development, this rural-to-urban migration has become the primary factor that is boosting urbanization (i.e., the increasing share of a population living in urban areas) and having migrants in the family has become an integral feature of rural family life. This situation, in combination with natural population growth, is expected to accelerate urbanization in the coming decades; the current urban population of 3.9 billion people is expected to reach 6.4 billion by 2050 (International Organization for Migration, 2015).

There have been a series of studies which have investigated the health impact of migration as migrants often experience a drastic change in their living environment, which is one of the central determinants of health (Carp, 1977). Migrants tend to experience social stress in attempting to adapt to the host population. More specifically,

the cultural change that results from migrants' continuous, first-hand contact with the groups that are culturally different is called acculturation (Redfield et al., 1936), and stress experienced in the course of acculturation (i.e., acculturative stress), such as that associated with the pressure of having to learn a new language, and balancing differing cultural values (Rodriguez et al., 2002), can result in a deterioration in health (Torres et al., 2012) both physically (e.g., obesity, self-rated physical health, blood pressure) (Berkman & Glass, 2000; He et al., 1991; Steffen et al., 2006) and psychologically (e.g., depression, anxiety) (Bhugra & Ayonrinde, 2004; Lindert et al., 2009).

In earlier studies, it was generally reported that the impact of migration tends to be immediate and detrimental especially for psychological health, as migration usually co-occurs with family separation (Sluzki, 1992). For example, Ward (1962) identified increased rates of common mental disorders among foreign students in England compared to native students, and mentioned that foreign students were also more likely to complain about physical health problems. Another study showed that the admission rates to psychiatric hospitals among migrants were about twice as great as those among the native population in England and Wales (Cochrane, 1977). At the same time,

anthropologists found that South Pacific islanders had an increased risk of being obese, and of having higher serum lipids and blood pressure when they migrated to New Zealand (Mascie-Taylor & Lasker, 1988). These findings served as a base and motivating factor for subsequent research to investigate what happens to migrants' health.

Although some studies later found evidence of a seemingly paradoxical situation, which has been termed the healthy migrant phenomenon, adverse experiences during the acculturation process in their new environment have been broadly recognized to have a detrimental effect on migrants' health. The healthy migrant phenomenon refers to a situation where migrants, who have a low socioeconomic status and are expected to be in worse health due to their unhealthy living environment, are in fact healthier, compared with the native-born residents in urban areas (e.g., lower mortality among Latino Americans than non-Latino Whites in the U.S. (Abraido-Lanza et al., 1999). However, this situation is now believed to result from an initial advantage of migrants that is associated with selective migration out of the sending community (i.e., that those who out-migrate are healthier) (Palloni & Morenoff, 2001), and it has been

shown that this initial health advantage of migrants disappears across time (i.e., as a result of acculturation). For example, using data from the 1991 National Health Interview Survey (NHIS) (N = 36,401), Abraido-Lanza et al. (2005) found that Latino Americans had a health behavior advantage in terms of less smoking (Odds ratio [OR] = 0.42, 95% confidence interval [CI] = 0.37 – 0.49) and less drinking (OR = 0.69, 95% CI = 0.59 – 0.81) when compared to non-Latino white Americans, but that these health advantages were lost in the course of the acculturation process (i.e., among those with a longer stay in the U.S. or who were born in the U.S.). Indeed, when examining the association among Latino Americans only, it was shown that Latinos who had experienced a greater degree of acculturation in terms of time spent in the U.S. and nativity status, had a higher risk of smoking (OR = 1.46, 95% CI = 1.14 – 1.88) and consuming alcohol (OR = 1.98, 95% CI = 1.36 – 2.90), compared to less-accultured Latinos. Regarding physical health, a meta-analytic review by Steffen et al. (2006) that investigated the association between acculturation to Western society (i.e., assessed in terms of experiencing westernization or industrialization [e.g., modernization or urbanization within nonwestern countries, rural-to-urban migration], migration to

Western society [e.g., immigration to the U.S. and Europe from nonwestern countries], as well as adaptation to the host culture [e.g., acquisition of a western language]) and blood pressure, showed that people who were more acculturated had 4 mmHg higher systolic and 3 mmHg higher diastolic blood pressure than less acculturated people (effect size for systolic blood pressure = 0.28, for diastolic blood pressure = 0.30), and that this effect size was similar to that of known risk factors for high blood pressure such as diet and physical activity.

A limited but now rapidly growing volume of studies has also focused on the situation in developing countries. For example, using data from the Indonesia Family Life Survey (IFLS) obtained from 5,597 people aged 18 to 45 years, Lu (2010) showed that labor rural-to-urban migration was having a negative effect on the psychological health status of migrants in Indonesia. Specifically, labor migrants were much more likely to have depressive symptoms than non-migrants (OR = 1.99,  $p < 0.001$ ), and the impact of migration on mental health status was more pronounced among those who migrated alone (OR = 2.17,  $p < 0.001$ ). Inoue et al. (2016) further showed that in rural Hainan communities in China, C-reactive protein (CRP) concentration, an inflammatory

marker which reflects future cardiovascular disease risk, was higher among women who experienced migratory work (i.e., returned migrants) in the past year, compared to those who did not (coefficient = 0.151,  $p < 0.01$ ).

### ***1.2. Migration and its impact on family members left behind***

While there has been much research on the health of migrants as described above, relatively little attention has been paid to the health of those who have been left behind in the sending communities, despite the fact that the population left behind is as great as that which migrates to the cities and that the impact of family separation induced by migration can also affect those who are left behind in the sending community. As migratory work is adopted as a family strategy to diversify and maximize its income, there is undoubtedly a positive effect of migratory work on the family left behind (Lauby & Stark, 1988; Stark & Bloom, 1985). At the same time, however, out-migration may diminish social support which can produce positive emotional and social experiences (Cohen & McKay, 1984), and the shortage of

household labor can also be a stressor among the people left behind, as left-behind members often have to undertake multiple responsibilities to compensate for the loss of household personnel (Taylor et al., 1996). This increased physical and psychological burden might also affect the health and/or health behaviors of those who remain in the sending communities (Steptoe et al., 1996).

Some studies have investigated the effect of parental migration in relation to the health or health-related behaviors of children and shown the protective effects of migration. For example, using population representative data from the Encuesta Nacional de la Dinámica Demográfica (ENADID) collected in 1997 that included data from 23,607 infants, Frank and Hummer (2002) showed that children born into families where a family member had been a migrant in the past 5 years and sent remittances had more than 40% lower odds of having had a low birth weight when compared to infants born into non-migrant households (OR = 0.54,  $p < 0.01$ ). A subsequent study by Hildebrandt et al. (2005) used the same data to show the impact of migration in more detail. They reported that in Mexico, children aged 6 years or younger ( $n = 12,117$ ) whose mother experienced migration to the U.S. had a higher birth weight (364 grams

increase) and that there was lower infant mortality among these children (they were 3 to 4.5% less likely to die in their first year) when compared to children born in households without a migrant member. Similarly, Donato and Duncan (2011) used data from the Health and Migration Survey (HMS), a project that examined the health consequences of Mexico – U.S. migration, to show that at the time of the survey, children aged younger than 10 years (N = 804) who had migrated to the U.S. with their parents had a significantly better mother-reported health status than children in non-migrant families residing Mexico (coefficient = 1.09, standard error [SE] = 0.17,  $p < 0.001$ ). In addition, Antman (2012) used data from the Mexican Migration Project (MMP) (n=16,593), to highlight that paternal migration to the U.S. had a significant and positive impact on the educational attainment of daughters, while internal migration did not, which suggests that remittances from abroad may enable left-behind children to achieve positive educational results.

On the other hand, there are an increasing number of studies which have highlighted the adverse impact of parental migration on the health status of children left behind. For example, Nobles (2007) used data from the Mexican Family Life Survey

(MxFLS), a longitudinal nationally-representative household survey, to investigate the association between children's parental migration status in 2002 to 2005 and children's height-for-age in 2005 ( $n = 6,707$ ); she found that compared to children in non-migrant households, there was a positive, although statistically insignificant effect of migration on children's height-for-age (coefficient = 0.21, SE = 0.14); however, when comparing children who had experienced parental migration when they were aged 0 to 2 years old (during 2002 to 2005) with those who did not, there was a significantly inverse effect of parental migration on height-for-age (coefficient =  $-1.13$ , SE = 0.57,  $p < 0.05$ ). In settings other than Mexico, Graham and Jordan (2011) used data from the Child Health and Migrant Parents in Southeast Asia (CHAMPSEA) survey that were collected in four South-East Asian countries in 2008, and found that the psychological status of children who had migrant fathers in Indonesia ( $N = 961$ , coefficient = 0.96,  $p < 0.001$  for emotional symptoms) and in Thailand ( $N = 995$ , coefficient = 0.39,  $p < 0.05$  for conduct problems) was more likely to be poor compared to children in non-migrant households. Giannelli and Mangiavacchi (2010) used data from the Living Standard Measurement Survey in Albania in 2005, to show that parental migration had an adverse effect on

children's school attendance; for school-aged children aged 6 to 13 years ( $n = 2,575$ ), each additional month left behind increased the probability of dropping out of school by 0.8% and the probability of attending with some form of delay by 1% (i.e., starting school later than during the normal enrollment period, having dropped out for a short period of time or had to repeat a year). They concluded that the absence of parents can induce a psychological burden on households and results in changes in the household decision-making process, where a requirement for greater household labor falls on children that can lead to them spending less time on school activities. These studies indicate that although an improved economic situation may be beneficial for children's health in their early life, deficits in necessary parental support in childhood or adolescence may adversely affect children's mental health and related behaviors.

Findings concerning the impact of family members' migration on the health of adults left behind (e.g., the spouse or parents of migrants) have been relatively inconsistent to date. In particular, there is some indication that the observed relationship can vary across settings and is dependent on the specific situation. Some studies have shown a beneficial impact of migration on the health of those who were left behind; for

instance, Kuhn et al. (2011) used longitudinal data from the IFLS (N = 2,155) and found that, in Indonesia, having migrant children was associated with better health among left behind parents aged 50 years and older, i.e., a better activity of daily living (ADL) score (coefficient =  $-0.11$ ,  $p < 0.05$ ), better self-rated health (coefficient =  $-0.43$ ,  $p < 0.01$ ) and lower mortality (coefficient =  $-0.60$ ,  $p < 0.05$ ). Abas et al. (2009) reported that in rural Thailand rural-to-urban migration of children was protective against depression among left behind parents aged 60 years and older (N = 1,147). Specifically, they found that parents who had all of their children migrate had the lowest level of depression compared to those who had some or no children migrating and that there was a significant interaction between poverty and the location of children; depression was highest when the household was poor and no children had migrated (mean European Depression scale [EURO-D] score = 4.8, 95% CI = 3.9 – 5.6) compared to when the household was wealthier and no children had migrated (mean EURO-D scale score = 3.5, 95% CI = 2.5 – 3.6) or compared to when the household was poor and all the children had migrated (no specific scores were reported for this group in the article).

Other studies have shown that those who were left behind experienced poor

health following family members' migration. Adhikari et al. (2011) reported that in Thailand parents who had migratory working children were more likely to have a poor mental health status (OR = 1.10, 95% CI = 1.05 – 1.17), whereas no association was observed in relation to their physical health status (i.e., chronic diseases, perceived poor health and illness). Moreover, higher utilization of health services was observed among parents left behind regardless of their socioeconomic status (OR = 1.22, 95% CI = 1.11 – 1.33). Graham et al. (2015) used CHAMPSEA data (N = 3,026) collected in several countries in South-East Asia, to show that in Indonesia, the Philippines and Vietnam, the left-behind caregivers of children (i.e., any adults including the mother, father or other relatives who stayed behind to take care of children) were about twice as likely to suffer from common mental disorders as caregivers in non-migrant households. In particular, wives who had migrant husbands overseas had an especially increased risk of having a poor psychological health status (OR = 1.90, 95% CI = 1.12 – 3.23 in Indonesia; OR = 1.80, 95% CI = 1.05 – 3.10 in the Philippines; OR = 2.67, 95% CI = 1.45 – 4.90 in Vietnam). Using cohort data (IFLS) collected in Indonesia (N = 4,391), Lu (2012) found that left behind spouses (most were women) had increased odds for

depressive symptoms (OR = 1.97, 95% CI = 1.02 – 3.81), while left behind parents had higher odds for both depressive symptoms (OR = 2.28, 95% CI = 1.09 – 4.79) and hypertension (OR = 1.52, 95% CI = 1.06 – 2.19) than their non-left-behind counterparts, although both sets of odds decreased as the length of separation increased (i.e., the adverse health effects were most prominent in the first 1 to 3 years of migration).

### ***1.3. Historical background and characteristics of migration in China***

China is one of the countries which has experienced the most rapid increase in the number of rural-to-urban migrants in recent decades, most of whom are regarded as being part of the “floating population”, which is defined in China as internal migrants without urban household registration (Li, 2006). The number of the floating population in China has increased rapidly since the 1990s. The total number was 70 million in 1993, 150 million in 2005 (Tong & Piotrowski, 2012), and had increased to more than 253 million by 2014, which comprises about 19% of the Chinese population (National Bureau of Statistics of China, 2015).

This increase in the number of migrants also means that an increasing number of people are being left behind in rural communities. For example, it was estimated that among the 159 million floating population, 126 million people had left children behind in their communities of origin in 2011 (Cheng & Sun, 2015). As most migrant workers decide to leave their children in their hometown because they cannot raise children in urban settings due to the high living expenses and the unaffordability of social security in cities (e.g., health insurance, public school) (Tao & Xu, 2007), the increasing number of children being left behind in rural areas is one of the most serious problems that China faces (Wang et al., 2015). Since these children are usually taken care of by their grandparents, it is commonly observed that old people and children predominate in rural communities (Wang et al., 2015), which indicates that the problem is not only one of an increasing number of people being left behind but also of socio-demographic transition (i.e., where the population is aging due to increased life expectancy and the outflow of the younger generation) that is changing the traditional family structure in rural China.

There have been many studies which have tried to evaluate the impact of migration on health among children who were left behind in the rural communities in

China. In particular, the psychosocial burden on children left behind has been identified in various studies. Wang and Mesman (2015) published a meta-analysis of the impact of rural-to-urban migration on child development in China; they reviewed 67 studies published in 2000 – 2014, that compared the psychosocial situation between children left behind and those not left behind in rural areas, and showed a significant negative impact of migration on both the emotional (the number of studies = 38, effect size = 0.31, 95% CI = 0.19 – 0.34), and social functioning (35 studies, effect size = 0.20, 95% CI = 0.12 – 0.29) of children left behind, and also found a marginally significant trend for school functioning (8 studies, effect size = 0.13. 95% CI = 0.00 – 0.26).

In contrast, as yet, relatively few studies have investigated the health impact of migration among adults who have been left behind in China. He et al. (2016) found that 36.9% of left-behind older people suffered from depression which was higher than the prevalence in the general population (23.6% calculated in a meta-analysis that included data from 81 studies between 1987 to 2012 in rural China (Li et al., 2014).

While using China Health and Nutrition Survey (CHNS) data, Chang et al. (2011) found that the time use patterns among left-behind older women aged 51 and above (n =

3,231) changed after their adult children's migration; specifically, the time spent on farm work (576.2 to 689.8 hours/year) and domestic work (0.58 to 0.74 hours/day) increased. The observed growth in working time may reflect an increased future risk for worse psychological health as a shortage of household labor may bring additional stress if left-behind members feel pressure to maintain household daily life in conditions where there is a labor shortage (Taylor et al., 1996). Lu et al. (2012) used data from the Internal Migration and Health in China (IMHC) survey that were collected in 2008 to further highlight that left behind older people (N = 787) tended to have more depression (coefficient = 2.38, 95% CI = 0.34 – 4.42), although remittances buffered its negative impact. In newly emerging research in China that focuses on left-behind older parents living alone or with only a spouse, these individuals are referred to as the “empty-nest elderly”, which indicates how old people are being left behind while all the other household members are away. Liu and Guo (2007) found that in rural China, empty-nest elderly people (n = 275) were lonelier (95% CI = -3.361 – -0.335), and had poorer physical (95% CI = 0.228 – 6.044) and mental health scores (95% CI = 0.866 – 6.380) than those in the non-empty-nest group (n = 315).

#### ***1.4. Social capital: a potential buffer against psychological stress among those who are left behind***

Considering that population migration will further accelerate in China and other developing countries in the coming decades (Hu et al., 2008), it is important to identify factors which might help buffer against the psychological impact of being left behind in rural communities. One of the factors that might be important in this context is social capital. Social capital has been defined by Putnam as the institutions, relationships and norms that shape the quality and frequency of social interactions (Putnam, 1995), and described by researchers within the field of Social Epidemiology as the “resources that are accessed by individuals as a result of their membership of a network or a group” (Berkman et al., 2014). A number of studies have already shown that social capital protects physical (Kim et al., 2008) and mental health (Almedom, 2005) and is also protective against negative health-related behaviors (Lindström, 2008). For population health studies, social capital is often evaluated in terms of the following two forms (Table 1); cognitive social capital, that is, individual attitudes, perceptions, and cognitions about the group to which one belongs; and, structural social capital, that

is, actual behaviors such as participation in informal and formal social organizations (Harpham, 2008).

There are several categorizations of social capital which have been used in different analyses in relation to health. Individual-level social capital can supply health-relevant resources such as useful information, instrumental support, and social reinforcement, whereas community-level social capital is a property of the whole social network, which can bring benefits to each individual, and protects health by providing social contagion (i.e., the transitivity between members of a network), informal social control and collective efficacy (i.e., the ability to undertake collective action) (Berkman et al., 2014).

[Table 1. Forms and dimensions of social capital and their operationalization  
in empirical studies]

Prior research has indicated that social capital can have an effect on many types of health outcomes. Early studies were conducted in developed countries such as

the U.S., Europe and Japan (Islam et al., 2006), to explain health inequities from a social perspective. More recent research has shown that individual-level social capital is associated with a reduced risk of mortality and chronic diseases such as cardiovascular disease, obesity and hypertension (Hyypä et al., 2007; Moore et al., 2009; Yazawa et al., 2016). While community-level social capital has been less studied, some emerging research has started to investigate the contextual effect of social capital on individual health. For example, studies have found significant associations with various health outcomes, e.g., self-rated health, life satisfaction (Maass et al., 2016), cardiovascular diseases (Hu et al., 2014) and psychological well-being (Hamano et al., 2010).

Some previous studies have shown that community-level social capital can have a potential buffering effect in situations where a community faces some form of adverse situation which can potentially damage residents' health as a whole, such as experiencing high income inequality or a natural disaster. For example, a study that used data from the 2010 Aichi Gerontological Evaluation Study (AGES) Project (the former project of Japan Gerontological Evaluation Study [JAGES]) collected among Japanese people aged 65 years or above, revealed that community-level structural social

capital (i.e., the rate of people participating in volunteer groups) attenuated the inverse effect of income inequality on self-rated health by 16% (Aida et al., 2011). Hikichi et al. (2016) used data from 3,567 older people to focus on the effects of the Tohoku earthquake in Japan and found that people who lived in communities with higher community-level social capital (i.e., trust, reciprocity and attachment) were less likely to have posttraumatic stress disorder after the earthquake (OR = 0.75, 95% CI = 0.63 – 0.90). As the increase in rural-to-urban migratory work may be one of the biggest social changes underpinning the loss of social support from family/community members and might also result in worse health in developing countries, its effects may be detrimental to everyone in a rural community. In these circumstances, people with higher social capital or those living in communities with higher social capital may be protected from psychosocial stress. Moreover, it is possible that the increasing outflow of younger people might be especially detrimental in terms of increasing the psychosocial burden among the older rural population, who are already vulnerable as they are more likely to experience social exclusion and loneliness (Dong & Simon, 2010). Indeed, Dong and Simon (2010) reported that among the older Chinese population, rural subjects had

significantly poorer health and well-being than urban residents, and also had a significantly higher proportion of depressive symptomatology as well as less social support. As access to social capital enables older people to maintain productive, independent, and fulfilling lives (Kawachi et al., 2008), the protective effect of social capital might therefore be especially pronounced among older population in rural China.

So far, there has been comparatively little research on the effects of social capital on health in developing countries. In an earlier study, Harpham et al. (2004) evaluated many aspects of both cognitive and structural social capital: trust, collective efficacy (including social cohesion), social support, group participation, and civic participation among 1,168 youth (aged 15 to 25 years old) in Colombia. They investigated the association between each form of social capital and self-reported mental health status, but found a relatively weak association (OR = 0.8, 95% CI = 0.7 – 1.0) only between a lack of trust and worse mental health status. Godoy et al. (2006) examined the association between social capital and negative emotions among 655 adults in the Bolivian Amazon, and found that a lower level of village social capital, i.e., (1) the number of gifts given to other households, (2) the number of times participants

had proffered their labor to help other households, and (3) the number of times participants had participated in communal work, was associated with negative emotions. Few studies have looked at social capital as a buffer against detrimental outcomes in developing countries. Xu et al. (2015) hypothesized that social capital may buffer against the negative effects of a deprived living environment (living alone) on the health of older people in rural China. They found that there was an insignificant association between living alone and worse self-rated psychological health (emotional well-being), and that the association was not buffered by any form of social capital.

### ***1.5. Epstein-Barr virus antibody titer as a biomarker of psychological stress status***

This study will use a biomarker for the measurement of psychological stress status for several reasons (McDade et al., 2007). First, biomarkers may provide insights into the reciprocal links between the environment and health by shedding light on the specific physiological pathways linking socioeconomic, demographic, and psychosocial factors with health; this study used a biomarker not only because it is known to reflect

chronic psychological stress status, but also because it may demonstrate how the impact of a psychological burden “gets under the skin” (i.e., becomes a physical burden in the sense that it is detectable by biomarkers). Second, biomarkers can indicate direct pathways to disease by reflecting a pre-disease status (i.e., indicating a deteriorated health status which may increase the possibility of developing a disease). Third, biomarkers can overcome many of the shortcomings associated with self-report measures. For example, biomarkers can be obtained from people who speak any language, and are not subject to the different forms of bias that can be associated with self-reported measures of health, such as where people with a higher socioeconomic status tend to assume that their health status is better than people with a lower socioeconomic status (Burstrom & Fredlund, 2001). In addition, in rural China, older people often communicate in their local dialect and have no command of Mandarin. Furthermore, the level of educational attainment among them is relatively low; about half of all older people do not have any formal schooling (Luo et al., 2015). In this situation, it may be difficult to measure the participants’ psychological stress status adequately by using an “established” questionnaire. Fourth, recent improvements in

field-friendly sampling methods (e.g., the use of dried blood spots [DBS]) make community-based studies possible in many different contexts, therefore, the use of biomarkers is useful for generating and comparing results obtained in a wide variety of settings.

In this study, we used a biomarker for chronic psychological stress status, Epstein-Barr virus (EBV) antibody titer. EBV is one of the ubiquitous herpes viruses that has already infected over 90% of the world's population. In normal conditions, EBV is carried in a latent state, which is regulated by cell-mediated immune function (Macswen & Crawford, 2003; Thorley-Lawson & Gross, 2004). Chronic psychological stress can drive the reactivation and replication of the virus through an up-regulation of the hypothalamic-pituitary-adrenal axis (HPA axis) and results in chronic overproduction of stress hormones such as glucocorticoids and catecholamine (Cacioppo et al., 2002; Yang et al., 2010). This disruption of homeostasis which is necessary for the maintenance of normal cellular immune function is known to result in elevated EBV antibody titer in serum (Fagundes et al., 2014; Glaser & Kiecolt-Glaser, 2005; Steptoe et al., 2007).

Research has shown that EBV antibody titer is elevated when people experience psychological stress as a result of life strain or traumatic life events (Esterling et al., 1993), academic stress (i.e., examinations) (Glaser et al., 1987), family stressors (e.g., disagreement with decisions made at home) (Panter-Brick et al., 2008), poor quality marriages (Kiecolt-Glaser et al., 1987a), chronic fatigue syndrome (Glaser & Kiecolt-Glaser, 1998) or care giving to patients with Alzheimer's disease (Kiecolt-Glaser et al., 1987b) and with dementia (Kiecolt-Glaser et al., 1991). Several studies have investigated its association with validated questionnaire measures of psychological stress, such as the Life Event Scale (Cao et al., 2009) and the Profile of Mood Stress short form (Lutgendorf et al., 2001). Inoue et al. (2014) showed that a significant association exists between EBV antibody titer and the domain scores of the abbreviated version of the World Health Organization's Quality of Life questionnaire (WHOQOL-BREF) by using samples collected in rural China. EBV antibody titer has a long half-life (i.e., approximately 20 days) in serum (Cacioppo et al., 2002) and does not have a circadian rhythm (McDade et al., 2000a). This is better than, for example, cortisol, which is one of the most frequently used stress markers; it has 66 hours of

half-life in plasma (Wood et al., 1997) and has diurnal variation peaking early in the morning, gradually declining during the daytime and reaching its lowest level at midnight (Rose et al., 1972). These characteristics enhance the usefulness of EBV antibody titer as a biomarker of chronic psychological stress.

