Does Living Alone Worsen Health among Young Adults? Health Outcomes of Young Single-Person Households in South Korea

By

KIM, Bomi

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