### ***1.6. Study objectives***

This study was intended to build on and extend the abovementioned studies in several ways. First, the impact of family members' migration on the psychological health status of people left behind in rural communities is not well understood, especially among adults/older people. Focusing on psychological health is especially important in this context as it provides an early sign of the health impact of family separation due to family members' migration and because it also has the potential to affect physical health both directly and indirectly via unhealthy behaviors induced by psychological stress (Schneiderman et al., 2005). Second, as previously stated, social capital has been shown to function as a buffer against the effects of negative events both

at the individual- and community-level and thus, might also protect people living in Chinese rural communities from psychological stress due to family separation. Given this, by examining the potentially buffering effect of social capital in relation to psychological stress it might be possible to shed light on how to protect and promote health among rural communities in developing countries, where resources and facilities for health are limited. Third, to the best of our knowledge, no previous study has used biomarker data for the measurement of psychological stress status among people left behind by family members' migration in developing countries. In addition, no study has used EBV antibody titer as a marker of psychological stress status in connection with social capital. The use of biomarker data will enable psychological stress to be assessed while minimizing the risk of confounders arising from respondents' characteristics (e.g., language fluency, temperament, and the relationship with the interviewer).

The aims of this study were therefore to detail and understand migrant working habits among rural people in Fujian, China, to test the hypothesis that people left behind experience greater psychological stress, and then test the buffering effect of individual-and community-level social capital on psychological stress by using

biomarker data, i.e., EBV antibody titer.

In addition to the main aims described above, this study also investigated the association between the experience of being left behind and psychological distress assessed by the Kessler 6 Psychological Distress Scale (K6) (Kessler et al., 2002) to see if the findings based on EBV antibody titer were replicated when using another psychological outcome. The K6 scale is a self-reported measure which has previously been used in China (e.g., Lin et al., 2016). For this outcome measure, analysis was conducted in relation to the experience of being left behind, which is the variable of primary interest in this study.

## Chapter 2      Methods

### *2.1. Research location*

#### *2.1.1. Background information*

Fujian Province is located on the southeast coast of mainland China (Figure 1); it is situated between latitude 23° 33'to 28° 20'N and longitude 115° 50'to 120° 40'E, and is bordered by Zhejiang Province to the north, Jiangxi Province to the west and Guangdong Province to the south. It has an area of 121,400 square kilometers and a humid subtropical climate (according to the Köppen Climate Classification), with an average temperature of 15 – 22°C and annual precipitation of 930 – 1840 mm (Fujian Provincial People's Government, 2014). Approximately 38.06 million people live in the province (as of 2014) with the majority of them being Han (98%), with other, smaller ethnic minorities (Fujian Provincial Bureau of Statistics, 2015).

[Figure 1. Map of Fujian]

Since Xiamen City was designated as a Special Economic Zone in 1980 and Fuzhou City, the provincial capital, adopted an open-door policy for foreign investment in 1984, Fujian Province has experienced rapid economic growth (Figure 2). As illustrated in Figure 2, over a period of 30 years, the gross domestic product (GDP) of Fujian Province increased by more than 50 times from 5.8 billion USD in 1980 to 312 billion USD in 2012. More specifically, the total product of the primary, secondary and tertiary industrial sectors increased from 23.9, 28.2 and 14.3 hundred million ren min bi (RMB) in 1978 to 2014.8, 12515.4 and 9525.6 hundred million RMB respectively, in 2014 (Fujian Provincial Bureau of Statistics, 2015) (ren min bi is the Chinese currency. 1 RMB = 0.16 USD as of 2015). The main industries in the province are centered on the production of electronics, feather, fur, and mineral products, as well as fishing, and there are also active trade relations with overseas countries in products such as mechanical and electrical goods, etc (China Diary, 2015). The total trade value (the sum of imports and exports) was 1.08 billion RMB in 1981, and had reached 1,089 billion RMB by 2014 (Fujian Provincial Bureau of Statistics, 2015). The number of foreign tourists visiting Fujian has also increased; 708,000 in 1990 but 5.45 million in 2014

(Fujian Provincial Bureau of Statistics, 2015).

[Figure 2. GDP per capita in Fujian Province]

Economic growth has been accompanied by a significant change in the lifestyle of the local populace. For example, an increasing number of people have begun to work in the secondary and tertiary industrial sectors; in 1980, only 14.6% of the population did not engage in farming but by 2014 that proportion had increased to 76.8% (with 38.2% of the population working in the secondary sector and 38.6% in the tertiary sector) (Fujian Provincial Bureau of Statistics, 2015). A noticeable increase in educational attainment was also observed during the same period; while only 12.6% of people had an education of 9 years or more (equivalent to graduating from junior high school) in 1982, by 2010 junior high school graduates comprised 37.9% of the population. This was accompanied by a reduction in the proportion of people who were illiterate, which fell from 25.2 % to 3.2% between 1982 and 2010 (Fujian Provincial Bureau of Statistics, 2015). Per capita disposable income increased more than 80 times

in the 35-year period from 1978 to 2014, rising from 371 to 30,722 RMB in urban areas and from 138 to 12,650 RMB in rural areas.

### ***2.1.2. Demographic changes observed in Fujian during the period between 1980 and 2015***

The economic growth that accompanied the transformation of the economic system in Fujian Province created new employment opportunities and resulted in an increase in the number of migratory workers from rural areas in order to meet the demand of the expanding industrial and business sectors. This trend was not only observed within the province but also across the provincial borders. As of 1995, it was estimated that the number of the “floating population”, defined as internal migrants without household registration in their receiving communities, was 2 million people, which comprised 6.3% of the total population; 1.1 million of them were from rural Fujian communities while the remainder were from outside the province (Li & Zhu, 2004). This number increased rapidly reaching 11 million people in urban Fujian by 2013 (renkou.org.cn, 2014), with 7 million coming from rural Fujian communities and 4

million from outside the province (renkou.org.cn, 2015).

Along with the increasing number of rural-to-urban migrants, the proportion of the urban population has also increased – from comprising 21.2% of the whole population in 1982 to 61.8% in 2014 (Fujian Provincial Bureau of Statistics, 2015) (i.e., 23.5 million people in urban areas and 14.5 million people in rural areas in 2014). The Fujian Province 1% National Population Sample Survey in 2015 revealed that the *de facto* urban population is 24.0 million people (62.5%) and the rural population is 14.4 million (37.5%) (Fujian Provincial People's Government, 2016).

As observed in other parts of China, the ongoing socio-demographic transformation of Fujian province since the early 1980s has also had negative consequences. One example of this can be seen in rural areas where the out-migration of young adults to urban areas has resulted in community aging. The average age of the floating population in Fujian was about 32 years old in 2013 (renkou.org.cn, 2014). The percentage of people aged 65 years or older to the number of people aged 15 – 64 years (i.e., the aged dependency ratio) was 7.4% in 1982 but had gradually increased to 11.1% in 2014 (Fujian Provincial Bureau of Statistics, 2015), while it was 13.7% for the whole

of China in the same year (National Bureau of Statistics of China, 2015). It should be noted that this was disproportionately observed in the rural areas whose aged dependency ratio was much higher (13.6) in 2010, compared with urban areas (7.2).

However, community aging is only one of the problems affecting rural communities.

Another example comes with the large number of children in Fujian who are left behind by parents that have migrated to urban areas for work, who lack the parental care and support which is necessary for healthy development; a newspaper reported that there were 105,176 left behind children in Fujian in 2015, consisting of 29,744 children aged younger than 6, 62,369 children aged from 6 to 13 and 13,063 children aged from 14 to 16 (Lin, 2016). This suggests that there are also many grandparents taking care of their grandchildren who have been left behind by their own children in rural communities.

This, in combination with population aging, makes it possible that the *de facto* population of older people is in fact much higher than the number that are actually registered (Liu, 2014).

## ***2.2. Study communities***

For the present study, seven rural communities were selected from one county in Nanping City, which consists of 142 communities and is located 170 km from Fuzhou City, the provincial capital. This county (hereinafter referred to as County A for anonymity) was chosen as the best location to determine the psychological impact of out-migration on those who were left behind as it is a typical county in Fujian Province. Among the counties in Nanping city these seven communities were deemed as being at an average ranking in terms of the degree of their economic development and population size based on the author's observation. While its registered population was 3.19 million people, its *de facto* population (defined as the population with a minimum residence requirement of 6 months by the Chinese government (Wu, 2014)) was 2.62 million in 2014 (Fujian Provincial Bureau of Statistics, 2015), which suggests that many people had left for migratory work. The percentage of people aged 65 years or older to total year-end population was 10.1% in 2014 (Nanping City Bureau of Statistics, 2015).

The land in County A is rich in forest and water, which, in combination with the warm weather, provides a good environment for the cultivation of Mandarin oranges,

mushrooms, tea leaves and tobacco leaves. In addition to agriculture, the main industrial activity involves the processing of food, chemicals, wood and bamboo. Limestone mining is also an important industry in this area. The main source of income inside the study area varied across communities according to the geographical conditions; in the main it came from growing cash crops such as tobacco, watermelon and bamboo. These communities have been supplied with electricity and tap water since the 1960s and 1980s, respectively. In 2014 the total per capita income in County A was 21,711 RMB in urban areas and 10,709 RMB in rural areas, while the total expenditure per capita was 15,199 RMB in urban areas and 8,114 RMB in rural areas (Nanping City Bureau of Statistics, 2015). In County A, in 2014 the registered population was 239,000 people, of which 172,000 were registered as farmers (in China, people have two types of registration: farmer or non-farmer). However, the *de facto* population was only 97,000 people in rural areas (Nanping City Bureau of Statistics, 2015), which suggests that almost half of the rural population in this area had migrated to cities.

### **2.3. Field survey**

A field survey was conducted in August 2015 to investigate the psychological impact of family separation following family members' out-migration from rural Fujian communities. All residents aged 18 years or older and residing in the study communities were informed about, and invited to participate in the study, through an advertisement that was posted in front of each village health center. The final number of participants recruited was 797. The number of participants recruited from within each study location is shown in Table 2.

Information on the size of the registered population was available from the local government while information on the estimated *de facto* population was provided by each village doctor, who was usually a member of the community and who had received basic medical training in order to provide primary health care to rural community members. After estimating the number of adults in each community by using statistical information on the proportion of adults-to-children in rural Nanping city (Nanping City Bureau of Statistics, 2015), the overall participation rate was estimated to be 61.7% of the *de facto* population.

[Table 2. The number of participants in each study community in rural Fujian, 2015]

DBS samples, which are drops of whole blood collected on a specific type of filter paper (903 Protein Saver Cards, Whatman) following a simple finger prick, were collected by local health professionals. This method is often utilized in community-based surveys in remote areas where necessary equipment such as centrifuges, freezers, or even electricity is limited, as it is easy to preserve and transport samples at 'normal' temperatures (McDade et al., 2007). After complete desiccation, the DBS samples were stored at room temperature for a few weeks during the survey and then preserved at  $-20^{\circ}\text{C}$  in the laboratory at Fujian Medical University.

All the interviews were conducted individually by trained interviewers (graduate students at Fujian Medical University) in either Mandarin Chinese or the Fujian dialect. Information on socio-demographic variables such as age, sex, marital status, educational attainment, household income, household size, as well as on family migration and social capital through the use of questionnaire. The K6 score was

obtained as a part of the methodological examination of EBV antibody titer among participants aged 70 years or younger using the Chinese version of the questionnaire; 70 years of age or younger was chosen as an eligibility criterion based on the field observation of our research group, that in rural China, older people cannot participate properly in survey research if the questions included in the questionnaire are complex. The Chinese version of the K6 scale was previously validated to identify those with serious mental illness in China (reliability: Cronbach's Alpha = 0.843 (Lee et al., 2012); validity: area under the receiver operating characteristic curves for the association between the K6 (13 or higher as cut-off) and serious mental illness ranged from 0.69 to 0.86 (Kessler et al., 2010; Lee et al. 2012)). In addition, a cut-off of 7 or higher was also used to identify those with mild distress (Pirraglia et al. 2011).

Height was measured using a standard anthropometer (DKSH Switzerland, Ltd., Zurich, Switzerland) while weight was measured using a digital scale (HD-654, Tanita Corp., Tokyo, Japan); Body Mass Index (BMI) was calculated by dividing weight (kg) by height squared ( $m^2$ ). Waist and hip circumference were measured by using tape measures and the waist-to-hip ratio (WHR) was calculated as waist

circumference divided by hip circumference. As there are different WHR standard values for women and men the comparison was done separately for each sex.

## ***2.4. Measurement of biomarkers***

### ***2.4.1. Measurement of EBV antibody titer***

The measurement of biomarkers from the collected samples was undertaken by the author (A.Y.) in the laboratory at the School of Public Health, Fujian Medical University; EBV antibody titer was measured during the period between February and March, while CRP concentration was measured during the period between June and July, 2016. EBV antibody titer was analyzed by enzyme-linked immunosorbent assay (ELISA). Anti-EBV viral capsid antigen (VCA) IgG was measured using a commercial kit (Mikrogen recomWell EBV VCA IgG kit [Cat.#7204], Neuried, Germany). One disk of dried blood (1/8 inch in diameter; equivalent to 1.525  $\mu$ L of serum (Mei et al., 2001)) was eluted overnight at 4°C in 250  $\mu$ L of sample diluent buffer. On the following day, the eluted sample was diluted x20 again with sample diluent buffer, and then 100  $\mu$ L of

the extraction was put onto microtiter wells coated with anti-EBV VCA antibody. After incubating at 37°C for 1 hour, secondary antibody was added and again incubated at 37°C for 30 minutes. Then 100 µL of substrate was added to the wells and incubated at room temperature in the dark for 30 minutes. After 100 µL of stop solution was added, absorbance was read at 450 nm using a reference wavelength of 620 - 650 nm by microplate photometer (Molecular Devices SPECTRA max PLUS 384, California, U.S.). A four-parameter logistic model was used for estimation of the concentrations. A cut-off value of 20 ELISA Units was determined as being indicative of no detectable EBV VCA IgG levels, i.e., seronegative. Every sample which gave a reading that showed a “gray zone” value i.e., 20 to 24 ELISA Units was rerun and the second reading was used, while those that had a reading over the highest calibrator were rerun after eluting in 1 mL of sample diluent. Only individuals with EBV values > 20 ELISA Units were included in subsequent analyses. (There were no seronegative samples among the present study participants.) Limits of detection (LOD) were calculated by using the mean and standard deviation (SD) of the absorbance of calibrators at the lowest (mean + 3SD) and the highest (mean – 3SD) concentrations. As for the quality

control, positive control was used in every assay and the inter-assay coefficient of variation (CV) for the positive control was 8%.

The protocol for EBV antibody titer from DBS described above was based on the protocol developed by the Department of Anthropology at the University of Oregon (Eick et al., 2016). Since one of the commercial kits which is used in this protocol developed by Eick et al. (2016) was not available in China, an alternative protocol which only uses the Mikrogen kit was suggested by the same research team via personal communication (with Geeta Eick, University of Oregon, 29 January 2016). A comparison of the results from the two protocols was subsequently undertaken by using samples from 13 Asian participants and analyzing them in a laboratory at the University of Tokyo; the Pearson correlation coefficient for these two protocols was 0.88 (see Appendix 1 for details).

#### ***2.4.2. Measurement of high-sensitivity C-reactive protein concentration***

CRP concentration in DBS was also measured to distinguish individuals at an acute stage of systemic inflammation, infection, or tissue injury (Libby & Ridker, 2004), following the standardized protocol devised by Brindle et al. (2010). This process was justifiable since immune function is influenced by current infection; higher levels of inflammation may drive EBV reactivation (Bennett et al., 2012). Samples that exceeded 6.25 mg/L in DBS CRP, equivalent to 10 mg/L in serum CRP (Blevins et al., 2016; Brindle et al., 2010; Thompson et al., 2014) were excluded from the analysis.

Duplicated samples were assayed for CRP with a high-sensitivity sandwich enzyme immunoassay using polyclonal antibodies (Monoclonal Antibody to Human CRP #M86005M for primary antibody, and #M01319B for secondary antibody, Meridian, U.S.). A four-parameter logistic model was used for the estimation of the concentrations. LOD were calculated by using the mean and standard deviation of the absorbance of calibrators at the lowest (mean + 3SD) and the highest (mean – 3SD) concentrations. The inter-assay CV was 14, 10, and 13% for the low, middle and high concentration of controls, respectively.

## ***2.5. Definition of “people left behind”***

A participant was defined as a left behind person if she or he did not go out to work in the last 6 months by herself/himself and had a household member who was outside of their community for at least 6 months and who, for whatever reason, had not returned to the community for at least 6 months. This is in accordance with the Chinese registration system where people are regarded as *de facto* population if they continuously live in a community for more than 6 months. In this study, household members were defined as the total number of (a) people currently living in the community for 6 months or more, (b) migratory workers who were currently living outside the community for at least 1 month and previously living together with their families (i.e., the participants), (c) students who were living outside the community and (d) people serving in the army. It does not include men who had established a branch family (i.e., become a household head) and did not share household income or women who had got married to a man in another household.

We also collected detailed information on family members' migration, such as their relationship with the respondents, the timing of the migration (e.g., when they

started migratory work, and the last time they returned to the community), the migration destination, type of work and the amount of remittance. This information was obtained for each family member who was outside the rural community.

## ***2.6. Evaluation of social capital***

As mentioned in the Introduction, information was collected on social capital as a potential buffering factor against psychological stressors. This was done with the use of a questionnaire that was created on the basis of fieldwork observations and interviews with local health professionals. Social capital variables included structural and cognitive social capital (Anirudh & Elizabeth, 2000; Harpham et al., 2002).

Structural social capital was measured by the frequency of eating together with the people from other households and participating in wedding ceremonies or funerals in the previous year, as these are the most commonly observed form of structural social capital (i.e., social participation) in this area. More specifically, we decided to ask about attendance at weddings and funerals following discussions with

community members, researchers and government officials. Moreover, a questionnaire created for the measurement of social capital in developing countries by the World Bank, the Integrated Questionnaire for the Measurement of Social Capital (SC-IQ), also includes questions on these particular forms of social participation (Christiaan et al., 2004).

If the participants ate together with the members from other households at least once in 2 to 3 months, or had participated in wedding ceremonies or funerals at least once in the past year, they were categorized as “1”, if participants had merely ate together with members from other households and not participated at a wedding ceremony or funeral in the past year, they were categorized as “0”.

Cognitive social capital was assessed in terms of trust, reciprocity and attachment to the community members, and measured with the following questions; “Generally speaking, do you trust people in your community?”, “Do people in your community try to be helpful to others?” and “How attached do you feel to your community?”, respectively. Participants answered using a Likert-type scale with five response options (i.e., never, rarely, sometimes, most of the time, always), with people

that answered most of the time or always being categorized as “1” (i.e. as possessing cognitive social capital). The sum of the three scores was calculated (range 0 - 3), with the cognitive social capital score being categorized as either 1: (a score of 2 or 3) or 0: (0, 1). These questions have been commonly used for the measurement of cognitive social capital (i.e., social cohesion) in many settings previously in both developed and developing countries (Agampodi et al., 2015; Riumallo-Herl et al., 2014).

Community-level social capital was calculated as the mean value of individual-level social capital responses from the same community members. Previous studies have mainly used two types of strategy to evaluate community-level social capital; (1) aggregation of individual-level social capital variables (Kim et al., 2006), and (2) the use of specific variables which indicate community-level social capital, such as the percentage of people voting, density of voluntary organizations or income inequality level (Macinko & Starfield, 2001; Scheffler et al., 2008). As most of the previous studies conducted in low- and middle-income countries obtained community- or group-level social capital by aggregating individual responses (Agampodi et al., 2015), and it was not possible to use the second option in this setting, the author decided

to create community-level social capital variables by aggregating the responses to individual-level social capital questions.

### ***2.7. Socio-demographic information***

Marital status was categorized into three: not yet married; has a partner (married/cohabitate); and divorced/widowed. Educational attainment was also divided into three categories: illiterate (received no formal education); graduated from elementary school (6 years of schooling); and junior high school or above (9 years of schooling or above). For household income, we asked participants about their relative economic status in comparison to the other households in the same community.

Specifically, following the lead of a survey that targets older people in China, the China Health and Retirement Longitudinal Study (CHARLS) (National School of Development Peking University), we asked “Suppose that the household income of the poorest in your community is 0 and that of the richest is 10, how would you rate your household income on a scale from 0 to 10?” Responses were divided into two: higher or

lower than the median value (which was 5) (see Appendix 2 for the validation of this variable).

Other socio-demographic information was obtained to understand the lifestyle of the participants in greater detail. Employment status was divided into eight categories; no employment, engaging in farming, running their own small business, part-time work with a heavy physical activity level, part-time work with a light physical activity level, army and other (e.g., doctors and veterinarians). Information on the respondents' self-rated physical activity level was obtained by asking "Suppose the physical activity of the least active in the community is 0 and that of the most active is 10, how would you rate your own physical activity level on a scale that runs from 0 to 10?". Responses were then divided into three categories; low (0 – 3.9), middle (4 – 5.9) and high (6 – 10). Dietary information was obtained on the consumption of seven sources of protein; pork, beef, lamb, poultry (chicken / goose / duck), eggs, seafood, river fish. Information was also obtained on smoking (never / have quit or currently smoke) and alcohol consumption (never or rarely / once a week or more). Mobile phone usage, which was previously found to be associated with psychological stress status in

rural China (Yazawa et al., 2014) was assessed using information on monthly payments; do not use, 1 – 20 RMB, 21 – 40 RMB, and 40 or more RMB. Data on place of birth was obtained by asking the participants whether they were born in the research community or not.

## ***2.8. Statistical analysis***

Questionnaire data was obtained from 797 people. After excluding people who did not provide a blood sample ( $n = 2$ ), whose blood was insufficient to measure both biomarkers ( $n = 1$ ), those with a CRP concentration higher than 10 mg/L in their serum ( $n = 27$ ), who did not provide information on cognitive or structural social capital ( $n = 29$ ), who did not provide information on age, household size and household income ( $n = 4$ ), the size of the final sample used in the analysis was 734.

First, a Student's t-test for continuous variables and Pearson's chi-square test for categorical variables were calculated to determine if there were any differences in the study variables between people left behind and those not left behind.

A mixed effects regression analysis with a random effects model to account for multiple individuals in each community was used to investigate the association between log-transformed EBV antibody titer and being left behind as a result of out-migration among the rural population in Fujian Province. Models were developed following the procedure described below. Model 1 included biological characteristics (age, age squared, sex and log-transformed CRP concentration), demographic variables (marital status, education, household income and household size) and the proportion of those left behind in the community (as a percentage) as covariates. CRP concentration was included as an accelerated inflammatory status can drive EBV reactivation (Bennett et al., 2012). The CRP concentration values were log transformed to normalize their distribution. Social capital variables were then included in the analysis to examine their potential buffering effect on the association between being left behind and EBV antibody titer; Model 2 included individual-level cognitive social capital while Model 3 included individual-level structural social capital. Models 4 and 5 additionally included community-level cognitive and structural social capital, respectively. To investigate the association between being left behind and the K6 score, a Poisson regression analysis

with a robust variance estimator was conducted while adjusting for age, sex, marital status, educational attainment, household income, household size and proportion of those left behind in the community. As recommended by the scale guidelines, a cut-off score of 13 or greater was used to indicate the presence of severe distress (Kessler et al., 2002) and a cut-off score of 7 or greater was defined as mild distress (Pirraglia et al., 2011). These analyses also used a random effects model to account for multiple individuals within a community and were conducted among 553 participants aged 70 years or younger.

All statistical analyses were conducted using Stata 13.1. The level of statistical significance was set at  $p < 0.05$  (two-tailed).

## ***2.9. Research ethics***

The participation of the local residents was voluntary, using informed consent procedures and respondents were informed that they could withdraw from the study at any time. The research protocol was officially approved by the appropriate sectors of

the Chinese government. The field surveys were conducted after obtaining approval from the Ethics Committee for Medical Research at the University of Tokyo (No. 10515-(1)) and the Ethics Committee of the Institute of Tropical Medicine at Nagasaki University (No. 120910100).

## Chapter 3 Results

### *3.1. Characteristics of the study participants*

The basic characteristics of the participants are shown in Table 3. People left behind ( $n = 280$ ) comprised 38.1% of the total population ( $N = 734$ ). The mean age was 58.9 years ( $SD = 12.9$ ) with people left behind being older than their not left behind counterparts (62.4 vs. 56.7,  $p < 0.001$ ). Male participants comprised 38.7 % of the total sample with the proportion being higher among those left behind (43.6% vs. 35.7%,  $p = 0.033$ ). More than four-fifths of the participants (80.8%) were married, while the remainder were either widowed or divorced (15.4%), or not married (3.8%), with more of the not left behind being not married (5.3% vs. 1.4%). Just under 40% of the participants attended elementary school, 23.3% graduated from junior high school or had a higher education, while 37.1% were illiterate. The left behind had lower overall educational attainment (e.g., illiteracy was more prevalent among people left behind compared with those not left behind [42.1% vs. 33.9%]). Household income did not differ between the left behind and the not left behind (high - 56.1% vs. 55.5%). Mean

household size (including migratory working family members) was 4.82 persons (SD = 2.38), and was significantly higher among those left behind (5.34 vs. 4.49,  $p < 0.001$ ). There were no statistically significant differences between the left behind and the not left behind in relation to the social capital indicators; more than 60% of the participants answered the question on individual cognitive social capital in the affirmative, while more than three-quarters of them did so when responding to the question about individual structural social capital. Community-level social capital did not differ between the left behind and the not left behind both in relation to structural social capital and cognitive level social capital. Median EBV antibody titer and CRP concentration were 125.0 (interquartile range [IQR] = 74.0 – 241.6) ELISA units and 0.68 (IQR = 0.33 – 1.51) mg/L, respectively. People left behind had higher EBV antibody titer compared to people not left behind (136.7 ELISA units vs. 118.2 ELISA units,  $p = 0.020$ ).

[Table 3. Basic characteristics of the participants (N = 734)]

Information on the physical health status and health-related lifestyles of people left behind and people not left behind is reported in Table 4. Two-thirds (67.2%) of the participants were engaged in farming, with the figure being slightly higher among people left behind (70.4% vs. 65.2%). People not left behind were more likely to run small shops in their communities (5.5% vs. 2.1%) and have a part-time job requiring light physical activity (11.5% vs. 4.6%) compared to people left behind. Self-rated physical activity was slightly lower among those who were left behind although this difference was not statistically significant. WHR was significantly higher among left behind females ( $n = 158$ ,  $p < 0.001$ ), whereas no difference was found among the male participants. Other lifestyle factors including diet (sources of protein), smoking, alcohol consumption, mobile phone usage (monthly payments), and place of birth (research community or not) did not differ between people left behind and people not left behind. The participants consumed pork more than three times per week and eggs approximately two times a week. In terms of other meats, neither beef nor lamb was commonly consumed in the study communities. Less than 15% of the participants were smokers or former smokers. Alcohol was consumed once a week or more frequently by

more than one-quarter of the participants. In addition, one-quarter of them did not use a mobile phone while 20% spent more than 40 RMB per month on their mobile phones.

[Table 4. Comparison of lifestyle factors between people left behind  
and people not left behind (N = 734)]

Description of people left behind in relation to migrants' characteristics is shown in Table 5. Among the 734 participants, 280 were categorized as being left behind; most of them were left behind by a son (88.9%) or grandchildren (27.5%), and 41.8% had migrant family members work in Nanping City, 64.6% had family members outside Nanping but in Fujian Province, and 37.1% had family members working outside the Province. There were no cases of international migration. As for remittance, 26.4% of families received no remittance (this group included those with student migrants), while over 80% of people left behind received less than 3,000 RMB per year in remittance. More than half of the migrants engaged in sedentary part-time jobs, while others were self-employed (e.g., drivers, run a restaurant), were formal employees (e.g.,

teachers, employed by a company or governmental office), or engaged in part-time jobs with heavy physical activity (e.g., construction laborer).

[Table 5. Description of people left behind in relation to migrants' characteristics in rural Fujian, China in 2015 (n = 280)]

### **3.2. Factors associated with EBV antibody titer**

A mixed effects regression analysis with a random effects model to account for multiple individuals in each community was used to examine the association between being left behind and EBV antibody (Table 6). In Model 1 which adjusted for all covariates, being left behind was significantly associated with EBV antibody titer (coefficient = 0.14, 95% CI = 0.01 – 0.27,  $p = 0.038$ ). There was a quadratic relationship between age and EBV antibody titer (Age: coefficient =  $-0.04$ , 95% CI =  $-0.07 - 0.00$ ,  $p = 0.051$ ; Age squared: coefficient =  $3.58 \times 10^{-4}$ , 95% CI =  $0.51 \times 10^{-4} - 6.65 \times 10^{-4}$ ,  $p = 0.022$ ), which indicated that EBV antibody titer was lowest at the age of

approximately 50.22 years and higher among those who were both younger and older.

Female sex was associated with higher EBV antibody titer in Model 1 (coefficient =

0.14, 95% CI = 0.00 – 0.27,  $p = 0.047$ ). CRP concentration was not associated with

EBV antibody titer (coefficient = 0.05, 95% CI = -0.00 – 0.11,  $p = 0.070$ ). The

proportion of those left behind in the community was not associated with EBV antibody

titer or any of the socioeconomic variables i.e., marital status, education, household

income and household size were not associated with EBV antibody titer.

A mixed effects regression analysis that incorporated social capital indicators

was used to investigate the association between being left behind and EBV antibody

titer (Models 2 to 5). Participants with higher individual-level structural social capital

had a significantly higher level of EBV antibody titer in Models 3 and 5 (coefficient =

0.20, 95% CI = 0.05 – 0.35,  $p = 0.009$  in Model 3; coefficient = 0.21, 95% CI = 0.06 –

0.36,  $p = 0.006$  in Model 5), while community-level structural social capital was

negatively associated with EBV antibody titer; people living in communities with

greater structural social capital had a lower level of EBV antibody titer (coefficient =

-1.20, 95% CI = -2.40 – -0.00,  $p = 0.050$  in Model 5). The inclusion of

individual-level structural social capital in the analysis did not attenuate the association between being left behind and EBV antibody titer (coefficient = 0.14, 95% CI = 0.01 – 0.26,  $p = 0.038$  in Model 3), while the further inclusion of community-level structural social capital did little to attenuate the association. On the other hand, neither individual- nor community-level cognitive social capital was associated with EBV antibody titer (Models 2 and 4).

In Models 3 and 5, the association between education and EBV antibody titer became significant; people with greater educational attainment had lower EBV antibody titer (Less than elementary school: coefficient =  $-0.15$ , 95% CI =  $-0.29$  –  $-0.00$ ,  $p = 0.048$  in Model 3, coefficient =  $-0.15$ , 95% CI =  $-0.30$  –  $-0.01$ ;  $p = 0.040$  in Model 5, compared to those who were illiterate).

[Table 6. Association between being left behind, EBV antibody titer  
and the social capital variables (N = 734)]

Among 589 participants aged 70 years or younger, 553 (93.9%) completed the

K6 questionnaire. Among them, 22.2% of them were categorized as mild-to-moderate distress (the K6 score of 7 – 12) while 7.6% of them were categorized as severe distress (i.e., the K6 score of 13 or higher). The analysis that used the K6 score of 7 or higher as an outcome among participants aged 70 years or younger (n = 553) showed that there was a significantly higher prevalence of distress among people left behind (prevalence ratio = 1.47, 95% CI = 1.28 – 1.69) (Table 7). However, such an association was not found in relation to severe distress (prevalence ratio = 1.00, 95% CI = 0.62 – 1.60).

[Table 7. Association between being left behind and  
the Kessler 6 Psychological Distress Scale score (n = 553)]

## Chapter 4 Discussion

### *4.1. Summary of the study findings*

This study found that in rural Fujian, China people left behind by family members who migrated to the other locations had a higher level of psychological stress when using EBV antibody titer, a biomarker of psychological stress, as an assessment tool. This finding was supported by the analysis which used a questionnaire-measured distress status (i.e., the K6 score) as the outcome and showed that the experience of being left behind was linked particularly with subclinical psychological distress among participants aged 70 years or younger. It was also shown that structural social capital was associated with psychological stress among the study participants. More specifically, community-level structural social capital was inversely associated with psychological stress, whereas individual-level structural social capital was positively associated with psychological stress. This suggests that community-level structural social capital protects people from psychological stress whereas individual-level structural social capital is rather linked with psychological stressors in rural Fujian,

China. The effects of structural social capital were observed among the study population as a whole irrespective of the family's specific migration status; in other words, social capital was not shown to function as a buffer against psychological stress due to family separation among people left behind in this research location.

#### ***4.2. Psychological stress among people left behind in rural Fujian, China***

In this study people left behind had a significantly higher level of psychological stress as measured by EBV antibody titer compared to those living in households with no migrants. This is in line with the results from some previous studies conducted in China and other countries. For example, Guo et al. (2009) used longitudinal data for 1,237 older people aged 60 years or above in rural China to show that older parents who had more migrant children in 2001 tended to have more depression in 2013 (as measured by the Center for Epidemiologic Studies–Depression (CES-D) scale (coefficient = 0.20,  $p < 0.05$ )). He et al. (2016) also conducted a cross-sectional survey in rural China among 509 left-behind people aged 65 years or

older in 2014, and found that 36.9% of those left-behind suffered from depression as assessed by the Geriatric Depression Scale (GDS); this figure was higher than that reported among older people in the general population in rural China (23.6%), calculated in a meta-analysis that included 81 studies from 1987 to 2012 (Li et al., 2014). Similar results have also been reported in other countries. Adhikari et al. (2011) showed that left-behind parents aged 60 years or above in Thailand had poorer self-reported mental health than those with no migrant children (OR = 1.10, 95% CI = 1.05 – 1.17). Using longitudinal Indonesian data (1997 to 2007), Lu (2012) found that left behind spouses (most of whom were women) and parents had more depressive symptoms as assessed by the CES-D scale (OR = 2.05, 95% CI = 1.17 – 3.59). A cross-sectional study conducted in several South-East Asian countries (i.e., Indonesia, the Philippines and Vietnam) in 2008 to 2009 also highlighted that stay-behind caregivers of children were about twice as likely to suffer from common mental disorders (measured with the Self-Reporting Questionnaire [SRQ-20]) as caregivers in non-migrant households; the association was most evident when focusing exclusively on caregivers in Indonesia: when compared to not being left behind by migrants the

ORs for common mental disorders were 2.01 (95% CI = 1.18 – 3.42) when fathers were left behind, 1.90 (95% CI = 1.12 – 3.23) when mothers were left behind and 1.93 (95% CI = 1.05 – 3.55) when others (e.g., grandparents and other relatives) took care of the children (Graham et al., 2015).

It is also true however, that there are some studies which have shown that the migration of family members can have a protective effect on the psychological health of people left behind, although these studies were not conducted in China. For example, Abas et al. (2009) used cross-sectional data (EURO-D) collected in 2006 to 2007 to show that in rural Thailand, rural-to-urban migration of children was protective against depression among their left behind parents. Specifically, they found that parents who had all of their children migrate to other locations were less likely to experience depression compared to those parents who had some or no children migrate. They also reported that having migrant children was associated with receiving more remittance, and that this might be one of the possible mechanisms through which the migration of more family members resulted in a better psychological outcome, compared to in those families with fewer children being away.

Other studies have also found that remittance has a buffering effect against psychological burden among people left behind. For example, in China, Lu et al. (2012) used CES-D data (as a continuous variable) from 2008 to show that remittance buffered against the negative impact of having children migrate to other locations; thus, although left-behind older people still had more depression compared to those who were not left behind (coefficient = 2.38, 95% CI = 0.34 – 4.42), there were fewer depressive symptoms among people in households receiving remittance i.e. using people not left behind as a reference, the coefficient for those with remittance was 1.53 (95% CI = –0.94 – 3.99) but 2.65 (95% CI = 0.29 – 5.01) for those without remittance. Graham et al. (2015) also showed that among caregivers left behind, receiving remittance was inversely associated with common mental disorders (OR = 0.63, 95% CI = 0.45 – 0.87 [when using those with no remittance as a reference]) in a combined sample of South-East Asian countries (Indonesia, the Philippines and Vietnam).

In this study, those who were left behind in rural Fujian did not receive much remittance – in approximately 80% of households the sum was less than 3,000 RMB (equivalent to 471 USD as of September 1, 2015) annually. Furthermore, there was no

significant association between remittance and EBV antibody titer among people left behind (i.e., having 1,000 or more RMB per year was not associated with EBV antibody titer [when using those who received remittance of less than 1,000 RMB as a reference;  $p = 0.54$ ]). There are two possible scenarios here in relation to the null association between EBV antibody titer and the remittance being sent to people left behind; the first possibility is that though people left behind expect their family members to remit money, the sum sent is not sufficient to meet the demands of those who remain and thus, there is no variation in terms of psychological stress. The second possibility is that people left behind do not rely on remittance and their migrant family members are not expected to remit money and thus, there is also no variation in terms of psychological stress. As mentioned in the Introduction, there are two contrasting explanations regarding the factors determining migration (i.e., push and pull factors). Given this, it is possible, that the impact of remittance may differ according to whether the migration was characterized more by either push or pull factors; if households expect migrant family members to remit money, it is likely that the impact of remittance on psychological stress will be visible when variation in remittance is large enough to be tested. If

households are wealthy and they do not rely on remittance, it is less likely that the impact of remittance on psychological stress would be observed.

As the participants in this study did not differ in terms of the effects of remittance (or at least did not differ in terms of its effects on psychological stress) but the members of migratory families had higher levels of stress then it is possible that the overall effect of family members' migration may have been detrimental in relation to psychological stress with the negative impacts outweighing the positive impacts.

Migration can be detrimental as it results in family separation, which can induce loneliness, isolation, and the loss of basic family support (He & Ye, 2014). In China, this phenomenon has been well characterized by the term "empty-nest elderly", which describes the situation where older people either live alone or with only a spouse without their children or grandchildren, i.e., the people most severely affected by the loss of family members in terms of those left behind. For example, Wu et al. (2010) have shown that there is a high prevalence (80.94%) of loneliness among the empty-nest elderly in rural China. Cheng et al. (2015) have also described poorer psychosocial adjustment among empty-nest elderly in China where they have a higher

level of loneliness, depression, lower social support, family support and a lower quality of life (QOL) than non-empty nest older adults. He and Ye (2014) investigated the situation of left-behind older parents in China, while paying particular attention to factors such as the amount of remittance and the frequency of communication. They found that the level of remittance was low in most of the households (80% received less than 1,000 RMB per year) and that there was little communication despite the widespread use of mobile phones. This study also showed that 54.0% of people left behind spent less than 20 RMB per month using their mobile phones and that 33.9% of them rarely made contact with family members who had migrated to other areas. As stated by He and Ye (2014), it seems as if the traditional collective system which Chinese rural communities have maintained, that is based on familial relationships, has been changing in the course of modernization, and that families no longer function as a safety network or source of support for older people in rural China. Many older people in rural communities have literally been left behind to fend for themselves and are psychologically stressed as a result of this. This was also confirmed in a sensitivity analysis conducted only among older people which used two cut-off ages – 65 (based

on the World Health Organization definition of older people (World Health Organization, 2010)) and 50 (based on the U-shaped association observed between age and EBV antibody titer which was lowest in those participants aged around 50 years) which revealed a positive association between being left behind and EBV antibody titer (see Appendix 3).

It should be stated that there may have been several possible scenarios that could have led to reverse causality in relation to the association between being left behind and psychological stress. First, it is possible that unhealthy people, who might also have been psychologically stressed, were more likely to be left behind (i.e., not be migrants). For example, Laland and Brown (2006) have shown that people with mental illness or depression are more likely to stay in their home community. Second, those who were from low socioeconomic status households and psychologically stressed because of their low standard of living could have been more likely to be left behind by family members who decided that the poor economic situation of their family necessitated that they earn money in other locations. However, as Du (2000) has shown that the poorest people in rural communities are not the ones who are most likely to

migrate, this explanation might not be applicable here.

### ***4.3. Social capital and psychological stress among residents in rural Fujian, China***

#### ***4.3.1. Community-level structural social capital***

In this study, some of the social capital variables were associated with psychological stress. First, higher community-level structural social capital was associated with lower psychological stress, which was in line with the result of a study conducted among 655 adults (16 years or older) in 13 villages in the Bolivian Amazon where village social capital was inversely associated with negative emotions (Godoy et al., 2006). In that study, village social capital was evaluated as the aggregated mean of individual responses to questions on social capital, that concerned (1) the number of gifts given to other households, (2) the number of times participants had proffered their labor to help other households, and (3) the number of times participants had engaged in communal work, while negative emotions were assessed in relation to the frequency of sadness, anger and fear experienced in the past seven days. In a regression analysis

where sadness, anger and fear were the outcomes, the coefficients for village social capital were  $-0.34$  ( $p < 0.0001$ ),  $-0.28$  ( $p < 0.0001$ ), and  $-0.24$  ( $p < 0.002$ ), respectively.

Another study, which was conducted in Japan, also reported that community-level structural social capital had a positive effect on psychological well-being (Hamano et al., 2010). In that study a multilevel analysis was conducted among 5,956 people nested in 199 neighborhoods which showed that there was a positive association between community-level structural social capital and self-reported mental health which was measured by the 36-Item Short Form Survey (SF-36) questionnaire. In particular, higher membership in sports, hobby, recreation, or cultural groups was linked to better mental health after adjusting for individual confounders (coefficient = 8.73,  $p < 0.001$ ). In addition, Lofors and Sundquist (2007) also showed a positive effect of community-level structural social capital on depression in Sweden while using cohort data from 4.5 million people aged 25 to 64; they calculated the average voting rates in local government elections by the smallest Swedish geographical units (the small area for market statistics [SAMS], a division based on municipalities, sub-divisions in larger municipalities and on electoral districts in the smaller municipalities) which they used

as an indicator of community-level structural social capital, to investigate the association between voting rates and hospitalization due to depression. They found that when compared to those people living in communities with high voting rates (i.e., where there was higher community-level social capital), people living in communities with middle or low voting rates had significantly higher odds ratios for depression (males: OR = 1.16, 95% CI = 1.09 – 1.23; females: OR = 1.11, 95% CI = 1.06 – 1.17).

There are also however, some previous studies conducted in Western countries which have shown that community-level structural social capital is not necessarily associated with better health. For example, Stafford et al. (2008) investigated the role of community-level structural social capital on common mental disorders in England and Scotland; using data from 9,082 people aged 16 years and above and operationalizing community-level social capital as the participation rates in organized activities in 239 electoral wards, they found it had no statistically significant association with common mental disorders. While the exact reason for the discrepancy in the results between their study and this study is unclear, these contrasting results suggest that different types of social capital indicators (Table 1) may vary in terms of

their capacity to assess social capital in different contexts. For example, as the lifestyles of people living in developed societies are more complex and diversified than those of people living in rural communities in developing societies (e.g., our study location), it is possible that a single marker of structural social capital (e.g., the participation rate in organized activities in Stafford et al. (2008)) might not sufficiently capture the various aspects of community-level structural social capital found in developed societies. If this is the case, then our approach in which we evaluated structural social capital based on fieldwork observations and interviews with local health professionals may have been appropriate and have enabled us to better capture the various aspects of village social capital, and thus find a significant association between structural social capital and psychological stress.

The association between community-level structural social capital (the occurrence of social interaction in the community (i.e., attendance at funerals, marriages and sharing meals)) and psychological stress observed in this study suggests that living in communities with higher levels of active social interaction can reduce psychological stress among residents. Although the exact mechanisms underlying this association need

to be elucidated in this particular setting, earlier research in other locations has highlighted that social interaction reduces psychological stress through the increased sense of companionship and belonging it engenders (Thoits, 2011; Yang et al., 2015), which can act to prevent social isolation within a community. In terms of the current study this might be important as social isolation has been associated with greater psychological stress (Cacioppo & Hawkley, 2003).

#### ***4.3.2. Individual-level structural social capital***

On the other hand, higher individual-level structural social capital was associated with greater psychological stress. This is in line with the findings reported in several studies that have shown a positive association between individual-level structural social capital and psychological health. For example, Mitchell and LaGory (2002) showed that in impoverished communities (i.e., assessed in census blocks) in the U.S., individual-level structural social capital (defined in terms of group membership) was associated with depressive symptoms measured using the CES-D; they suggested that those individuals who had strong bonding social capital were often not autonomous

within their relationships and might suffer from having too many obligations and being in a closed network and that in these circumstances, active participation may not necessarily be beneficial for well-being. Myroniuk and Anglewicz (2015) assessed health-related quality of life longitudinally among 2,328 people in rural Malawi with the Short Form-12 Health Survey questionnaire (SF-12). Using social participation in 2008 (e.g., attendance at a funeral or wedding ceremony) as a form of structural social capital and health-related QOL in 2010 as an outcome, they found that social participation predicted a worse psychological health status two years later (females: coefficient =  $-0.06$ ,  $p < 0.05$ ; males: coefficient =  $-0.02$ ,  $p < 0.1$ ) although it was associated with better physical health.

Although it should be noted that a number of previous studies have shown that individual-level structural social capital has a protective effect on psychological health (Hamano et al., 2010; Murayama et al., 2013; Takagi et al., 2013; Yip et al., 2007), one of the reasons for the positive association observed in this study and in some previous studies might be related to the fact that the demands and obligations that can on occasion be associated with social interaction can sometimes outweigh the positive

benefits and became a source of psychological stress. The co-existence of positive and negative effects of social interaction was previously detected in tight-knit traditional societies (such as in small rural communities in the U.S. in the 1970s) and was explained using Durkheim's social class theory (Durkheim, 1995) where social cohesiveness was seen as protecting people from psychological burdens whereas social regulation was regarded as a mechanism that could increase the psychological burden of people by restricting their behavior and limiting their desires (Kawachi & Berkman, 2001). As described in the Introduction, in our study communities older people and children predominated, and thus, given the comparative absence of working age adults, it is feasible that those individuals actively engaging in social activities such as weddings or funerals or frequently sharing meals with neighbors might have also been burdened by a bigger (community) workload, more obligations and hence greater stress. The bonding nature of these relationships might also have been associated with greater social regulation and hence more psychological stress among those people in the study communities, a phenomenon which has been termed the "dark side" of social capital (van Deth & Zmerli, 2010).

The conflicting findings concerning individual- and community-level structural social capital in this study suggest that in rural Fujian, structural social capital is associated with psychological stress but that its effect varies depending on the level it is measured at. Although living in a community with active social interaction may benefit the residents psychologically, social interaction in the form of strongly bonded relationships may be a source of psychological stress due to the potential demands and obligations that can be associated with it. Moreover, it can be speculated that as the number of rural-to-urban migrants will continue to increase in the coming decades, it is possible that the migration trend might increasingly impose a strain on those who provide and maintain structural social capital. This may worsen the health of the very persons who provide social capital and eventually lead to the erosion of community social capital. This result contrasts with the findings by Subramanian et al. (2002) who reported that in the U.S., individual-level social capital was associated with better health outcomes at a given degree of community-level social capital. Furthermore, in their study, there was a significant cross-level interaction between community- and individual-level trust (i.e., living in a highly cohesive community was protective for

trusting individuals but was detrimental for mistrusting individuals). We assume that the inter-relationships between individual-level social capital, community-level social capital and their health consequences might be determined by the nature of social capital in each context (e.g., if human relationships are characterized as being more individualistic or collectivistic). The reason there was no cross-level interaction in this study ( $p = 0.86$ , Appendix 4) might have been associated with such differences, while a lack of statistical power due to the small number of investigated communities might also account for these conflicting findings.

It should also be mentioned that in rural China it is important to minimize the burden on individual members due to the potential demands and obligations that can be associated with individual-level social capital, while at the same time maintaining community-level social capital. While Chinese society has become more diversified and stratified in terms of people's lifestyles in the course of economic development (Inoue et al., 2016), there are still many communities which possess their own community salon where people can interact with each other (e.g., chatting, drinking tea, playing majong, and watching TV) (Wan et al., 2007). If the local government can subsidize

these activities, this might help with the maintenance of community-level structural social capital without giving rise to or exacerbating individual-level psychological stress.

#### ***4.3.3. Individual-level and community-level cognitive social capital***

Although this study showed that cognitive social capital was not significantly associated with psychological stress at either the individual or community level, some previous studies have shown a statistically significant association between cognitive social capital and better psychological health at both levels (De Silva et al., 2005), one of which was conducted in China (Yip et al., 2007). Specifically, in a study that included 2,401 people aged 16 to 80 years living in 192 rural Shandong communities, individual- and community-level cognitive social capital were both inversely associated with poor mental health as measured by the GHQ-12 (individual level: OR = 0.58, z-score = 2.28 (equivalent to  $p = 0.023$ ); community level: OR = 0.71, z-score = 3.92 (equivalent to  $p < 0.001$ )). Two other studies conducted among older people in Japan have also shown that lower community-level trust and reciprocity were associated with

higher psychological distress (Kobayashi et al., 2015), and self-reported mental health (Hamano et al., 2010).

As Yip et al. (2007) conducted their study in China in a similar research setting to this study and found a statistically significant association between cognitive social capital (trusting people from the same village) and psychological health, at both at the individual and community level, it is possible that the non-association observed in this study may have been due to a lack of statistical power. It is also worth considering that effects of the spatial unit at which cognitive social capital was conceptualized (e.g., within community, city or country) might be specific to each research setting. For example, while conducting research among residents in impoverished communities in the U.S., Mitchell and LaGory (2002) showed that the trust participants exhibited towards their neighbors in the same community was higher than that towards people in general. Thus, as cognitive social capital may differ by measurement unit, future research should focus on the different effects of cognitive social capital in different spatial units such as the community, town, or city and identify the unit which best predicts residents' health.

#### ***4.3.4. Possible reverse causality or confounding related to social capital***

It should be noted that reverse causality might also exist in relation to the association between social capital and psychological health. For example, people with mental illness, who may be more likely to experience psychologically stress (Link et al., 1999), might also have problems in interacting with other people, and thus have less social capital. While a review by Ehsan and De Silva (2015) concluded that the association between social capital and mental illness was not solely due to reverse causality, this possibility cannot be ruled out in the current study due to its cross-sectional nature.

#### ***4.3.5. Social capital as a buffer against psychological stress***

As for the buffering effect of social capital on psychological stress among people left behind, we found little evidence that social capital buffered against psychological stress due to family separation following household members' migration. Specifically, the inclusion of the social capital variables in the analytic models did not substantially attenuate the association between being left behind and EBV antibody titer

(the coefficients for the association between them was not changed after controlling for social capital variables). In addition, the interaction term between community-level structural social capital and being left behind was not significant ( $p = 0.83$ ; Appendix 4), which indicates that the association between being left behind and psychological stress did not differ between those living in communities with higher social capital and those in communities with lower social capital. Family separation and social capital seem therefore to be important, but independent determinants of psychological health in rural China.

This finding concurs with the result from an earlier study by Godoy et al. (2006). In that study, it was hypothesized that the association between income inequality and poor health was due to the erosion of community social capital, with this hypothesis being tested among 655 adults residing in 13 communities in the Bolivian Amazon. Godoy and colleagues found that income inequality at the community level (measured with the Gini coefficient) was positively associated with negative emotions (sadness, anger and fear) among residents (e.g., sadness: coefficient = 1.83 [SE = 0.68],  $p < 0.01$ ) and that these associations were not attenuated when village social capital was

incorporated in the statistical analysis (measured as the frequency of gift giving, asking other households for help with labor and participation in communal work, i.e., community-level structural social capital). They concluded that social capital did not buffer the effect of community-level income inequality on negative emotions.

In contrast to Aida et al. (2011) and Hikichi et al. (2016) who found that social capital had a buffering effect on psychological well-being, this study, like the study by Godoy et al. (2006) found no such effect. One of the possible explanations for this difference might relate to the fact that an insufficient number of communities were investigated in this study. While Aida et al. and Hikichi et al. conducted their studies among 79 and 99 communities, respectively, the number of communities investigated in our study was 7 while Godoy et al. investigated 13. These numbers might have been insufficient in terms of capturing the association between community-level social capital and the variation in psychological well-being associated with psychological stressors (i.e., being left behind in our study and income inequality in the study by Godoy et al.). Another possibility for these conflicting findings, which is closely related to the first point, might relate to the fact that both this study and the study by Godoy et

al. were conducted in rural communities in developing countries, where most people usually live in small, close-knit communities, and where there is thus smaller variation in community-level social capital across study communities, compared with the variation observed in developed countries such as Japan. While, in this study, it was shown to be associated with individual psychological stress (irrespective of whether people were left behind or not), the variation in community-level social capital might not have been large enough to detect the difference in psychological stress between people left behind and people not left behind. Taken together, this suggests that future research studies should include a larger number of communities which vary in terms of their social capital, so that the association between social capital and inter-individual variation in psychological stress within communities can be better determined.

#### ***4.4. Biological factors explaining variations in EBV antibody titer***

The present study showed that age and sex were statistically significant biological determinants of EBV antibody titer. CRP concentration was marginally

associated with EBV antibody titer.

#### ***4.4.1. Age***

Some previous research focusing on the adult population has indicated that a positive association exists between age and EBV antibody titer. For instance, in a previous study conducted in rural Hainan, China, the author (A.Y.), found a positive association between age and EBV antibody titer among 221 adults aged 20 to 59.

Similarly, using data from 143 adults aged 18 to 79 in rural Siberia, Sorensen et al. (2009) showed that there was a positive association between age and EBV antibody titer.

When comparing EBV antibody titer among 1,457 adults aged 25 to 90 in the U.S.,

Stowe et al. (2010) showed that there was an age gradient with EBV antibody titer

being lowest among people younger than 45 years, at an intermediate level among those aged 45 to 64 years, and highest among people aged 65 years or older. The finding of

higher EBV levels among older people was also reported in an earlier study by Glaser et

al. (1985) who showed that older people (mean age of 72) in the U.S., had higher EBV

antibody titer than their younger controls (mean age of 23). On the other hand, there are

also many previous adult studies that have not shown a significant association between age and EBV antibody titer. For example, Fagundes et al. (2014) reported that there was no difference in EBV antibody titer among U.S. adults (N = 183) with a mean age of 55.91 (SD = 10.36) years, while Borders et al. (2010) showed that among U.S. women of reproductive age (N = 205), there was no difference in the level of EBV antibody titer between women aged 25 years or older and less than 25 years.

In the current study, a U-shaped (convex) relationship was observed between EBV antibody titer and age; EBV antibody titer was lowest in participants aged around 44 to 50 years (depending on the models), and higher among those individuals who were either younger or older. One possible interpretation of this finding is that those younger people who were left behind might have been psychologically stressed due to their high levels of obligation, increased workloads or felt lonely as a result of the outmigration of their same generation community peers, while the older population might have had higher levels of psychological stress because of health problems or functional limitations etc. Future studies should examine the impact of age group-specific stressors on psychological stress in these communities, as this may lead

to a better understanding of the U-shaped association between age and psychological stress.

#### **4.4.2. Sex**

In general, a number of studies have shown that women have a worse mental health status; for example, females are more likely than males to have depression (Nolen-Hoeksema, 2001), fear and anxiety (McLean & Anderson, 2009), and panic disorder (Yonkers et al., 1998). There are also some studies indicating the EBV antibody titer is higher among females. For example, Inoue et al. (2014) found that EBV antibody titer was higher among females aged 20 to 59 years compared to in their male counterparts in rural Hainan, China. In addition, U.S. National Health and Nutrition Examination Survey (NHANES) data for children and adolescents aged 6 to 19 (n = 8,417) has been used to show that EBV antibody titer is higher in females (Dowd et al., 2013).

Consistent with the findings from previous studies, in this study, female participants had higher EBV antibody titer than male participants, which might be

explained in two different ways; females are actually exposed to more stressors and/or females are more susceptible to stressors than males. In terms of the former, an earlier study conducted in China indicated that the increase in workload due to migration of family members was greater among females left behind than for their male counterparts (Chang et al., 2011), which suggests that the increased physical burden that arises due to the loss of household labor may fall disproportionately on females, which in turn, would increase their psychological burden. As for the latter, previous studies have indicated that females have consistently higher EBV antibody titer in relation to a wide range of stressors which suggests EBV antibody titer is higher in females than in males other things being equal. For example, McDade et al. (2000b) found that a sex difference was observed in EBV antibody titer even after controlling for exposure to urbanization (a stressor in their study), nutritional status, or the presence of infectious disease. It is known that females have more vigorous cellular immune responses which regulate EBV antibody reactivation, and that females are more resistant to many kinds of infections (Ansar Ahmed et al., 1985); given this it is plausible that compared to males, females in general might have an increased cell-mediated immune response to stressors, including

psychological ones.

In rural China, a high suicide rate has been reported among women. Indeed, China is one of the few countries in the world where the rate of suicide is higher among females than males (Pearson & Liu, 2002; Yip et al., 2005). He et al. (2016) have also shown that the prevalence of depression among older people left behind was higher among women (45.10%) than men (33.43%) in rural China. These studies suggest that in rural China women may be more socially vulnerable to the effects of psychological stressors.

#### ***4.4.3. CRP concentration***

There was a marginally significant association between CRP concentration and EBV antibody titer (coefficient = 0.05, 95% CI = -0.01 – 0.11). There are few previous studies which have indicated that a significant correlation exists between them. For example, although Inoue et al. (2014) found that they were significantly associated in community members in rural Hainan, China when controlling for overall QOL using the WHOQOL-BREF questionnaire (coefficient = 0.081,  $p = 0.036$ ,  $n = 218$ ), the

majority of previous study have not found a significant association (Bennett et al., 2012; Miller et al., 2005) and many studies have not even adjusted for CRP concentration (Borders et al., 2010; Fagundes et al., 2014; Lee, 2016). In this study we adjusted for CRP concentration as it has been recently suggested that there are biological mechanisms that may connect EBV antibody titer and CRP concentration (Bennett et al., 2012); chronic psychological stress can lead to a deterioration in cellular immune function by disturbing HPA axis function and the secretion of hormones such as cortisol, which leads to the reactivation of EBV as described in the Introduction. At the same time, the dysfunction of the HPA axis may also, in theory, enhance inflammation i.e., the secretion of CRP (Johnson et al., 2013).

#### ***4.5. Sociodemographic factors explaining variations in EBV antibody titer***

Educational attainment was a significant predictor of EBV antibody titer in this study, while marital status, household size and relative household income were not.

#### ***4.5.1. Socio-economic status***

In Fujian, people with higher educational attainment had lower EBV antibody titer. As yet, few studies have investigated the association between educational attainment or income and EBV antibody titer, and of these, only one study, that focused on women diagnosed with breast cancer or awaiting diagnostic results in the U.S., found a significant association between educational attainment and EBV antibody titer (Fagundes et al., 2012). In developing countries in general, higher education and a better economic situation are associated with better psychological health. In a review article on the association between poverty and common mental disorders in low- and middle-income countries, Lund et al. (2010) reported that among the 115 studies they reviewed, 79% showed positive associations between common mental disorders and a series of socio-economic factors potentially related to poverty, such as education, income, employment, housing and the living environment and food insecurity. In relation to people left behind, Graham et al. (2015) found that among left-behind child caregivers in Indonesia, greater educational attainment (OR = 0.61, 95% CI = 0.41 – 0.92) and greater wealth (Middle: OR = 0.64, 95% CI = 0.48 – 0.87; High: OR = 0.59,

95% CI = 0.40 – 0.86 compared to low) were protective factors against psychological stress arising from the migration of family members. In this study, there was no interaction between educational attainment and being either left behind or not being left behind, and the inclusion of an interaction term did not change the significant association between EBV antibody titer and being left behind (data not shown).

#### ***4.5.2. Marital status and household size***

A study conducted by Kiecolt-Glaser et al. (1988) investigated the association between marital status and EBV antibody titer among 32 separated or divorced men (mean age = 34.0, SD = 1.5) and 32 socio-demographically matched married men (mean age = 33.7, SD = 1.4) in the U.S. They found that divorced or separated men had significantly higher EBV antibody titer than married men (mean EBV antibody titer = 248.5, SE = 59.3 vs. mean = 92.1, SE = 24.4). In contrast, Borders et al. (2010) showed that there was no association between EBV antibody titer and marital status among 205 reproductive-age women in the U.S.

In this study, there was no association between marital status and EBV

antibody titer, and the results were consistent when separate analyses were undertaken for each sex (data not shown). This might have been because of the fact that the participants in this study were older than those who participated in the above-mentioned studies and that most of the participants had a partner (80.8%). For example in a recent study by Lu et al. (2012) where the participants were younger than those in our study (i.e., adults aged 18 to 64) they found that marital status was associated with depression (CES-D score) among people left behind in rural China: compared to people who had never married, both currently married people (coefficient =  $-3.93$ , 95% CI =  $-7.34 - -0.52$ ) and those who were divorced, separated or widowed (coefficient =  $-5.35$ , 95% CI =  $-10.45 - -0.24$ ) had lower depression (with depression itself having been previously linked with higher EBV antibody titer (Haeri et al., 2011)).

Although we included household size as a covariate since it has been shown to be one of the key components of family support in China (Zimmer & Kwong, 2003), it was not statistically significantly associated with EBV antibody titer (coefficient =  $-0.10$ , 95% CI =  $-0.23 - 0.04$ ). However, it should be emphasized that there was a significant interaction between household size and household income in relation to EBV

antibody titer (coefficient for interaction =  $-0.24$ ,  $p = 0.058$ , data not shown); specifically, when the household size of people living in a lower income household was 5 or more people, EBV antibody titer was higher than among people living in a higher income household with 5 or more people. This finding supports the argument advanced by Abas et al. (2009) that where a household's economic situation is poor, having fewer mouths to feed or less people to support may reduce the psychological burden on family members. Future research should focus on examining the combined effects of household economic situation and household size as they may be related to the difference in reasons for migration in each household (i.e., push or pull factors), and thus possibly affect the impact of migration on the psychological health of family members.

#### ***4.6. Strengths and limitations of the present study and future research directions***

This study extends earlier research on the health impact of rural-to-urban migration in several ways. First, this is the first study to examine the effect of family

members' migration on the psychological well-being of those left behind in rural communities by using EBV antibody titer as a marker of stress. We believe that this makes a significant contribution to the research in this field as this method is independent from language ability and can be applied to any age group and in any areas of the world. As pointed out in previous research, when self-rated health is used as an outcome, common method bias, that is, the potential for confounding by unobserved individual characteristics can occur, i.e., people with higher self-rated health also tend to have higher cognitive social capital (Berkman et al., 2014), so the use of an objective outcome measure may provide more concrete evidence of underlying associations.

Second, in this study information on the migration of family members was obtained using a detailed questionnaire that inquired about the migration history of all of the household members, whereas previous studies have usually used a dichotomous variable (e.g., whether or not study participants had a family member who was away for migratory work). Adhikari et al. (2011) used a bivariate outcome: having no migrant child or having at least one migrant child; Guo et al. (2009) used two variables, one of which was a dummy variable that indicated whether a participant had any migrant

children or not, while the second referred to the number of the participant's children who were migrants. However, since there were some migrants who often returned home (e.g., once a month) in our research area, we clarified how long they had been continuously away from the village at the time of the survey. Third, this study investigated the effect of social capital on psychological stress in rural communities in China. As many developing countries are experiencing rapid population movement, especially in rural areas, where resources for health are limited, studying the effect of social capital in relation to psychological stress may increase understanding about how to protect and promote health among rural communities in developing countries.

This study also has several limitations. First, the cross-sectional nature of this study prevented us from making any causal inferences. As mentioned in the discussion, reverse causality might also have been important in this context, longitudinal research is needed to better understand any potential associations. Indeed, reverse causality may have also been an issue in relation to social capital, the amount of remittance, communication with migrants and their associations with psychological stress. For example, additional analyses revealed that those who were left behind and rarely

communicated with migrants had significantly lower psychological stress than those who were left behind and communicated with migrants more regularly (coefficient =  $-0.27$ , 95% CI =  $-0.49 - -0.07$ ,  $n = 280$ ; data not shown in Tables). This suggests that people who rarely communicate with migrants may not have felt lonely and did not need to communicate with them. Second, we measured EBV antibody titer with a single measurement which might have limited our capacity to evaluate psychological stress. However, it should also be emphasized that when compared to other biomarkers of psychological stress, EBV antibody titer has been shown to be stable across time (it does not have a circadian rhythm (McDade et al., 2000b) and has a half-life of approximately 20 days in serum (Cacioppo et al., 2002)) and has also been associated with validated psychological questionnaires (Cao et al., 2009; Esterling et al., 1992; Lutgendorf et al., 2001). Another limitation relating to the EBV antibody measurement was that we did not have data on the occurrence of stressful life events which were not related to the experience of being left behind but which might have increased EBV antibody titer (e.g., experiencing the death of a family member or friend). Third, our participants might not have fully represented people living in rural communities in

China or in Fujian as this study was conducted in seven communities in only one city in Fujian and we did not use a random sampling procedure. We were also not able to get information on their households which prevented us from conducting analyses accounting for multiple members in each household. It should be also mentioned that some people such as those who spent most of the week in town and came back to the community occasionally might not have been included in the study, which might have resulted in the age of our participant sample being biased upwards. As for the social capital variables, the number of communities in which we calculated social capital was limited and future research studies should include more communities to test the generalizability of the findings. It should also be mentioned that the community participation rates in this study were not high and that this might have biased our study results if those individuals with less social capital were less likely to participate. Fourth, we did not have data on some explanatory variables which might have helped us to better describe the situation in relation to population movement and subsequent psychological stress. For example, information on household income was subjectively assessed using a 10-point scale in comparison to the other people in the same

community. While this measure was validated against more detailed income information obtained from household heads (self-reported), there was still insufficient accuracy, which prevented us from conducting more detailed analyses (e.g., categorizing households into those who sent migrants due to push or pull factors).

Methodological limitations associated with the use of EBV antibody titer should also be mentioned. For example, EBV antibody titer does not function as a biomarker if the participant is not infected with the virus; this would cause the study participants to be misclassified. However, as the participants were all judged to have been infected with the virus (i.e., having antibody titer of > 20 ELISA units), this study was not subject to this limitation. It should also be mentioned that although it is the least invasive of the blood sampling methods, the sampling of dried blood spots (i.e., by finger prick) is still a more physically invasive method, compared to use of a questionnaire. This may have therefore been a disadvantage by discouraging some people from participating in the survey.

There are also some limitations relating to the measurement of social capital that should be mentioned. For example, for structural social capital, we did not collect

information on respondents' relationship with the groom or bride, or about the people respondents usually ate together with. When a person did not engage in either form of social participation (i.e., eating together or attending weddings/funerals), he or she was given a score of zero, while attending more than one wedding was regarded (and scored) in this study in the same way as attending only one wedding. While these questions were determined based on discussions with our research partners in Fujian, future research should aim to use more refined measures so as to capture the more nuanced characteristics of social capital in different settings.

This study has suggested several possible issues which should be focus of future research. First, future studies should try to better characterize the migration of family members. As previously stated, as migration can occur for different reasons (e.g., due to push or pull factors), it is possible that the effects of migration on family members will also vary as will a family's need for, or expectation of remittance. For example, in terms of China specifically, as the lifestyles of people have become increasingly diversified in the last few decades, even in rural communities, where people used to previously live an equally impoverished life under the political and

economic instruction of the local government organization (the People's Commune), it is important to contextualize migration with more information. Second, in future, it may also be important to consider differences in the effect of family members' migration on well-being by specific characteristics (e.g., by whom or for how long people were left behind, the type of migratory labor migrants were engaged in) as the psychological impact of out-migration among people left behind might differ by these attributes. Third, a greater focus needs to be placed on how to measure social capital and evaluate its health impact in developing countries. Given the potentially differing outcomes of different forms of social capital (e.g., individual level vs. community level, cognitive vs. structural and bonding vs. bridging), a focus on this issue may be important in future research to fully elucidate the association between social capital and health in developing countries. For example, the different association observed in this study between individual and community-level structural social capital and EBV antibody titer emphasizes this point; it is important to identify factors that can act to maintain community-level social capital while at the same time minimizing the burden on individual members otherwise it will result in the erosion of social capital. Fourth,

future research should clarify what elevated psychological stress, of the sort observed in this study, might actually mean in clinical terms. Specifically, while we showed that people left behind had greater psychological stress compared with those who were not left behind, we are unsure whether this higher level of psychological stress would actually result in clinically diagnosable diseases such as depression and other mental disorders. Fifth, future research should compare results of biomarkers such as EBV antibody titer and those of self-reported outcomes. The finding observed in this study in relation to the experience of being left behind was replicated when using the K6 scale despite the fact that self-reported questionnaires in general have been shown to be more vulnerable to respondents' personality, perception and social desirability (Furnham, 1986). However, the comparisons of the results obtained from different methodologies (both subjective and objective measures) would help us better understand how different aspects of stress can be captured by each outcome measure. Furthermore, we are not sure whether the effects of being left behind can be reversed when family members come back to the community or how long the effects last. This highlights the importance of prospective research among the members of migrant families to

determine such factors as how psychological stress affects different family members, whether it is maintained across time, and its health effects and the possible mechanisms underlying them. And it is also important to extend the research on the association between being left behind and psychological stress to other settings as psychological stress among people left behind as a result of community out-migration might not be specific to China or Fujian but might also be seen in other locations in China or other developing countries, where people have experienced rapid economic development and population movement.

## Chapter 5 Conclusion

This study found that in rural Fujian, China people left behind by family members who had migrated to other locations had a significantly higher level of psychological stress than people who were not left behind, as reflected in increased Epstein-Barr virus antibody titer. Thus, in this setting, the positive impact which has been associated with family members' migratory work in some previous studies was not evident in terms of psychological stress, but rather, migratory work was associated with psychological strain among those people left behind. Its negative impact thus seemingly outweighs its positive impact.

While it did not buffer against the psychological stress of being left behind, community-level structural social capital protected residents from psychological stress, i.e., living in a community with higher structural social capital was associated with lower psychological stress. On the other hand, participants with higher individual-level structural social capital had more psychological stress than participants who engaged in less social interaction. These findings suggest that while living in a community with

active social interaction may benefit the residents psychologically, social interaction in the form of strongly bonded relationships may be a source of psychological stress due to the potential demands and obligations that can be associated with it.

Given that population aging and the outflow of the younger generation will continue to increase in the coming decades in rural communities in developing countries, future research should examine which factors might be protective against the effects of psychological stress associated with family members' outmigration. It is important to identify factors that can act to maintain or increase community-level social capital while at the same time minimizing the burden on individual members.

## References

- Abas, M. A., Punpuing, S., Jirapramukpitak, T., Guest, P., Tangchonlatip, K., Leese, M., & Prince, M. (2009). Rural-urban migration and depression in ageing family members left behind. *Br J Psychiatr*, *195*(1), 54-60. doi: 10.1192/bjp.bp.108.056143
- Abraido-Lanza, A. F., Chao, M. T., & Florez, K. R. (2005). Do healthy behaviors decline with greater acculturation? Implications for the Latino mortality paradox. *Soc Sci Med*, *61*(6), 1243-1255. doi: 10.1016/j.socscimed.2005.01.016
- Abraido-Lanza, A. F., Dohrenwend, B. P., Ng-Mak, D. S., & Turner, J. B. (1999). The Latino mortality paradox: a test of the "salmon bias" and healthy migrant hypotheses. *Am J Public Health*, *89*(10), 1543-1548.
- Adhikari, R., Jampaklay, A., & Chamratrithirong, A. (2011). Impact of children's migration on health and health care-seeking behavior of elderly left behind. *Bmc Public Health*, *11*, 143. doi: 10.1186/1471-2458-11-143
- Agampodi, T. C., Agampodi, S. B., Glozier, N., & Siribaddana, S. (2015). Measurement of social capital in relation to health in low and middle income countries (LMIC): a systematic review. *Soc Sci Med*, *128*, 95-104. doi: 10.1016/j.socscimed.2015.01.005
- Aida, J., Kondo, K., Kondo, N., Watt, R. G., Sheiham, A., & Tsakos, G. (2011). Income inequality, social capital and self-rated health and dental status in older Japanese. *Soc Sci Med*, *73*(10), 1561-1568. doi: <http://dx.doi.org/10.1016/j.socscimed.2011.09.005>
- Almedom, A. M. (2005). Social capital and mental health: An interdisciplinary review of primary evidence. *Soc Sci Med*, *61*(5), 943-964.
- Anirudh, K., & Elizabeth, S. (2000). Cross-Cultural Measures of Social Capital: A Tool and Results from India and Panama. *The World Bank, Social Capital Initiative Working Paper, No. 21*.
- Ansar Ahmed, S., Penhale, W. J., & Talal, N. (1985). Sex hormones, immune responses, and autoimmune diseases. Mechanisms of sex hormone action. *Am J Pathol*, *121*(3), 531-551.
- Antman, F. M. (2012). Gender, educational attainment, and the impact of parental

- migration on children left behind. *J Popul Econ*, 25(4), 1187-1214. doi: 10.1007/s00148-012-0423-y
- Bennett, J. M., Glaser, R., Malarkey, W. B., Beversdorf, D. Q., Peng, J., & Kiecolt-Glaser, J. K. (2012). Inflammation and reactivation of latent herpesviruses in older adults. *Brain Behav Immun*, 26(5), 739-746. doi: DOI 10.1016/j.bbi.2011.11.007
- Berkman, L. F., & Glass, T. (2000). Social integration, social networks, social support, and health. *Social epidemiology*, 1, 137-173.
- Berkman, L. F., Kawachi, I., & Glymour, M. (2014). *Social epidemiology*: Oxford University Press.
- Bhugra, D., & Ayonrinde, O. (2004). Depression in migrants and ethnic minorities. *Adv Psychiatr Treat*, 10(1), 13-17.
- Blevins, C. L., Sagui, S. J., & Bennett, J. M. (2016). Inflammation and positive affect: Examining the stress-buffering hypothesis with data from the National Longitudinal Study of Adolescent to Adult Health. *Brain Behav Immun*. doi: 10.1016/j.bbi.2016.07.149
- Borders, A. E., Grobman, W. A., Amsden, L. B., McDade, T. W., Sharp, L. K., & Holl, J. L. (2010). The relationship between self-report and biomarkers of stress in low-income reproductive-age women. *Am J Obstet Gynecol*, 203(6), 577.e571-578. doi: 10.1016/j.ajog.2010.08.002
- Brindle, E., Fujita, M., Shofer, J., & O'Connor, K. A. (2010). Serum, plasma, and dried blood spot high-sensitivity C-reactive protein enzyme immunoassay for population research. *J Immunol Methods*, 362(1-2), 112-120. doi: 10.1016/j.jim.2010.09.014
- Burstrom, B., & Fredlund, P. (2001). Self rated health: Is it as good a predictor of subsequent mortality among adults in lower as well as in higher social classes? *J Epidemiol Commun H*, 55(11), 836-840. doi: 10.1136/jech.55.11.836
- Cacioppo, J. T., & Hawkley, L. C. (2003). Social isolation and health, with an emphasis on underlying mechanisms. *Perspect Biol Med*, 46(3 Suppl), S39-52.
- Cacioppo, J. T., Kiecolt-Glaser, J. K., Malarkey, W. B., Laskowski, B. F., Rozlog, L. A., Poehlmann, K. M., Burseson, M. H., & Glaser, R. (2002). Autonomic and glucocorticoid associations with the steady-state expression of latent Epstein-Barr virus. *Horm Behav*, 42(1), 32-41.

- Cao, Y. P., Zhang, Y. L., Chang, D. F., Wang, G. Q., & Zhang, X. H. (2009). Psychosocial and Immunological Factors in Neurasthenia. *Psychosomatics*, 50(1), 24-29.
- Carp, F. M. (1977). Impact of improved living environment on health and life expectancy. *The Gerontologist*, 17(3), 242-249.
- Chang, H., Dong, X.-y., & MacPhail, F. (2011). Labor Migration and Time Use Patterns of the Left-behind Children and Elderly in Rural China. *World Dev*, 39(12), 2199-2210. doi: 10.1016/j.worlddev.2011.05.021
- Cheng, J., & Sun, Y. H. (2015). Depression and anxiety among left-behind children in China: a systematic review. *Child care health dev*, 41(4), 515-523. doi: 10.1111/cch.12221
- Cheng, P., Jin, Y., Sun, H., Tang, Z., Zhang, C., Chen, Y., Zhang, Q., Zhang, Q., & Huang, F. (2015). Disparities in prevalence and risk indicators of loneliness between rural empty nest and non-empty nest older adults in Chizhou, China. *Geriatr Gerontol Int*, 15(3), 356-364.
- China Diary. (2015). Manufacturing leads Fujian's foreign trade Retrieved Oct. 5, 2016, from [http://fuzhou.chinadaily.com.cn/e/2015-04/14/content\\_20433003.htm](http://fuzhou.chinadaily.com.cn/e/2015-04/14/content_20433003.htm)
- Christiaan, G., Deepa, N., Veronica, N. J., & Michael, W. (2004). Measuring Social Capital An Integrated Questionnaire *World Bank Working Paper* (Vol. No. 18).
- Cochrane, R. (1977). Mental illness in immigrants to England and Wales: An analysis of mental hospital admissions, 1971. *Soc Psychiatr*, 12(1), 25-35. doi: 10.1007/bf00578979
- Cohen, S., & McKay, G. (1984). Social support, stress and the buffering hypothesis: A theoretical analysis. *Handbook of psychology and health*, 4, 253-267.
- De Silva, M. J., McKenzie, K., Harpham, T., & Huttly, S. R. A. (2005). Social capital and mental illness: a systematic review. *J Epidemiol Commun H*, 59(8), 619-627. doi: 10.1136/jech.2004.029678
- Donato, K. M., & Duncan, E. M. (2011). Migration, social networks, and child health in Mexican families. *J Marriage Fam*, 73(4), 713-728.
- Dong, X., & Simon, M. A. (2010). Health and aging in a Chinese population: urban and rural disparities. *Geriatr Gerontol Int*, 10(1), 85-93. doi: 10.1111/j.1447-0594.2009.00563.x

- Dowd, J. B., Palermo, T., Brite, J., McDade, T. W., & Aiello, A. (2013). Seroprevalence of Epstein-Barr Virus Infection in U.S. Children Ages 6-19, 2003-2010. *Plos One*, 8(5), e64921. doi: 10.1371/journal.pone.0064921
- Du, Y. (2000). Rural labor migration in contemporary China: an analysis of its features and the macro context. *Rural Labor Flows in China, Institute of East Asian Studies, University of California, Berkeley*.
- Durkheim, E. (1995). *The Elementary Forms of the Religious Life [1912]*: New York Free Press.
- Ehsan, A. M., & De Silva, M. J. (2015). Social capital and common mental disorder: a systematic review. *J Epidemiol Commun H*, 69(10), 1021-1028. doi: 10.1136/jech-2015-205868
- Eick, G., Urlacher, S. S., McDade, T. W., Kowal, P., & Snodgrass, J. J. (2016). Validation of an Optimized ELISA for Quantitative Assessment of Epstein-Barr Virus Antibodies from Dried Blood Spots. *Biodemography Soc Biol*, 62(2), 222-233. doi: 10.1080/19485565.2016.1169396
- Esterling, B. A., Antoni, M. H., Kumar, M., & Schneiderman, N. (1993). Defensiveness, trait anxiety, and Epstein-Barr viral capsid antigen antibody titers in healthy college students. *Health psychology*, 12(2), 132-139.
- Esterling, B. A., Antoni, M. H., Schneiderman, N., Carver, C. S., Laperriere, A., Ironson, G., Klimas, N. G., & Fletcher, M. A. (1992). Psychosocial Modulation of Antibody to Epstein-Barr Viral Capsid Antigen and Human Herpesvirus Type-6 in Hiv-1-Infected and at-Risk Gay Men. *Psychosom Med*, 54(3), 354-371.
- Fagundes, C. P., Bennett, J. M., Alfano, C. M., Glaser, R., Povoski, S. P., Lipari, A. M., Agnese, D. M., Yee, L. D., Carson, W. E., 3rd, Farrar, W. B., Malarkey, W. B., Chen, M., & Kiecolt-Glaser, J. K. (2012). Social support and socioeconomic status interact to predict Epstein-Barr virus latency in women awaiting diagnosis or newly diagnosed with breast cancer. *Health psychology*, 31(1), 11-19. doi: 10.1037/a0025599
- Fagundes, C. P., Jaremka, L. M., Glaser, R., Alfano, C. M., Povoski, S. P., Lipari, A. M., Agnese, D. M., Yee, L. D., Carson, W. E., Farrar, W. B., Malarkey, W. B., Chen, M., & Kiecolt-Glaser, J. K. (2014). Attachment anxiety is related to Epstein-Barr virus latency. *Brain Behav Immun*, 41, 232-238. doi: <http://dx.doi.org/10.1016/j.bbi.2014.04.002>

- Furnham, A. (1986). Response bias, social desirability and dissimulation. *Pers Individ Differ*, 7(3), 385-400.
- Frank, R., & Hummer, R. A. (2002). The Other Side of the Paradox: The Risk of Low Birth Weight among Infants of Migrant and Nonmigrant Households within Mexico. *Int Migr Rev*, 36(3), 746-765.
- Fujian Provincial Bureau of Statistics. (2015). *Fujian Statistical Yearbook*. Beijing: China Statistics Press.
- Fujian Provincial People's Government. (2014). Geography & Climate Retrieved Sep. 7, 2016, from <http://www.fujian.gov.cn/english/FujianInfo/AboutFujian/GeographyClimate/>
- Fujian Provincial People's Government. (2016). Retrieved Nov. 4, 2016, from [http://www.stats-fj.gov.cn/xxgk/tjgb/201605/t20160509\\_38712.htm](http://www.stats-fj.gov.cn/xxgk/tjgb/201605/t20160509_38712.htm)
- Giannelli, G. C., & Mangiavacchi, L. (2010). Children's Schooling and Parental Migration: Empirical Evidence on the 'Left-behind' Generation in Albania. *Labour*, 24(s1), 76-92.
- Glaser, R., & Kiecolt-Glaser, J. K. (1998). Stress-associated immune modulation: relevance to viral infections and chronic fatigue syndrome. *Am J Med*, 105(3a), 35s-42s.
- Glaser, R., & Kiecolt-Glaser, J. K. (2005). Science and society - Stress-induced immune dysfunction: implications for health. *Nat Rev Immunol*, 5(3), 243-251. doi: Doi 10.1038/Nri1571
- Glaser, R., Rice, J., Sheridan, J., Fertel, R., Stout, J., Speicher, C., Pinsky, D., Kotur, M., Post, A., Beck, M., & et al. (1987). Stress-related immune suppression: health implications. *Brain Behav Immun*, 1(1), 7-20.
- Glaser, R., Strain, E. C., Tarr, K. L., Holliday, J. E., Donnerberg, R. L., & Kiecolt-Glaser, J. K. (1985). Changes in Epstein-Barr virus antibody titers associated with aging. *Proc Soc Exp Biol Med*, 179(3), 352-355.
- Godoy, R. A., Reyes-García, V., McDade, T., Huanca, T., Leonard, W. R., Tanner, S., & Vadez, V. (2006). Does village inequality in modern income harm the psyche? Anger, fear, sadness, and alcohol consumption in a pre-industrial society. *Soc Sci Med*, 63(2), 359-372. doi: <http://dx.doi.org/10.1016/j.socscimed.2006.01.021>
- Graham, E., & Jordan, L. P. (2011). Migrant Parents and the Psychological Well-Being of Left-Behind Children in Southeast Asia. *J Marriage Fam*, 73(4), 763-787.

doi: 10.1111/j.1741-3737.2011.00844.x

- Graham, E., Jordan, L. P., & Yeoh, B. S. (2015). Parental migration and the mental health of those who stay behind to care for children in South-East Asia. *Soc Sci Med*, 132, 225-235. doi: 10.1016/j.socscimed.2014.10.060
- Guo, M., Aranda, M. P., & Silverstein, M. (2009). The impact of out-migration on the inter-generational support and psychological wellbeing of older adults in rural China. *Ageing Soc*, 29(7), 1085-1104. doi: 10.1017/S0144686X0900871X
- Haeri, S., Johnson, N., Baker, A. M., Stuebe, A. M., Raines, C., Barrow, D. A., & Boggess, K. A. (2011). Maternal depression and Epstein-Barr virus reactivation in early pregnancy. *Obstet Gynecol*, 117(4), 862-866. doi: 10.1097/AOG.0b013e31820f3a30
- Hamano, T., Fujisawa, Y., Ishida, Y., Subramanian, S. V., Kawachi, I., & Shiwaku, K. (2010). Social capital and mental health in Japan: a multilevel analysis. *Plos One*, 5(10), e13214. doi: 10.1371/journal.pone.0013214
- Harpham, T. (2008). The measurement of community social capital through surveys, *Social capital and health* (pp. 51-62): Springer.
- Harpham, T., Grant, E., & Rodriguez, C. (2004). Mental health and social capital in Cali, Colombia. *Soc Sci Med*, 58(11), 2267-2277.
- Harpham, T., Grant, E., & Thomas, E. (2002). Measuring social capital within health surveys: key issues. *Health Policy Plann*, 17(1), 106-111.
- He, C., & Ye, J. (2014). Lonely sunsets: impacts of rural-urban migration on the left - behind elderly in rural China. *Popul Space Place*, 20(4), 352-369.
- He, G., Xie, J. F., Zhou, J. D., Zhong, Z. Q., Qin, C. X., & Ding, S. Q. (2016). Depression in left-behind elderly in rural China: Prevalence and associated factors. *Geriatr Gerontol Int*, 16(5), 638-643. doi: 10.1111/ggi.12518
- He, J., Klag, M. J., Whelton, P. K., Chen, J.-Y., Mo, J.-P., Qian, M.-C., Mo, P.-S., & He, G.-Q. (1991). Migration, blood pressure pattern, and hypertension: the Yi Migrant Study. *Am J Epidemiol*, 134(10), 1085-1101.
- Hikichi, H., Aida, J., Tsuboya, T., Kondo, K., & Kawachi, I. (2016). Can Community Social Cohesion Prevent Posttraumatic Stress Disorder in the Aftermath of a Disaster? A Natural Experiment From the 2011 Tohoku Earthquake and Tsunami. *Am J Epidemiol*, kww335.
- Hildebrandt, N., McKenzie, D. J., Esquivel, G., & Schargrodsky, E. (2005). The effects

- of migration on child health in Mexico [with comments]. *Economia*, 6(1), 257-289.
- Hu, F., Hu, B., Chen, R., Ma, Y., Niu, L., Qin, X., & Hu, Z. (2014). A systematic review of social capital and chronic non-communicable diseases. *Biosci trends*, 8(6), 290-296. doi: 10.5582/bst.2014.01138
- Hu, X., Cook, S., & Salazar, M. A. (2008). Internal migration and health in China. *The Lancet*, 372. doi: 10.1016/s0140-6736(08)61360-4
- Hyypä, M. T., Mäki, J., Impivaara, O., & Aromaa, A. (2007). Individual-level measures of social capital as predictors of all-cause and cardiovascular mortality: a population-based prospective study of men and women in Finland. [journal article]. *Eur J Epidemiol*, 22(9), 589-597. doi: 10.1007/s10654-007-9153-y
- Inoue, Y., Stickley, A., Yazawa, A., Li, D., Du, J., Jin, Y., Chen, Y., & Watanabe, C. (2016). The association between economic development, lifestyle differentiation, and C-reactive protein concentration within rural communities in Hainan Island, China. *Am J Hum Biol*, 28(2), 186-196.
- Inoue, Y., Yazawa, A., Li, D., Du, J., Jin, Y., Chen, Y., Watanabe, C., & Umezaki, M. (2014). Epstein - Barr virus antibody titer and its association with the domain scores from the World Health Organization's Quality of Life questionnaire: Findings from Rural Hainan Province, China. *Am J Hum Biol*, 26(1), 51-55.
- International Organization for Migration. (2015). World Migration Report 2015: Migrants and Cities: New Partnerships to Manage Mobility Retrieved Feb. 15, 2016, from [http://publications.iom.int/system/files/wmr2015\\_en.pdf](http://publications.iom.int/system/files/wmr2015_en.pdf)
- Islam, M. K., Merlo, J., Kawachi, I., Lindstrom, M., Burstrom, K., & Gerdtham, U. G. (2006). Does it really matter where you live? A panel data multilevel analysis of Swedish municipality-level social capital on individual health-related quality of life. *Health Econ Policy Law*, 1(Pt 3), 209-235. doi: 10.1017/S174413310600301X
- Johnson, T. V., Abbasi, A., & Master, V. A. (2013). Systematic review of the evidence of a relationship between chronic psychosocial stress and C-reactive protein. *Mol Diagn Ther*, 17(3), 147-164. doi: DOI 10.1007/s40291-013-0026-7
- Kawachi, I., & Berkman, L. F. (2001). Social ties and mental health. *J Urban Health*, 78(3), 458-467. doi: DOI 10.1093/jurban/78.3.458

- Kawachi, I., Subramanian, S. V., & Kim, D. (2008). Social capital and health, *Social capital and health* (pp. 1-26): Springer.
- Kessler, R. C., Andrews, G., Colpe, L. J., Hiripi, E., Mroczek, D. K., Normand, S.-L., Walters, E. E., & Zaslavsky, A. M. (2002). Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychol Med*, 32(06), 959-976.
- Kessler, R. C., Green, J. G., Gruber, M. J., Sampson, N. A., Bromet, E., Cuitan, M., Furukawa, T. A., Gureje, O., Hinkov, H., Hu, C. Y., Lara, C., Lee, S., Mneimneh, Z., Myer, L., Oakley-Browne, M., Posada-Villa, J., Sagar, R., Viana, M. C., & Zaslavsky, A. M. (2010). Screening for serious mental illness in the general population with the K6 screening scale: results from the WHO World Mental Health (WMH) survey initiative. *International Journal of Methods in Psychiatric Research*, 19 Suppl 1, 4-22. doi: 10.1002/mpr.310
- Kiecolt-Glaser, J. K., Dura, J. R., Speicher, C. E., Trask, O. J., & Glaser, R. (1991). Spousal caregivers of dementia victims: longitudinal changes in immunity and health. *Psychosom Med*, 53(4), 345-362.
- Kiecolt-Glaser, J. K., Fisher, L. D., Ogrocki, P., Stout, J. C., Speicher, C. E., & Glaser, R. (1987a). Marital quality, marital disruption, and immune function. *Psychosom Med*, 49(1), 13-34.
- Kiecolt-Glaser, J. K., Glaser, R., Shuttleworth, E. C., Dyer, C. S., Ogrocki, P., & Speicher, C. E. (1987b). Chronic stress and immunity in family caregivers of Alzheimer's disease victims. *Psychosom Med*, 49(5), 523-535.
- Kiecolt-Glaser, J. K., Kennedy, S., Malkoff, S., Fisher, L., Speicher, C. E., & Glaser, R. (1988). Marital discord and immunity in males. *Psychosom Med*, 50(3), 213-229.
- Kim, D., Subramanian, S., & Kawachi, I. (2006). Bonding versus bridging social capital and their associations with self rated health: a multilevel analysis of 40 US communities. *J Epidemiol Commun H*, 60(2), 116-122.
- Kim, D., Subramanian, S., & Kawachi, I. (2008). Social capital and physical health, *Social capital and health* (pp. 139-190): Springer.
- Kobayashi, T., Suzuki, E., Noguchi, M., Kawachi, I., & Takao, S. (2015). Community-Level Social Capital and Psychological Distress among the Elderly in Japan: A Population-Based Study. *Plos One*, 10(11), e0142629. doi:

- 10.1371/journal.pone.0142629
- Kuhn, R., Everett, B., & Silvey, R. (2011). The effects of children's migration on elderly kin's health: a counterfactual approach. *Demography*, *48*(1), 183-209. doi: 10.1007/s13524-010-0002-3
- Laland, K. N., & Brown, G. R. (2006). Niche construction, human behavior, and the adaptive - lag hypothesis. *Evol Anthropol Issues News Rev*, *15*(3), 95-104.
- Lauby, J., & Stark, O. (1988). Individual migration as a family strategy: Young women in the Philippines. *Pop Stud-J Demog*, *42*(3), 473-486.
- Lee, P. H. (2016). Physical activity, sedentary behaviors, and Epstein-Barr virus antibodies in young adults. *Physiol Behav*, *164*, 390-394.
- Lee, S., Tsang, A., Ng, K. L., Ma, Y. L., Guo, W., Mak, A., & Kwok, K. (2012). Performance of the 6-item Kessler scale for measuring serious mental illness in Hong Kong. *Comprehensive Psychiatry*, *53*(5), 584-592. doi: 10.1016/j.comppsy.2011.10.001
- Li, B. (2006). Floating population or urban citizens? Status, social provision and circumstances of rural–urban migrants in China. *Soc Policy Admin*, *40*(2), 174-195.
- Li, D., Zhang, D. J., Shao, J. J., Qi, X. D., & Tian, L. (2014). A meta-analysis of the prevalence of depressive symptoms in Chinese older adults. *Arch Gerontol Geriatr*, *58*(1), 1-9. doi: 10.1016/j.archger.2013.07.016
- Li, X., & Zhu, Y. (2004). An study on the floating Population in Fujian Province. *Journal of Fujian Normal University*, *128*, 45 - 51.
- Libby, P., & Ridker, P. M. (2004). Inflammation and atherosclerosis: role of C-reactive protein in risk assessment. *Am J Med*, *116 Suppl 6A*, 9s-16s. doi: 10.1016/j.amjmed.2004.02.006
- Lin, Y., Zhang, Q., Chen, W., Shi, J., Han, S., Song, X., Xu, Y., & Ling, L. (2016). Association between Social Integration and Health among Internal Migrants in ZhongShan, China. *Plos One*, *11*(2), e0148397. doi: 10.1371/journal.pone.0148397
- Lin, Z. (2016). Over one hundred thousand children are left behind in rural Fujian Retrieved Sep. 6, 2016, from [http://zqb.cyol.com/html/2016-08/24/nw.D110000zgqnb\\_20160824\\_2-03.htm](http://zqb.cyol.com/html/2016-08/24/nw.D110000zgqnb_20160824_2-03.htm)
- Lindert, J., von Ehrenstein, O. S., Priebe, S., Mielck, A., & Brähler, E. (2009).

- Depression and anxiety in labor migrants and refugees—a systematic review and meta-analysis. *Soc Sci Med*, 69(2), 246-257.
- Lindström, M. (2008). Social capital and health-related behaviors, *Social capital and health* (pp. 215-238): Springer.
- Link, B. G., Phelan, J. C., Bresnahan, M., Stueve, A., & Pescosolido, B. A. (1999). Public conceptions of mental illness: labels, causes, dangerousness, and social distance. *Am J Public Health*, 89(9), 1328-1333. doi: 10.2105/AJPH.89.9.1328
- Liu, J. (2014). Ageing, migration and familial support in rural China. *Geoforum*, 51, 305-312. doi: <http://dx.doi.org/10.1016/j.geoforum.2013.04.013>
- Liu, L. & Guo, Q. (2007). Loneliness and health-related quality of life for the empty nest elderly in the rural area of a mountainous county in China. *Qual Life Res*, 16(8), 1275-1280.
- Lofors, J., & Sundquist, K. (2007). Low-linking social capital as a predictor of mental disorders: A cohort study of 4.5 million Swedes. *Soc Sci Med*, 64(1), 21-34. doi: <http://dx.doi.org/10.1016/j.socscimed.2006.08.024>
- Lu, Y. (2010). Rural-urban migration and health: evidence from longitudinal data in Indonesia. *Soc Sci Med*, 70(3), 412-419. doi: 10.1016/j.socscimed.2009.10.028
- Lu, Y. (2012). Household migration, social support, and psychosocial health: the perspective from migrant-sending areas. *Soc Sci Med*, 74(2), 135-142. doi: 10.1016/j.socscimed.2011.10.020
- Lu, Y., Hu, P., & Treiman, D. J. (2012). Migration and depressive symptoms in migrant-sending areas: findings from the survey of internal migration and health in China. *Int J Public Health*, 57(4), 691-698. doi: 10.1007/s00038-011-0314-0
- Lund, C., Breen, A., Flisher, A. J., Kakuma, R., Corrigall, J., Joska, J. A., Swartz, L., & Patel, V. (2010). Poverty and common mental disorders in low and middle income countries: A systematic review. *Soc Sci Med*, 71(3), 517-528. doi: DOI 10.1016/j.socscimed.2010.04.027
- Luo, Y., Zhang, Z., & Gu, D. (2015). Education and mortality among older adults in China. *Soc Sci Med*, 127, 134-142. doi: <http://dx.doi.org/10.1016/j.socscimed.2014.09.039>
- Lutgendorf, S. K., Reimer, T. T., Harvey, J. H., Marks, G., Hong, S. Y., Hillis, S. L., & Lubaroff, D. M. (2001). Effects of housing relocation on immunocompetence and psychosocial functioning in older adults. *J Gerontol a-Biol*, 56(2),

M97-M105.

- Maass, R., Kloeckner, C. A., Lindström, B., & Lillefjell, M. (2016). The impact of neighborhood social capital on life satisfaction and self-rated health: A possible pathway for health promotion? *Health Place, 42*, 120-128. doi: <http://dx.doi.org/10.1016/j.healthplace.2016.09.011>
- Macinko, J., & Starfield, B. (2001). The utility of social capital in research on health determinants. *Milbank Quarterly, 79*(3), 387-427.
- Macswen, K. F., & Crawford, D. H. (2003). Epstein-Barr virus-recent advances. *Lancet Infect Dis, 3*(3), 131-140.
- Mascie-Taylor, C. G. N., & Lasker, G. W. (1988). *Biological Aspects of Human Migration*: Cambridge University Press.
- McDade, T. W., Stallings, J. F., Angold, A., Costello, E. J., Burleson, M., Cacioppo, J. T., Glaser, R., & Worthman, C. M. (2000a). Epstein-Barr virus antibodies in whole blood spots: A minimally invasive method for assessing an aspect of cell-mediated immunity. *Psychosom Med, 62*(4), 560-568.
- McDade, T. W., Stallings, J. F., & Worthman, C. M. (2000b). Culture change and stress in Western Samoan youth: Methodological issues in the cross-cultural study of stress and immune function. *Am J Hum Biol, 12*(6), 792-802. doi: [10.1002/1520-6300\(200011/12\)12:6<792::Aid-Ajhb7>3.0.Co;2-F](https://doi.org/10.1002/1520-6300(200011/12)12:6<792::Aid-Ajhb7>3.0.Co;2-F)
- McDade, T. W., Williams, S., & Snodgrass, J. J. (2007). What a drop can do: Dried blood spots as a minimally invasive method for integrating biomarkers into population-based research. *Demography, 44*(4), 899-925. doi: [DOI 10.1353/dem.2007.0038](https://doi.org/10.1353/dem.2007.0038)
- McLean, C. P., & Anderson, E. R. (2009). Brave men and timid women? A review of the gender differences in fear and anxiety. *Clin Psychol Rev, 29*(6), 496-505. doi: <http://dx.doi.org/10.1016/j.cpr.2009.05.003>
- Mei, J. V., Alexander, J. R., Adam, B. W., & Hannon, W. H. (2001). Use of filter paper for the collection and analysis of human whole blood specimens. *J Nutr, 131*(5), 1631s-1636s.
- Miller, G. E., Freedland, K. E., Duntley, S., & Carney, R. M. (2005). Relation of depressive symptoms to C-reactive protein and pathogen burden (cytomegalovirus, herpes simplex virus, Epstein-Barr virus) in patients with earlier acute coronary syndromes. *Am J Cardiol, 95*(3), 317-321. doi:

- <http://dx.doi.org/10.1016/j.amjcard.2004.09.026>
- Mitchell, C. U., & LaGory, M. (2002). Social capital and mental distress in an impoverished community. *City Community, 1*(2), 199-222.
- Moore, S., Daniel, M., Paquet, C., Dube, L., & Gauvin, L. (2009). Association of individual network social capital with abdominal adiposity, overweight and obesity. *J Public Health (Oxf), 31*(1), 175-183. doi: 10.1093/pubmed/fdn104
- Murayama, H., Nishi, M., Matsuo, E., Nofuji, Y., Shimizu, Y., Taniguchi, Y., Fujiwara, Y., & Shinkai, S. (2013). Do bonding and bridging social capital affect self-rated health, depressive mood and cognitive decline in older Japanese? A prospective cohort study. *Soc Sci Med, 98*, 247-252.
- Myroniuk, T. W., & Anglewicz, P. (2015). Does Social Participation Predict Better Health? A Longitudinal Study in Rural Malawi. *J Health Soc Behav, 56*(4), 552-573. doi: 10.1177/0022146515613416
- Nanping City Bureau of Statistics 2015. (2015). *Statistics Yearbook of Nanping*: Nanping City Bureau of Statistics,.
- National Bureau of Statistics of China 2015. (2015). *China Statistical Yearbook*.
- National School of Development Peking University. The China Health and Retirement Longitudinal Study (CHARLS) Retrieved Nov. 1, 2016, from <http://charls.ccer.edu.cn/en>
- Nobles, J. (2007). *Parental migration and child health in Mexico*. Retrieved Nov. 1, 2016, from [http://www.ssc.wisc.edu/~scholz/Seminar/Nobles\\_MigChildHealth.doc](http://www.ssc.wisc.edu/~scholz/Seminar/Nobles_MigChildHealth.doc)
- Nolen-Hoeksema, S. (2001). Gender differences in depression. *Curr Dir Psychol Sci, 10*(5), 173-176.
- Palloni, A., & Morenoff, J. D. (2001). Interpreting the paradoxical in the hispanic paradox: demographic and epidemiologic approaches. *Ann N Y Acad Sci, 954*, 140-174.
- Panter-Brick, C., Eggerman, M., Mojadidi, A., & McDade, T. W. (2008). Social stressors, mental health, and physiological stress in an urban elite of young Afghans in Kabul. *Am J Hum Biol, 20*(6), 627-641. doi: 10.1002/ajhb.20797
- Pearson, V., & Liu, M. (2002). Ling's death: an ethnography of a Chinese woman's suicide. *Suicide Life Threat Behav, 32*(4), 347-358.
- Pirraglia, P. A., Hampton, J. M., Rosen, A. B., & Witt, W. P. (2011). Psychological

- distress and trends in healthcare expenditures and outpatient healthcare. *The American Journal of Managed Care*, 17(5), 319-328.
- Putnam, R. D. (1995). Bowling alone: America's declining social capital. *J Democr*, 6(1), 65-78.
- Redfield, R., Linton, R., & Herskovits, M. J. (1936). Memorandum for the study of acculturation. *Am Anthropol*, 38(1), 149-152.
- renkou.org.cn. (2014). Retrieved Sep. 6, 2016, from <http://www.renkou.org.cn/china/fujian/2014/1867.html>
- renkou.org.cn. (2015). New statistics of floating population in Fujian 2014 Retrieved Sep. 6, 2016, from <http://www.renkou.org.cn/china/fujian/2015/2325.html>
- Riumallo-Herl, C. J., Kawachi, I., & Avendano, M. (2014). Social capital, mental health and biomarkers in Chile: assessing the effects of social capital in a middle-income country. *Soc Sci Med*, 105, 47-58. doi: 10.1016/j.socscimed.2013.12.018
- Rodriguez, N., Myers, H. F., Mira, C. B., Flores, T., & Garcia-Hernandez, L. (2002). Development of the Multidimensional Acculturative Stress Inventory for adults of Mexican origin. *Psychol Assessment*, 14(4), 451.
- Rose, R., Kreuz, L., Holaday, J., Sulak, K., & Johnson, C. (1972). Diurnal variation of plasma testosterone and cortisol. *J Endocrinol*, 54(1), 177-178.
- Scheffler, R. M., Brown, T. T., Syme, L., Kawachi, I., Tolstykh, I., & Iribarren, C. (2008). Community-level social capital and recurrence of acute coronary syndrome. *Soc Sci Med*, 66(7), 1603-1613. doi: 10.1016/j.socscimed.2007.12.007
- Schneiderman, N., Ironson, G., & Siegel, S. D. (2005). Stress and Health: Psychological, Behavioral, and Biological Determinants. *Annu Rev Clin Psycho*, 1, 607-628. doi: 10.1146/annurev.clinpsy.1.102803.144141
- Sluzki, C. E. (1992). Disruption and reconstruction of networks following migration/relocation. *Fam Syst Med*, 10(4), 359.
- Sorensen, M. V., Snodgrass, J. J., Leonard, W. R., McDade, T. W., Tarskaya, L. A., Ivanov, K. I., Krivoschapkin, V. G., & Alekseev, V. P. (2009). Lifestyle incongruity, stress and immune function in indigenous Siberians: the health impacts of rapid social and economic change. *Am J Phys Anthropol*, 138(1), 62-69. doi: 10.1002/ajpa.20899

- Stafford, M., De Silva, M., Stansfeld, S., & Marmot, M. (2008). Neighbourhood social capital and common mental disorder: Testing the link in a general population sample. *Health Place, 14*(3), 394-405. doi: <http://dx.doi.org/10.1016/j.healthplace.2007.08.006>
- Stark, O., & Bloom, D. E. (1985). The new economics of labor migration. *Am Econ Rev, 75*(2), 173-178.
- Steffen, P. R., Smith, T. B., Larson, M., & Butler, L. (2006). Acculturation to Western society as a risk factor for high blood pressure: a meta-analytic review. *Psychosom Med, 68*(3), 386-397.
- Stephens, A., Shamaei-Tousi, A., Gylfe, A., Henderson, B., Bergstrom, S., & Marmot, M. (2007). Socioeconomic status, pathogen burden and cardiovascular disease risk. *Heart, 93*(12), 1567-1570. doi: 10.1136/hrt.2006.113993
- Stephens, A., Wardle, J., Pollard, T. M., Canaan, L., & Davies, G. J. (1996). Stress, social support and health-related behavior: a study of smoking, alcohol consumption and physical exercise. *J Psychosom Res, 41*(2), 171-180.
- Stowe, R. P., Peek, M. K., Perez, N. A., Yetman, D. L., Cutchin, M. P., & Goodwin, J. S. (2010). Herpesvirus reactivation and socioeconomic position: a community-based study. *J Epidemiol Community Health, 64*(8), 666-671. doi: 10.1136/jech.2008.078808
- Subramanian, S. V., Kim, D. J., & Kawachi, I. (2002). Social trust and self-rated health in US communities: a multilevel analysis. *J Urban Health, 79*(4 Suppl 1), S21-34.
- Takagi, D., Kondo, K., & Kawachi, I. (2013). Social participation and mental health: moderating effects of gender, social role and rurality. [journal article]. *Bmc Public Health, 13*(1), 701. doi: 10.1186/1471-2458-13-701
- Tao, R., & Xu, Z. (2007). Urbanization, rural land system and social security for migrants in China. *J Dev Stud, 43*(7), 1301-1320.
- Taylor, J. E., Arango, J., Hugo, G., Kouaouci, A., Massey, D. S., & Pellegrino, A. (1996). International migration and community development. *Popul Index, 397*-418.
- Thoits, P. A. (2011). Mechanisms linking social ties and support to physical and mental health. *J Health Soc Behav, 52*(2), 145-161. doi: 10.1177/0022146510395592
- Thompson, A. L., Houck, K. M., Adair, L., Gordon-Larsen, P., Du, S., Zhang, B., & Popkin, B. (2014). Pathogenic and obesogenic factors associated with

- inflammation in Chinese children, adolescents and adults. *Am J Hum Biol*, 26(1), 18-28. doi: 10.1002/ajhb.22462
- Thorley-Lawson, D. A., & Gross, A. (2004). Persistence of the Epstein-Barr virus and the origins of associated lymphomas. *New Engl J Med*, 350(13), 1328-1337. doi: 10.1056/NEJMra032015
- Tong, Y., & Piotrowski, M. (2012). Migration and health selectivity in the context of internal migration in China, 1997–2009. *Popul Res Policy Rev*, 31(4), 497-543.
- Torres, L., Driscoll, M. W., & Voell, M. (2012). Discrimination, Acculturation, Acculturative Stress, and Latino Psychological Distress: A Moderated Mediation Model. *Cult Divers Ethnic Minor Psychol*, 18(1), 17-25. doi: 10.1037/a0026710
- UN-Habitat. (2009). State of the World's Cities 2008/2009 - Harmonious Cities.
- United Nations Department of Economic and Social Affairs. (2016). *International Migration Report 2015 (Vol. 2016)*.
- United Nations Development Programme. (2009). Cross-National Comparisons of Internal Migration *Human Development Research Paper: UNDP*.
- van Deth, J. W., & Zmerli, S. (2010). Introduction: civicism, equality, and democracy—a “dark side” of social capital? *Am Behav Sci*, 53(5), 631-639.
- Wan, H., Manisha, S., Kaiti, Z., & Ping, G. (2007). Health and Health Care of the Older Population in Urban and Rural China: 2000 *International Population Reports*. U.S. Government Printing Office, Washington, DC,.
- Wang, C., Li, L., Cheng, W., Liu, S., Diao, M., Li, X., Qiao, G., Zhang, Z., & Chen, Z. (2015). A new approach for persistent cloaca: Laparoscopically assisted anorectoplasty and modified repair of urogenital sinus. *J Pediatr Surg*, 50(7), 1236-1240. doi: 10.1016/j.jpedsurg.2015.04.016
- Wang, L., & Mesman, J. (2015). Child Development in the Face of Rural-to-Urban Migration in China: A Meta-Analytic Review. *Perspect Psychol Sci*, 10(6), 813-831. doi: 10.1177/1745691615600145
- Ward, L. E. (1962). Some observations of the underlying dynamics of conflict in foreign students. *Studenterraad Med*, 10, 430-440.
- Wood, P. J., Barth, J. H., Freedman, D. B., Perry, L., & Sheridan, B. (1997). Evidence for the Low Dose Dexamethasone Suppression Test to Screen for Cushing's Syndrome—Recommendations for a Protocol for Biochemistry Laboratories.

- Ann Clin Biochem*, 34(3), 222-229. doi: doi:10.1177/000456329703400302
- World Health Organization. (2010). Definition of an older or elderly person. Retrieved Nov. 13, 2016, from <http://www.who.int/healthinfo/survey/ageingdefnolder/en/>
- Wu, X. (2014). Census Undertakings in China, 1953–2010. *University of Michigan Population Studies Center Research Report*, 14-833.
- Wu, Z. Q., Sun, L., Sun, Y. H., Zhang, X. J., Tao, F. B., & Cui, G. H. (2010). Correlation between loneliness and social relationship among empty nest elderly in Anhui rural area, China. *Aging Ment Health*, 14(1), 108-112. doi: 10.1080/13607860903228796
- Xu, Q., Norstrand, J. A., & Du, Y. (2015). Effects of Living Alone on Social Capital and Health Among Older Adults in China. *Int J Aging Hum Dev*, 82(1), 30-53.
- Yang, E. V., Webster Marketon, J. I., Chen, M., Lo, K. W., Kim, S. J., & Glaser, R. (2010). Glucocorticoids activate Epstein Barr virus lytic replication through the upregulation of immediate early BZLF1 gene expression. *Brain Behav Immun*, 24(7), 1089-1096. doi: 10.1016/j.bbi.2010.04.013
- Yang, Y. C., Boen, C., & Mullan Harris, K. (2015). Social relationships and hypertension in late life: evidence from a nationally representative longitudinal study of older adults. *J Aging Health*, 27(3), 403-431. doi: 10.1177/0898264314551172
- Yazawa, A., Inoue, Y., Fujiwara, T., Stickley, A., Shirai, K., Amemiya, A., Kondo, N., Watanabe, C., & Kondo, K. (2016). Association between social participation and hypertension among older people in Japan: the JAGES Study. *Hypertens Res*. doi: 10.1038/hr.2016.78
- Yazawa, A., Inoue, Y., Li, D., Du, J., Jin, Y., Chen, Y., Nishitani, M., Watanabe, C., & Umezaki, M. (2014). Impact of lifestyle changes on stress in a modernizing rural population in Hainan Island, China. *Am J Hum Biol*, 26(1), 36-42. doi: 10.1002/ajhb.22467
- Yip, P. S. F., Liu, K. Y., Hu, J., & Song, X. M. (2005). Suicide rates in China during a decade of rapid social changes. *Soc Psych Psych Epid*, 40(10), 792-798. doi: 10.1007/s00127-005-0952-8
- Yip, W., Subramanian, S. V., Mitchell, A. D., Lee, D. T., Wang, J., & Kawachi, I. (2007). Does social capital enhance health and well-being? Evidence from rural China.

*Soc Sci Med*, 64(1), 35-49. doi: 10.1016/j.socscimed.2006.08.027

Yonkers, K. A., Zlotnick, C., Allsworth, J., Warshaw, M., Shea, T., & Keller, M. B. (1998). Is the course of panic disorder the same in women and men? *Am J Psychiat*, 155(5), 596-602.

Zimmer, Z., & Kwong, J. (2003). Family size and support of older adults in urban and rural China: Current effects and future implications. *Demography*, 40(1), 23-44.

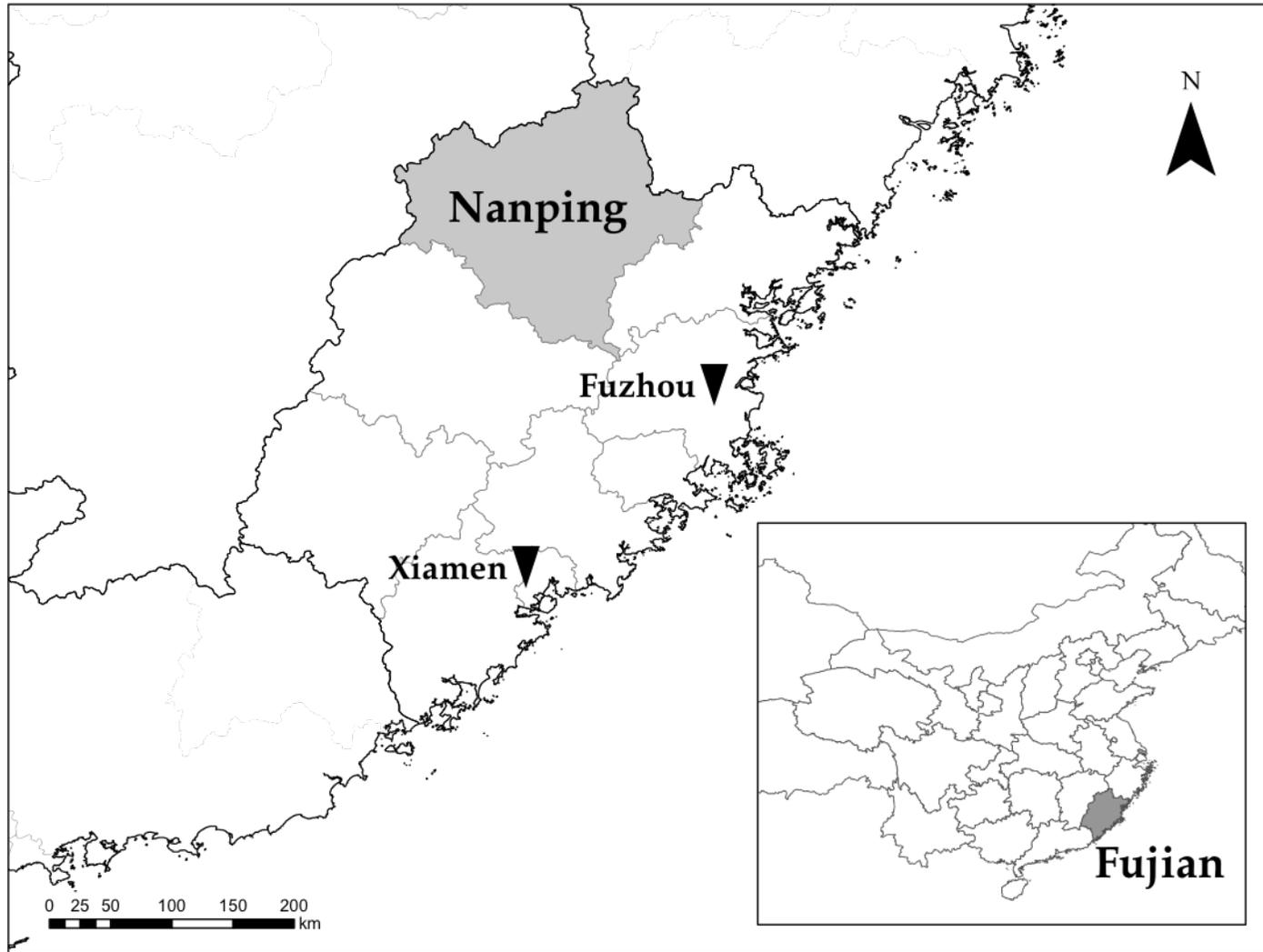


Figure 1. Map of Fujian

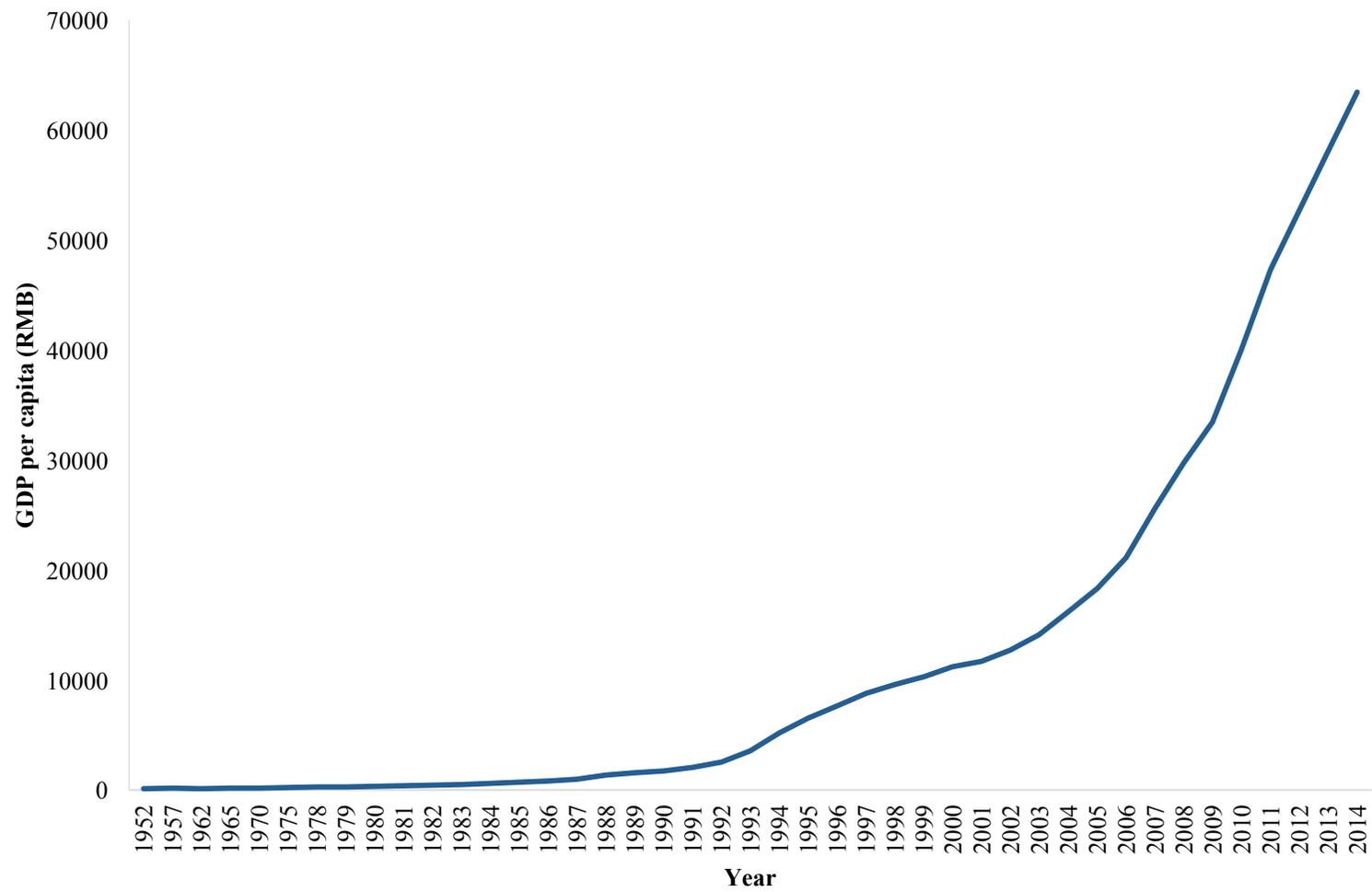


Figure 2. GDP per capita in Fujian Province  
Source: Fujian Statistical Year Book 2015

Table 1. Forms and dimensions of social capital and their operationalization in empirical studies

<b>Types of social capital</b>	<b>Description</b>
<i>Level of measurement</i>	
Individual-level social capital	Resources accessed by the individual through their ego-centered networks.
Community-level social capital	A property of the whole social network, for example, a network of connected residents in a community, which can bring benefits to individuals embedded in it.
<i>Whether subjective or objective</i>	
Cognitive social capital	Individual attitudes, perceptions, and cognitions about the group to which a person belongs (e.g., the trustworthiness of others).
Structural social capital	Actual behaviors, e.g., whether individuals participate in informal and formal social organizations (i.e., social participation).
<i>Types of typical relationship among the members</i>	
Bonding social capital	Resources that are accessed within networks or groups in which the members share similar background characteristics such as class or race/ethnicity.
Bridging social capital	Resources that are accessed across networks that cross (or "bridge") class, race/ethnicity, or other social characteristics, which enable residents to access resources outside their immediate social environment. It is a concept that explicitly links social capital to structural inequalities in power, resources, and authority.

This table was produced referring to Berkman et al., 2014.

Table 2. The number of participants in each study community in rural Fujian, 2015

	Number of participants	Reported <sup>(1)</sup>		Estimated <sup>(2)</sup>	
		Registered population	<i>De facto</i> population	Adults ( $\geq 18$ years)	Participation rate (%)
Community 1	102	740	200	144	70.8
Community 2	107	648	220	158	67.7
Community 3	100	500	200	144	69.4
Community 4	91	570	200	144	63.2
Community 5	113	800	300	216	52.3
Community 6	93	600	200	144	64.6
Community 7	191	1,220	600	432	44.2
Total	797	5,078	1,920	1,382	61.7

<sup>(1)</sup> The size of the registered population and estimated population currently living in each village were provided by village doctors.

<sup>(2)</sup> Information on the number of reported inhabitants currently living in each community and information on the age structure of Nanping City was used to calculate the expected number of adults who were eligible to participate in this study (Statistical Yearbook of Nanping 2015). The estimated participation rate in each community was then calculated.

Table 3. Basic characteristics of the participants (N = 734)

	<b>Total sample (N = 734)</b>	<b>People left behind (n = 280)</b>	<b>People not left behind (n = 454)</b>	<b>p-value<sup>(1)</sup></b>
Age (in years)	58.9 [12.9]	62.4 [10.9]	56.7 [13.5]	< 0.001
Sex (male)	284 (38.7)	122 (43.6)	162 (35.7)	0.033
Marital status				
Not married	28 (3.8)	4 (1.4)	24 (5.3)	0.028
Has a partner	593 (80.8)	230 (82.1)	363 (80.0)	
Divorced or widowed	113 (15.4)	46 (16.4)	67 (14.8)	
Education				
Illiterate	272 (37.1)	118 (42.1)	154 (33.9)	0.031
Less than elementary school	291 (39.6)	109 (38.9)	182 (40.1)	
Junior high school or high	171 (23.3)	53 (18.9)	118 (26.0)	
Household income (high)	409 (55.7)	157 (56.1)	252 (55.5)	0.881
Household size <sup>(2)</sup>	4 [3 – 6]	5 [4 – 6]	4 [3 – 6]	< 0.001
Individual-level social capital				
Cognitive social capital (high)	450 (61.3)	162 (57.9)	288 (63.4)	0.132
Structural social capital (high)	563 (76.7)	215 (76.8)	348 (76.7)	0.967
Community-level social capital <sup>(3)</sup>				
Cognitive social capital	0.61 [0.05]	0.61 [0.05]	0.61 [0.05]	0.993
Structural social capital	0.77 [0.08]	0.76 [0.09]	0.77 [0.08]	0.212

EBV antibody titer (ELISA unit) <sup>(2)</sup>	125.0 [74.0 – 241.6]	136.7 [79.7 – 273.2]	118.2 [71.3 – 223.1]	0.020
CRP concentration (mg/L) <sup>(2)</sup>	0.68 [0.33 – 1.51]	0.75 [0.38 – 1.48]	0.61 [0.31 – 1.55]	0.783

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Mean and standard deviation for continuous variables and number of participants and the percentage for categorical variables are shown (mean [SD]/n(%)).

<sup>(1)</sup> Student's t-test for continuous variables and Pearson's chi-square test for categorical variables were used to examine if there were differences between people left behind and people not left behind.

<sup>(2)</sup> Median and interquartile range are shown for household size, EBV antibody titer and CRP concentration.

<sup>(3)</sup> Community-level social capital was calculated as the mean value of individual-level social capital responses from the same community members.

Table 4. Comparison of lifestyle factors between people left behind and people not left behind (N = 734)

	<b>Total sample (N = 734)</b>	<b>People left behind (n = 280)</b>	<b>People not left behind (n = 454)</b>	<b>p-value<sup>(1)</sup></b>
<b>Employment status</b>				
No employment	179 (24.4)	70 (25.0)	109 (24.0)	0.004
Farming	493 (67.2)	197 (70.4)	296 (65.2)	
Small business	31 (4.2)	6 (2.1)	25 (5.5)	
Formally employed	10 (1.4)	4 (1.4)	6 (1.3)	
Part-time job (Heavy)	41 (5.6)	17 (6.1)	24 (5.3)	
Part-time job (Sedentary)	65 (8.9)	13 (4.6)	52 (11.5)	
Army	1 (0.1)	1 (0.4)	0 (0.0)	
Others	6 (0.8)	2 (0.7)	4 (0.9)	
<b>Self-rated physical activity</b>				
Low	230 (31.3)	100 (35.7)	130 (28.6)	0.091
Middle	215 (29.3)	72 (25.7)	143 (31.5)	
High	288 (39.2)	108 (38.6)	180 (39.6)	
Body Mass Index	23.3 ± 3.26	23.1 ± 3.13	23.4 ± 3.34	0.191
<b>Waist-hip ratio</b>				
Among males (n = 284) <sup>(2)</sup>	0.90 ± 0.06	0.90 ± 0.06	0.90 ± 0.06	0.976
Among females (n = 450) <sup>(3)</sup>	0.92 ± 0.08	0.94 ± 0.08	0.91 ± 0.08	<0.001

Diet (Sources of protein) (days per week)				
Pork	3.36 ± 2.57	3.38 ± 2.47	3.34 ± 2.63	0.841
Beef	0.06 ± 0.37	0.04 ± 0.22	0.07 ± 0.44	0.191
Lamb	0.02 ± 0.17	0.01 ± 0.12	0.03 ± 0.19	0.347
Chicken/Duck/Goose	0.81 ± 1.39	0.80 ± 1.36	0.81 ± 1.41	0.911
Eggs	1.96 ± 2.25	1.83 ± 2.16	2.04 ± 2.30	0.219
Seafood	0.34 ± 0.96	0.27 ± 0.75	0.38 ± 1.06	0.116
Freshwater fish	0.57 ± 1.19	0.51 ± 1.05	0.61 ± 1.27	0.289
Smoking				
Currently smokes	98 (13.4)	43 (15.4)	55 (12.1)	0.054
Has stopped	49 (6.7)	25 (8.9)	24 (5.3)	
Never	587 (80.0)	212 (75.7)	375 (82.6)	
Alcohol (Once a week or more)	192 (26.2)	78 (27.9)	114 (25.1)	0.411
Mobile phone usage (RMB/month) <sup>(4)</sup>				
Do not use	186 (25.3)	79 (28.2)	107 (23.6)	0.157
1 – 20	181 (24.7)	72 (25.7)	109 (24.0)	
21 – 40	220 (30.0)	84 (30.0)	136 (30.0)	
> 40	147 (20.0)	45 (16.1)	102 (22.5)	
Place of birth (Research community)	456 (62.1)	178 (63.6)	278 (61.2)	0.526

Mean and standard deviation for continuous variables and number of participants and the percentage for categorical variables are shown.

<sup>(1)</sup> Student's t-test for continuous variables and Pearson's chi-square test for categorical variables were used to examine if there were differences between people left behind and people not left behind.

- (2) Number of males left behind was 122, males not left behind was 162.
- (3) Number of females left behind was 158, females not left behind was 292.
- (4) 1 RMB = 0.16 USD as of 2015.

Table 5. Description of people left behind in relation to migrants' characteristics in rural Fujian, China in 2015 (n = 280)

	<b>n</b>	<b>%</b>
<b>Relationship<sup>(1)</sup></b>		
Parents	4	1.4
Children	249	88.9
Son	(227)	(81.1)
Daughter	(43)	(15.4)
Grandchildren	77	27.5
Brothers & sisters	3	1.1
Spouse	9	3.2
<b>Place of migration of family members<sup>(1)</sup></b>		
Inside Nanping	117	41.8
Outside Nanping in Fujian	181	64.6
Outside Fujian	104	37.1
<b>Remittances (RMB)<sup>(2)</sup>/year</b>		
No remittance	69	26.4
1 – 1000	89	31.8
1001 – 3000	68	24.3
3001 – 10000	45	16.1
10001 –	9	3.2
<b>Type of migrant labor of family members<sup>(1)</sup></b>		
Self-employed	75	26.8
Formal employee	57	20.4
Part-time job (Heavy)	68	24.3
Part-time job (Sedentary)	152	54.3
Farming/Fishing	3	1.1
Army	9	3.2
Other	18	6.4

<sup>(1)</sup> The figures do not sum to 100% in the section as respondents could choose more than one category.

<sup>(2)</sup> 1 RMB = 0.16 USD as of 2015.

Table 6. Association between being left behind, EBV antibody titer and the social capital variables (N = 734)

	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>	<b>Model 4</b>	<b>Model 5</b>
Being left behind	0.14 * (0.01, 0.27)	0.13 * (0.00, 0.26)	0.14 * (0.01, 0.26)	0.13 * (0.00, 0.26)	0.14 * (0.01, 0.26)
Individual-level					
Cognitive social capital		-0.06 (-0.18, 0.07)		-0.05 (-0.17, 0.07)	
Structural social capital			0.20 ** (0.05, 0.35)		0.21 ** (0.06, 0.36)
Community-level					
Cognitive social capital				-0.82 (-2.52, 0.89)	
Structural social capital					-1.20 * (-2.40, -0.00)
Age (in years)	-0.04 (-0.07, 0.00)	-0.03 (-0.07, 0.00)	-0.04 * (-0.07, -0.00)	-0.04 (-0.07, 0.00)	-0.04 * (-0.07, -0.00)
Age squared	$3.58 \times 10^{-4} *$ ( $0.51 \times 10^{-4}$ , $6.65 \times 10^{-4}$ )	$3.50 \times 10^{-4} *$ ( $0.43 \times 10^{-4}$ , $6.57 \times 10^{-4}$ )	$3.76 \times 10^{-4} *$ ( $0.70 \times 10^{-4}$ , $6.81 \times 10^{-4}$ )	$3.50 \times 10^{-4} *$ ( $0.43 \times 10^{-4}$ , $6.58 \times 10^{-4}$ )	$3.67 \times 10^{-4} *$ ( $0.62 \times 10^{-4}$ , $6.73 \times 10^{-4}$ )
Sex (ref. Male)	0.14 * (0.00, 0.27)	0.14 * (0.00, 0.27)	0.14 * (0.00, 0.27)	0.14 * (0.00, 0.27)	0.13 * (0.00, 0.27)
Marital status (ref. Has a partner)					

Not married	-0.18 (-0.52, 0.17)	-0.18 (-0.52, 0.16)	-0.11 (-0.46, 0.23)	-0.18 (-0.53, 0.16)	-0.09 (-0.44, 0.25)
Divorced or widowed	0.02 (-0.16, 0.21)	0.02 (-0.17, 0.21)	0.05 (-0.13, 0.24)	0.02 (-0.17, 0.21)	0.06 (-0.13, 0.24)
Education (ref. Illiterate)					
Less than elementary school	-0.12 (-0.27, 0.02)	-0.13 (-0.27, 0.02)	-0.15 * (-0.29, -0.00)	-0.12 (-0.27, 0.02)	-0.15 * (-0.30, -0.01)
Junior high school or more	-0.13 (-0.32, 0.06)	-0.13 (-0.32, 0.06)	-0.16 (-0.35, 0.03)	-0.13 (-0.32, 0.06)	-0.16 (-0.35, 0.03)
Household income (ref. Low)	-0.04 (-0.16, 0.08)	-0.04 (-0.16, 0.09)	-0.04 (-0.16, 0.08)	-0.04 (-0.16, 0.09)	-0.03 (-0.16, 0.09)
Household size (log-transformed)	-0.11 (-0.24, 0.03)	-0.10 (-0.24, 0.03)	-0.12 (-0.25, 0.01)	-0.10 (-0.24, 0.03)	-0.12 (-0.25, 0.01)
CRP concentration (log-transformed)	0.05 (-0.00, 0.11)	0.05 (-0.01, 0.11)	0.05 (-0.00, 0.11)	0.05 (-0.01, 0.11)	0.05 (-0.00, 0.11)
Proportion of those left behind in the community (in percentage)	0.00 (-0.03, 0.03)	0.00 (-0.03, 0.03)	0.01 (-0.02, 0.04)	0.00 (-0.02, 0.03)	-0.01 (-0.04, 0.02)

Coefficient and 95% confidence interval are shown.

A random effects model was used to account for multiple individuals in each community.

\*\*:  $p < 0.01$ ; \*:  $p < 0.05$

Table 7. Association between being left behind and the Kessler 6 Psychological Distress Scale score (n = 553)

	<b>Mild distress<sup>(1)</sup></b>	<b>Severe distress<sup>(1)</sup></b>
Being left behind	1.47 ** (1.28, 1.69)	1.00 (0.62, 1.60)
Age (in years)	1.01 (0.99, 1.02)	1.07 ** (1.03, 1.11)
Sex (ref. Male)	1.30 (0.83, 2.03)	1.87 * (1.12, 3.11)
Marital status (ref. Has a partner)		
Not married	1.86 ** (1.28, 2.71)	2.68 (0.36, 20.01)
Divorced or widowed	1.05 (0.65, 1.70)	0.97 (0.48, 1.95)
Education (ref. Illiterate)		
Less than elementary school	0.93 (0.72, 1.21)	0.59 ** (0.41, 0.86)
Junior high school or more	0.61 ** (0.50, 0.75)	0.34 ** (0.15, 0.75)
Household income (ref. Low)	0.47 ** (0.36, 0.60)	0.29 ** (0.22, 0.38)
Household size (log-transformed)	1.05 (0.82, 1.33)	0.90 (0.55, 1.47)
Proportion of those left behind in the community (in percentage)	1.00 (0.96, 1.04)	1.06 ** (1.04, 1.09)

Prevalence ratio and 95% confidence interval are shown.

A random effects model was used to account for multiple individuals in each community.

\*\* :  $p < 0.01$ ; \* :  $p < 0.05$

<sup>(1)</sup> The Kessler 6 Psychological Distress Scale score (range: 0 – 24) were obtained from 553 people aged 70 years or younger. The cut-off score of 7 or higher indicates the presence of mild distress while that of 13 or higher indicates the presence of severe distress.

## **Appendix 1. Validating the EBV antibody titer measurement protocol**

### **Methods:**

Eick et al. (2016) have established a protocol for the measurement of EBV antibody titer in DBS samples (Protocol A). As protocol A uses two commercial kits (i.e., the Diamedix EBV ELISA kit (Fisher Scientific, Hanover Park, IL, Cat. #720-600) and the Mikrogen recomWell EBV VCA IgG kit, Cat. #7204) and the Diamedix kit was not available in China, an alternative protocol (Protocol B) which only uses the Mikrogen kit was suggested by the same research team (i.e., Eick and colleagues) via personal communication.

To validate this alternative protocol, Protocol B, a comparison of the results obtained when using the two protocols was undertaken by the author (A.Y.) in the laboratory at the Department of Human Ecology, the University of Tokyo, by using 13 samples obtained from the members of the Department of Human Ecology. DBS samples were collected on a specific type of filter paper (903 Protein Saver Cards, Whatman) following a simple finger prick by a nurse in November 2015. The DBS samples were then stored at  $-20^{\circ}\text{C}$  in the laboratory until they were measured. EBV antibody titer in the same DBS sample was measured following the two protocols and compared by calculating a Pearson correlation coefficient. Details of the measurement procedures for Protocol A and B have been reported previously (Eick et al., 2016) and are reported again in the main text of this Dissertation (Methods 2.4.), respectively.

**Results:**

The Pearson correlation coefficient for the results of two protocols was 0.88 (N = 13). After consulting with Eick and colleagues it was decided to use Protocol B for the measurement of EBV antibody titer in China, as these protocols are now regarded as being comparable.

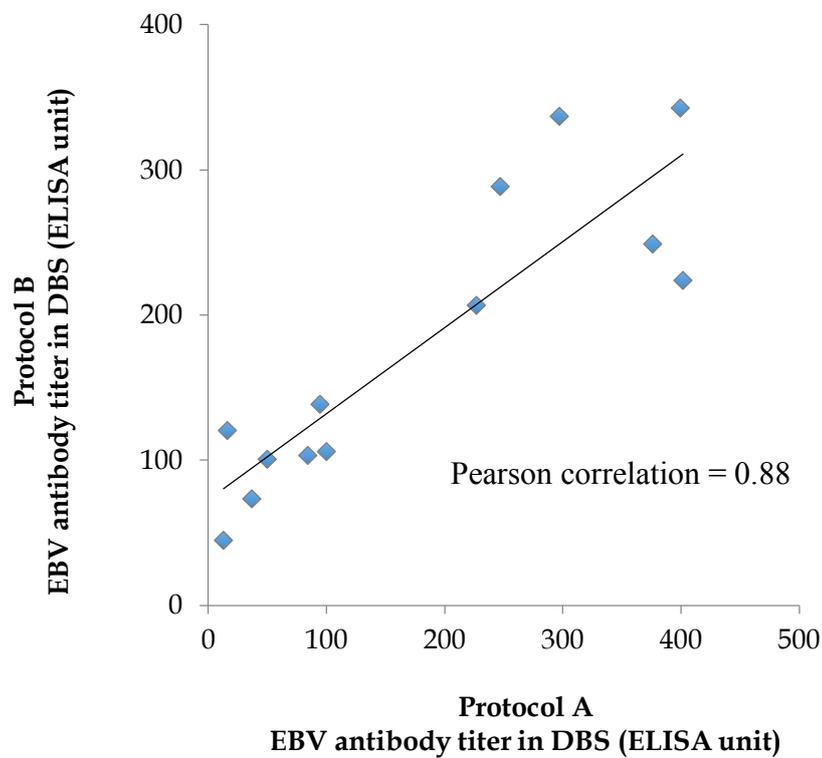


Figure A1. A scatter plot showing the association between EBV antibody titer in DBS samples measured by Protocol A and B.

## **Appendix 2. Examining the consistency of different measures of self-rated household income status**

### **Methods:**

This study asked participants about their household income status in comparison with other households in the same community (N = 797). Specifically, participants were asked the following question; “Suppose the household income of the poorest in the community is 0 and that of the richest is 10, how would you rate your household income on a scale that runs from 0 to 10?”

Furthermore, we asked the household heads (n = 161) to provide detailed information about their household income. The income from various sources was inquired about separately and then summed up to obtain the total annual income, which included monetary income from (a) regular employment (per month); (b) retirement pay (per month); (c) farming (surplus rice); (d) farming (cash crops other than rice); (e) forestry; (f) livestock; (g) fishing; (h) short-term migratory work outside the community (while living in the community); (i) long-term migratory work outside the community (while living outside the community); (j) income from small shops (usually selling daily commodities, preserved foods, and beverages); (k) government subsidies; (l) other sources.

To check the consistency of self-reported income across measures, a least-squares regression analysis was conducted to check the association between self-rated relative household income and log-transformed annual household income (n = 161).

**Results:**

The median value and interquartile range of annual household income was 11,500 (4,800 – 24,000) RMB (1 RMB = 0.16 USD as of 2015). A least-squares regression analysis revealed that there was a significant correlation between self-rated household income and log-transformed actual household actual income (coefficient = 0.244,  $p < 0.001$ ). Thus, we used self-rated household income as a proxy for household income in the study communities.

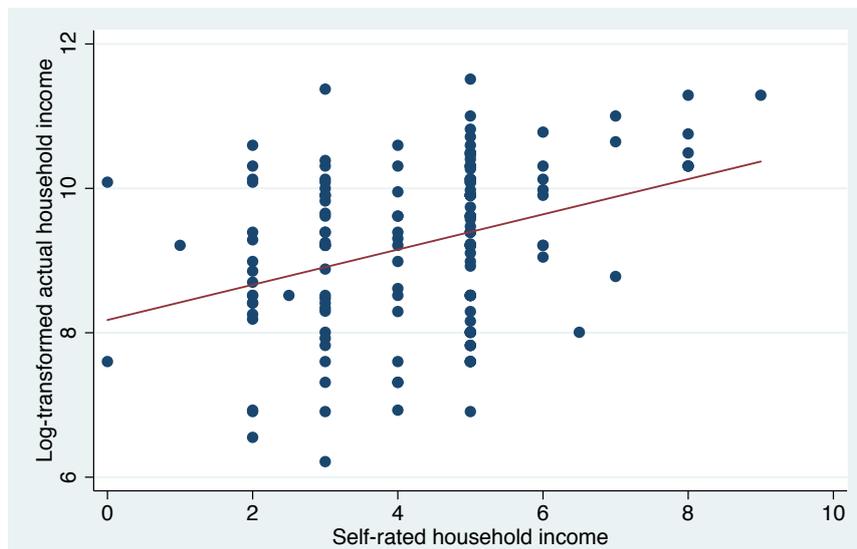


Figure A2. A scatter plot showing the association between self-rated household income and information on household income obtained during interviews with the household heads in rural Fujian, China in 2015.

**Appendix 3. Association between being left behind and EBV antibody titer among older people**

	<b>50 years or older (n = 560)</b>	<b>65 years or older (n = 255)</b>
Being left behind	0.17 * (0.02, 0.31)	0.29 * (0.07, 0.51)
Age (in years)	0.01 ** (0.00, 0.02)	0.01 (-0.01, 0.03)
Sex (ref. Male)	0.12 (-0.04, 0.28)	0.12 (-0.12, 0.36)
Marital status (ref. Has a partner)		
Not married	-0.38 (-0.92, 0.16)	-0.35 (-0.98, 0.27)
Divorced or widowed	0.02 (-0.18, 0.22)	-0.07 (-0.31, 0.18)
Education (ref. Illiterate)		
Less than elementary school	-0.14 (-0.31, 0.02)	-0.24 (-0.49, 0.01)
Junior high school or more	-0.05 (-0.28, 0.18)	-0.49 * (-0.93, -0.06)
Household income (ref. Low)	0.00 (-0.14, 0.15)	0.08 (-0.14, 0.30)
Household size (log-transformed)	-0.13 (-0.28, 0.02)	-0.22 * (-0.42, -0.03)
CRP concentration (log-transformed)	0.06 (-0.00, 0.13)	0.11 * (0.02, 0.21)
Proportion of those left behind in the community (in percentage)	0.00 (-0.03, 0.04)	-0.01 (-0.06, 0.04)

Coefficient and 95% confidence interval are shown.

A random effects model was used to account for multiple individuals in each community.

\*\* $: p < 0.01$ ; \* $: p < 0.05$

#### Appendix 4. Interaction plots in relation to structural social capital

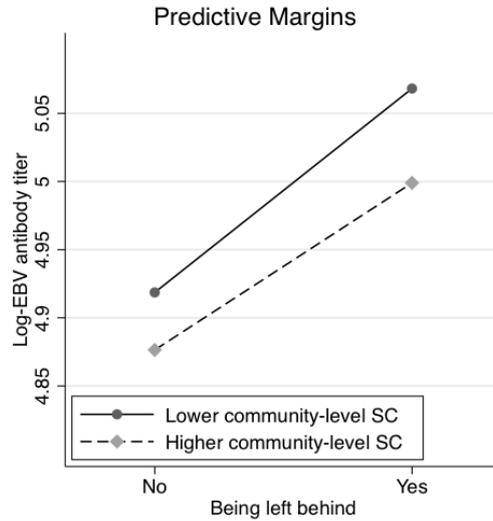


Figure A3. Interaction between being left behind and community-level structural social capital on EBV antibody titer.

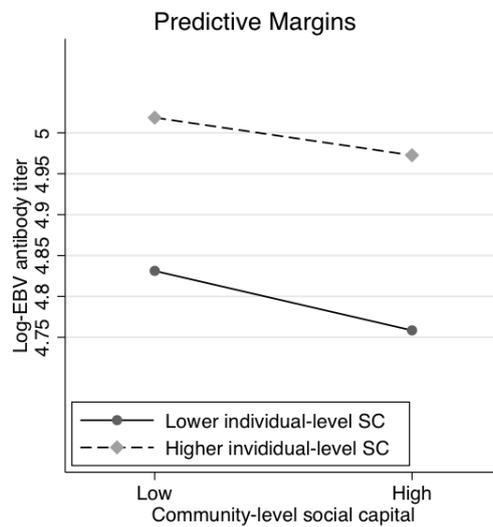


Figure A4. Cross-level interaction of structural social capital on EBV antibody titer.

## Appendix 5. Questionnaire

# 关于“中国经济发展与农村居民健康”的研究 (2015)

## 一 问卷一

福建医科大学

ID: \_\_\_\_\_

调查参加者: \_\_\_\_\_

电话号码: \_\_\_\_\_ (本人 / 家人)

调查日期: \_\_\_\_\_ 年 \_\_\_\_ 月 \_\_\_\_ 日

调查人员: \_\_\_\_\_

调查地点: \_\_\_\_\_ 乡 (镇)

\_\_\_\_\_ 行政村 / \_\_\_\_\_ 自然村

使用的语言: 普通话、福建方言、其他



10. 你出生时有没有人说过你出生的时候比别的宝宝更小，体重比较低。（包括早产儿）  
 0. 没有                      1. 有                      -999. 不记得                      \_\_\_\_\_
11. 你出生时的分娩方式如何？  
 1. 顺产                      2. 剖腹产                      -999. 不记得                      \_\_\_\_\_
12. 你有几个亲兄弟姐妹？（一起长大的。包括已经过世的。不包括你自己。）                      \_\_\_\_\_ 个人
- 12.1. 你有几个哥哥？                      \_\_\_\_\_ 个人
- 12.2. 你有几个姐姐？                      \_\_\_\_\_ 个人
- 12.3. 你有几个弟弟？                      \_\_\_\_\_ 个人
- 12.4. 你有几个妹妹？                      \_\_\_\_\_ 个人
13. 你有几个孩子？（包括抱养）                      男孩 \_\_\_\_\_ 个人    女孩 \_\_\_\_\_ 个人
14. 文化程度（如果现在读书的话，选择现在的学校。比如大学生选择 5）  
 0: 文盲                      1: 小学没毕业                      2: 小学毕业  
 3: 初中                      4: 高中/中专                      5: 大专及以上  
 \_\_\_\_\_
15. 婚姻情况  
 0: 未婚                      1: 已婚                      2: 离异  
 3: 丧偶                      4: 同居  
 \_\_\_\_\_
16. 您的出生地  
 1: 本村  
 2: 非本村（具体的出生地名：  
 A: 南平市内    B: 厦门市                      C: 福州市                      D: 龙岩市  
 E: 宁德市                      F: 莆田市                      G: 泉州市                      H: 三明市  
 J: 漳州市                      K: 外省（哪个省？） \_\_\_\_\_                      M: 国外 \_\_\_\_\_ 国  
 \_\_\_\_\_

17. 你经常从事农业、林业、牧业、渔业吗？

0: 不做

1: 做

\_\_\_\_\_

18. 农业、林业、牧业、渔业之外，你有什么职业？（可以多选）

\_\_\_\_\_

0: 没有

1: 自己做生意（司机、商店、开车等）

2: 正式工（各种单位、老师、政府工作等）

3: 临时工（重活）（木工、铁工、厨师等）

4: 临时工（轻活）（管家、服务员、保安、理发员、家政、保育员等）

5: 军队

6: 其他 \_\_\_\_\_

19. 比所有村里的邻居们（包括不同年龄的），你的身体活动量（干活、走路之类的总的活动量）如何（村里最不运动的人 0 分，身体活动量最大的人 10 分的话，你多少分）？

\_\_\_\_\_

## 第二部：生活情况

你过去 1 年的情况。

20. 每周几天吃下列食品？（请填写天数）

- |             |          |
|-------------|----------|
| A: 猪肉       | _____天/周 |
| B: 牛肉       | _____天/周 |
| C: 羊肉       | _____天/周 |
| D: 鸡肉、鸭肉、鹅肉 | _____天/周 |
| E: 鸡蛋、鸭蛋    | _____天/周 |
| F: 海鲜       | _____天/周 |
| G: 河鲜       | _____天/周 |

21. 您现在用烟筒抽烟吗？ \_\_\_\_\_斤/月  
(不用的话, 请填写“0”)

21.1. 如果现在不用的话, 以前用吗?                      0. 没有                      1. 有 \_\_\_\_\_

22. 您现在抽烟吗? \_\_\_\_\_支/天  
(不抽的话, 请填写“0”)

22.1. 如果现在不抽的话, 以前抽吗?                      0. 没有                      1. 有 \_\_\_\_\_

23. 您喝酒的频率: \_\_\_\_\_

- 0: 平时不喝      1: 每月 1-3 次      2: 每周 1-2 次      3: 每周 3-4 次  
4: 每周 5-6 次      5: 每天 1 顿      6: 每天 2-3 顿

23.1. 您一般喝什么酒?

- |                 |             |
|-----------------|-------------|
| 1: 啤酒           | 平均每次喝_____瓶 |
| 2: 米酒 (25 度左右)  | 平均每次喝_____两 |
| 3: 高粱酒 (50 度左右) | 平均每次喝_____两 |
| 4: 葡萄酒          | 平均每次喝_____两 |

24. 手机费上个月花多少钱? \_\_\_\_\_元/月

25. 你使用 QQ 或微信的频率? \_\_\_\_\_

- 0: 根本没用 (包括没有 QQ 或微信号)                      1: 有事用 (1 个月 2, 3 次)  
2: 1 周 1 次                      3: 2, 3 天 1 次                      4: 每天用

26. 网络(宽带)费, 上个月花多少钱? (不包括手机上网。网吧或用自己电脑(包括平板电脑)上网的) (每月/一年) \_\_\_\_\_元

27. 你家的家用电器使用的情况

1: 电视	0: 无	1: 有	_____
2: 手机	0: 无	1: 有	_____
3: 电脑 (包括平板电脑—Ipad)	0: 无	1: 有	_____
4: 电脑网络 (不包括手机上网)	0: 无	1: 有	_____
5: 电饭煲	0: 无	1: 有	_____
6: 摩托车/电动车	0: 无	1: 有	_____
7: 小车	0: 无	1: 有	_____
8: 轿车/工具车(皮卡车)/拖拉机	0: 无	1: 有	_____
9: 冰箱	0: 无	1: 有	_____
10: 空调	0: 无	1: 有	_____
11: 洗衣机	0: 无	1: 有	_____
12: 微波炉	0: 无	1: 有	_____
13: 浴霸	0: 无	1: 有	_____

28. 您是家庭最主要的经济来源提供者吗? 0: 否 1: 是 \_\_\_\_\_  
( → 不是的话, 跳到 30)

29. 家庭经济来源

A: 正规职业 (不包括退休金)	_____元/月
B: 退休金	_____元/月
C: 农业 (在外面卖的水稻)	_____元/年
D: 农业 (其他经济作物)	_____元/年
E: 林业	_____元/年
F: 牧业 (家畜)	_____元/年
G: 渔业 (包括鱼塘)	_____元/年
H: 现在在 <u>村里</u> 生活的家人打工	_____元/年
I: 现在在 <u>村外</u> 生活的家人打工	_____元/年
J: 商店 (利益)	_____元/年
K: 政府贫穷补助金	_____元/年
L: 其他	_____元/年

### 第三部：经济情况

30. 与村里其他人比较，你家庭的收入如何（最穷人 0 分，最富裕的人 10 分的话，你多少分）？  
\_\_\_\_\_ 分

31. 你有没有 1 个月以上离开过家里吗？（包括上学）

0：没有            1：有

（从来没有 → 跳到 38）

32. 过去 1 年，您有没有 1 个月以上不回家的情况

0：没有            1：有

（没有 → 跳到 38）

33. 上一次，你去哪里？

A：南平市内

B：厦门市

C：福州市

D：龙岩市

E：宁德市

F：莆田市

G：泉州市

H：三明市

J：漳州市

K：省外（哪个省？） \_\_\_\_\_

M：国外（哪里？） \_\_\_\_\_

34. 你去那里做什么？

1：自己做生意（司机，商店，开车等）

2：正式工（各种单位，老师，政府工作等）

3：临时工（重活）（木工，铁工，厨师等）

4：临时工（轻活）（管家，服务员，保安，理发员，售货员，家政，保育员等）

5：农业、林业、牧业、渔业

6：军队

7：学生

8：旅游，自由活动

9：其他 \_\_\_\_\_

35. 你回来多久了？

\_\_\_\_\_ 个月

我问打过工的人。（如 34 选择 7~9 → 跳到 38）

36. 你打工的收入 1 个月平均多少钱？

\_\_\_\_\_ 元/月

37. 您打工的钱都是怎么花的？

1：全部自己花

2：四分之一给家人，其他自己花

3：一半给家人，一半自己花

4：四分之三给家人，四分之一自己花

5：全部给家人

38. 家庭情况

- A. 现在多少个人常住在您家（当前 6 个月以上在你家）    □□个人    \_\_\_\_\_
- B. 外面打工（1 个月以上不回家的）    □□个人    \_\_\_\_\_
- C. 外面上学（1 个月以上不回家的）    □□个人    \_\_\_\_\_
- D. 从军（1 个月以上不回家的）    □□个人    \_\_\_\_\_

39. 除您以外，过去 1 年，几个家人去过外面？（1 个月以上不回家的，包括打工、搬出、上学、当兵、出嫁的）    \_\_\_\_\_ 个人

40. 问 39 回答的人之中，现在几个家人，不在村里？    \_\_\_\_\_ 个人

41. 他们是你的...    第一： \_\_\_\_\_ ， 第二： \_\_\_\_\_ ， 第三： \_\_\_\_\_ 第四： \_\_\_\_\_  
第五： \_\_\_\_\_ ， 第六： \_\_\_\_\_ ， 第七： \_\_\_\_\_ 第八： \_\_\_\_\_

- |        |        |          |        |        |
|--------|--------|----------|--------|--------|
| 1: 爸爸  | 2: 妈妈  | 3: 哥哥    | 4: 姐姐  | 5: 弟弟  |
| 6: 妹妹  | 7: 儿子  | 8: 女儿    | 9: 丈夫  | 10: 妻子 |
| 11: 公公 | 12: 婆婆 | 13: 岳父   | 14: 岳母 | 15: 姐夫 |
| 16: 嫂子 | 17: 妹夫 | 18: 小姨   | 19: 姑爷 | 20: 媳妇 |
| 21: 孙子 | 22: 孙女 | 23: 其他亲族 |        |        |

42. 他们什么时候开始出外面？（包括打工、搬出、上学、当兵、出嫁的）

- |               |               |
|---------------|---------------|
| 第一： _____ 个月前 | 第二： _____ 个月前 |
| 第三： _____ 个月前 | 第四： _____ 个月前 |
| 第五： _____ 个月前 | 第六： _____ 个月前 |
| 第七： _____ 个月前 | 第八： _____ 个月前 |

43. 上一次他们什么时候回来了？

- |               |               |
|---------------|---------------|
| 第一： _____ 个月前 | 第二： _____ 个月前 |
| 第三： _____ 个月前 | 第四： _____ 个月前 |
| 第五： _____ 个月前 | 第六： _____ 个月前 |
| 第七： _____ 个月前 | 第八： _____ 个月前 |

44. 他们在哪里？    第一： \_\_\_\_\_ ， 第二： \_\_\_\_\_ ， 第三： \_\_\_\_\_ 第四： \_\_\_\_\_  
第五： \_\_\_\_\_ ， 第六： \_\_\_\_\_ ， 第七： \_\_\_\_\_ 第八： \_\_\_\_\_

- |         |                  |                  |        |
|---------|------------------|------------------|--------|
| A: 南平市内 | B: 厦门市           | C: 福州市           | D: 龙岩市 |
| E: 宁德市  | F: 莆田市           | G: 泉州市           | H: 三明市 |
| J: 漳州市  | K: 省外（哪里？） _____ | M: 国外（哪里？） _____ |        |

45. 他们干什么? 第一: \_\_\_\_\_, 第二: \_\_\_\_\_, 第三: \_\_\_\_\_ 第四: \_\_\_\_\_  
第五: \_\_\_\_\_, 第六: \_\_\_\_\_, 第七: \_\_\_\_\_ 第八: \_\_\_\_\_

- 1: 自己做生意 (司机, 商店, 开车等)
- 2: 正式工 (各种单位, 老师, 政府工作等)
- 3: 临时工 (重活) (木工, 铁工, 厨师等)
- 4: 临时工 (轻活) (管家, 服务员, 保安, 理发员, 售货员, 家政, 保育员等)
- 5: 农业、林业、牧业、渔业
- 6: 军队
- 7: 学生
- 8: 旅游、自由活动
- 9: 出嫁
- 10: 其他 \_\_\_\_\_

46. 您跟他联系的频率是怎么样? (打电话, 用 QQ 或微信交流, 等等)

第一: \_\_\_\_\_, 第二: \_\_\_\_\_, 第三: \_\_\_\_\_ 第四: \_\_\_\_\_  
第五: \_\_\_\_\_, 第六: \_\_\_\_\_, 第七: \_\_\_\_\_ 第八: \_\_\_\_\_

- 1: 1 个星期 3 次以上
- 2: 1 个星期 1、2 次
- 3: 2、3 个星期 1 次
- 4: 1 个月 1 次
- 5: 2、3 个月 1 次
- 6: 很少

47. 他们 1 年几次回来家里?

第一: \_\_\_\_\_ 次, 第二: \_\_\_\_\_ 次, 第三: \_\_\_\_\_ 次, 第四: \_\_\_\_\_ 次  
第五: \_\_\_\_\_ 次, 第六: \_\_\_\_\_ 次, 第七: \_\_\_\_\_ 次, 第八: \_\_\_\_\_ 次

48. 他们给家人现金或买的礼物一年平均值多少? (包括 020 模式, 过年的红包)

第一: \_\_\_\_\_ 元, 第二: \_\_\_\_\_ 元, 第三: \_\_\_\_\_ 元, 第四: \_\_\_\_\_ 元  
第五: \_\_\_\_\_ 元, 第六: \_\_\_\_\_ 元, 第七: \_\_\_\_\_ 元, 第八: \_\_\_\_\_ 元

49. 比所有村里的邻居们 (包括不同样年龄的), 您觉得自己的生活如何 (村里生活最差的人 0 分, 最好的人 10 分的话, 你多少分)? \_\_\_\_\_

50. 比所有村里的邻居们 (包括不同样年龄的), 您觉得自己的收入如何 (村里生活最穷的人 0 分, 最富的人 10 分的话, 你多少分)? \_\_\_\_\_

#### 第四部：环境意识

51. 对您和您的家庭现在最担心的是什么事情？

- 1: 经济收入                      2: 健康状况                      3: 医疗保险                      4: 环境（空气，水等）  
5: 社会治安                      6: 食品安全                      7: 其他：\_\_\_\_\_ 8: 没有担心的

52. 您听说过以下的哪（几）项环境问题（可多选）？

- 1: 温室效应                      2: 地球温暖化                      3: 大气污染                      4: 水体污染  
5: 酸雨                              6: 雾霾（PM2.5）                      7: 噪音污染                      8: 土壤污染  
9: 固体废弃物污染（垃圾污染）                      10: 其他：\_\_\_\_\_

53. 你村里的环境问题是什么（可多选）？

- 0: 无污染（跳到 55）                      1: 大气污染                      2: 水体污染  
3: 噪音污染                      4: 土壤污染                      5: 固体废弃物污染（垃圾污染）  
6: 其他：\_\_\_\_\_

54. 您所在社区的环境污染主要来自哪里？

- 1: 农药                              2: 汽车尾气                      3: 工业生产                      4: 生活排水  
5: 采矿采煤                      6: 生活垃圾                      7: 其他：\_\_\_\_\_

55. 您认为环保工作最应该是谁的事？

- 1: 每一个人                      2: 政府                              3: 环保人员                      4: 不知道

56. 您认为您社区的环境近 10 年来的变化情况如何？

- 1: 变好                      2: 变差                              3: 不变                              4: 不知道

57. 您从哪里了解到环境相关的知识？（可多选）

- 1: 广播                              2: 电视                              3: 报纸                              4: 杂志                              5: 书籍  
6: 互联网                      7: 学校教育                      8: 政府部门宣传                      9: 其他：\_\_\_\_\_

## 第五部：人际关系

58. 除家人以外，你有几个遇到困难时马上会跟他说的的好朋友？ \_\_\_\_\_ 个人
59. 过去一年中，有没有这种经验？经常会见面的好朋友为了打工或出嫁去了外面，不在这里了。  
(没有 请填写 0 并 → 跳到 61) \_\_\_\_\_ 个人
60. 在这些在外面的朋友中，您跟最好的朋友联系的频率是怎么样？(打电话用 QQ 或微信交流，等等) \_\_\_\_\_
- 1: 1 个星期 3 次以上      2: 1 个星期 1、2 次      3: 2、3 个星期 1 次  
4: 1 个月 1 次      5: 2、3 个月 1 次      6: 没有多少
61. 你家有病人吗？(不能自己生活，需要帮助的(一年以上)) \_\_\_\_\_ 个人
62. 过去一年中、亲族或朋友过世了吗？(可以多选) \_\_\_\_\_
- 0: 没有      1: 爷爷      2: 奶奶      3: 外公      4: 外婆  
5: 爱人的爷爷      6: 爱人的奶奶      7: 爱人的外公      8: 爱人的外婆      9: 爸爸  
10: 妈妈      11: 哥哥      12: 姐姐      13: 弟弟      14: 妹妹  
15: 儿子      16: 女儿      17: 丈夫      18: 妻子      19: 公公  
20: 婆婆      21: 岳父      22: 岳母      23: 姐夫      24: 嫂子  
25: 妹夫      26: 小姨      27: 女婿      28: 媳妇      29: 孙子  
30: 孙女      31: 其他亲族      32: 好朋友

已婚女的娘家情况。(男的或者未婚女的 → 跳到 65)

63. 你会不会经常见娘家的家族？ \_\_\_\_\_
- 1: 经常会(1 个星期 1 次以上)      2: 有时会(1 个月 1 次以上)  
3: 不太多(1 年 1 次以上)      4: 很少
64. 您跟娘家人联系的频率是怎么样？(打电话用 QQ 或微信交流，等等)？ \_\_\_\_\_
- 1: 1 个星期 3 次以上      2: 1 个星期 1、2 次      3: 2、3 个星期 1 次  
4: 1 个月 1 次      5: 2、3 个月 1 次      6: 很少
65. 1 个月几次去村外面？(买东西，拜访朋友，工作等。一天算一次。) \_\_\_\_\_
- 0: 没有多少      1: 每月一次      2: 每月两、三次  
3: 每周一次      4: 每周两、三次      5: 每周四、五次  
6: 每周六、七次

66. 您跟别的家庭的人一起吃饭的频率是怎么样？

在村里 \_\_\_\_\_ 在村外 \_\_\_\_\_

- 1: 1 个星期 3 次以上      2: 1 个星期 1、2 次      3: 2、3 个星期 1 次
- 4: 1 个月 1 次            5: 2、3 个月 1 次        6: 很少

67. 您给别人家庭东西（食品，饮料或者药品之类）的频率是怎么样？

在村里 \_\_\_\_\_ 在村外 \_\_\_\_\_

- 1: 1 个星期 3 次以上      2: 1 个星期 1、2 次      3: 2、3 个星期 1 次
- 4: 1 个月 1 次            5: 2、3 个月 1 次        6: 很少

68. 别人家庭给您家东西（食品，饮料或者药品之类）的频率是怎么样？

在村里 \_\_\_\_\_ 在村外 \_\_\_\_\_

- 1: 1 个星期 3 次以上      2: 1 个星期 1、2 次      3: 2、3 个星期 1 次
- 4: 1 个月 1 次            5: 2、3 个月 1 次        6: 很少

69. 最近 1 年，你参加了几次婚礼？      1: 在村里 \_\_\_\_\_ 次      2: 在村外 \_\_\_\_\_ 次

70. 最近 1 年，你参加了几次丧礼？      1: 在村里 \_\_\_\_\_ 次      2: 在村外 \_\_\_\_\_ 次

71. 你从出生到 16 岁之前，经验过孤儿院的生活吗？ （ →没有的话，跳到 72）

0: 没有      1: 有      \_\_\_\_\_

71.1. 有的话，几岁到几岁？一共多少年？      \_\_\_\_\_岁到\_\_\_\_\_岁（一共\_\_\_\_\_年）

72. 你父母（养育你的父母）现在的年龄是多少？      父亲\_\_\_\_\_岁，母亲\_\_\_\_\_岁

72.1. 已经过世的话，什么时候过世了？

	父亲	你_____岁的时候
	母亲	你_____岁的时候

73. 你从出生到 16 岁之前，你经验历一年以上跟父母离开的生活吗？ （ →没有的话，跳到 74）

- |    |       |      |       |
|----|-------|------|-------|
| 父亲 | 0: 没有 | 1: 有 | _____ |
| 母亲 | 0: 没有 | 1: 有 | _____ |

73.1. 有的话，第一次离开父母是什么时候（你几岁的时候）？

- |    |            |
|----|------------|
| 父亲 | 你_____岁的时候 |
| 母亲 | 你_____岁的时候 |

73.2. 离开生活多久了吗？      父亲一共\_\_\_\_\_年，母亲一共\_\_\_\_\_年

73. 3. 离开生活的原因或目的是什么? 父亲\_\_\_\_, 母亲\_\_\_\_  
1: 父母外出打工    2: 离婚、分居    3: 生病、过世    4: 其他 \_\_\_\_\_  
5: 不知道

☆请您用答题卡填写答案☆

74. [1] 一般来说, 你们村里的人值得信任吗?  
1: 绝对不会    2: 几乎不会    3: 有时会    4: 经常会    5: 十分经常  
会
75. [2] 村外的人跟村里的人一样值得信任吗?  
1: 绝对不会    2: 几乎不会    3: 有时会    4: 经常会    5: 十分经常  
会
76. [3] 一般来说, 你们村里的人会经常为了大家出力, 愿意互相帮助吗?  
1: 根本不    2: 有点    3: 中等    4: 很大    5: 极其
77. [4] 你对这个村有没有特别的感情?  
1: 根本没有    2: 有点    3: 中等    4: 很大    5: 极其

## 第六部：自测健康

78. [5] 您觉得现在您自己的健康状况怎么样？  
1: 非常好      2: 好      3: 一般      4: 差      5: 非常差
79. 在过去一个月中，您是否有下列症状（包括今天）？
- |                  |      |        |       |        |
|------------------|------|--------|-------|--------|
| A. [6] 发烧、咽喉痛、咳嗽 | 1: 无 | 2: 不严重 | 3: 一般 | 4: 相当重 |
| B. [7] 腹泻、胃痛     | 1: 无 | 2: 不严重 | 3: 一般 | 4: 相当重 |
| C. [8] 头痛、头晕     | 1: 无 | 2: 不严重 | 3: 一般 | 4: 相当重 |
| D. [9] 关节、肌肉酸痛   | 1: 无 | 2: 不严重 | 3: 一般 | 4: 相当重 |
| E. [10] 皮疹、皮炎    | 1: 无 | 2: 不严重 | 3: 一般 | 4: 相当重 |
| F. [11] 眼、耳疾病    | 1: 无 | 2: 不严重 | 3: 一般 | 4: 相当重 |
| G. [12] 心脏病、心口痛  | 1: 无 | 2: 不严重 | 3: 一般 | 4: 相当重 |
| H. [13] 其他疾病     | 1: 无 | 2: 不严重 | 3: 一般 | 4: 相当重 |
80. [14] 你目前服降压药吗？      1. 不吃      2. 吃
81. [15] 你目前服糖尿病的药吗？      1. 不吃      2. 吃
82. [16] 你感到寂寞吗？（一个月）  
1: 总是      2: 经常      3: 有时      4: 很少      5: 从不
83. [17] 综合考虑一切，你觉得自己  
1: 很不幸福      2: 不很幸福      3: 一般      4: 十分幸福      5: 非常幸福
84. [18] 您如何评价您的生活质量？  
1: 很差      2: 差      3: 一般      4: 好      5: 很好
85. [19] 您对自己健康状况满意吗？  
1: 非常不满意      2: 不满意      3: 一般      4: 满意      5: 很满意

K-6 (70 岁以下)

下面的问题是询问您在过去一个月中的情绪。回答每一个问题时，请圈出最能描述这种情绪的出现频率的号码。

86. [20] 在过去 30 天中，您经常会感到紧张？  
1: 全部时间      2: 大部分时间      3: 一部分时间      4: 偶尔      5: 无
87. [21] 在过去 30 天中，您经常会感到绝望？  
1: 全部时间      2: 大部分时间      3: 一部分时间      4: 偶尔      5: 无
88. [22] 在过去 30 天中，您经常会感到不安或烦躁？  
1: 全部时间      2: 大部分时间      3: 一部分时间      4: 偶尔      5: 无
89. [23] 在过去 30 天中，您经常会感到太沮丧以至于什么都不能让您愉快起来？  
1: 全部时间      2: 大部分时间      3: 一部分时间      4: 偶尔      5: 无
90. [24] 在过去 30 天中，您经常会感到不安或做每一件事情都很费劲？  
1: 全部时间      2: 大部分时间      3: 一部分时间      4: 偶尔      5: 无
91. [25] 在过去 30 天中，您经常会感到无价值？  
1: 全部时间      2: 大部分时间      3: 一部分时间      4: 偶尔      5: 无

Self-efficacy (70 岁以下)

\* 不用想太多，请凭直觉回答以下的问题。

92. [26] 如果我尽力去做的话，我总是能够解决问题的  
1: 完全不正确 2: 有点正确 3: 多数正确 4: 完全正确
93. [27] 即使别人反对我，我仍有办法取得我所要的  
1: 完全不正确 2: 有点正确 3: 多数正确 4: 完全正确
94. [28] 对我来说，坚持理想和达成目标是轻而易举的  
1: 完全不正确 2: 有点正确 3: 多数正确 4: 完全正确
95. [29] 我自信能有效地应付任何突如其来的事情  
1: 完全不正确 2: 有点正确 3: 多数正确 4: 完全正确
96. [30] 以我的才智，我定能应付意料之外的情况  
1: 完全不正确 2: 有点正确 3: 多数正确 4: 完全正确
97. [31] 如果我付出必要的努力，我一定能解决大多数的难题  
1: 完全不正确 2: 有点正确 3: 多数正确 4: 完全正确
98. [32] 我能冷静地面对困难，因为我信赖自己处理问题的能力  
1: 完全不正确 2: 有点正确 3: 多数正确 4: 完全正确
99. [33] 面对一个难题时，我通常能找到几个解决方法  
1: 完全不正确 2: 有点正确 3: 多数正确 4: 完全正确
100. [34] 有麻烦的时候，我通常能想到一些应付的方法  
1: 完全不正确 2: 有点正确 3: 多数正确 4: 完全正确
101. [35] 无论什么事在我身上发生，我都能应付自如  
1: 完全不正确 2: 有点正确 3: 多数正确 4: 完全正确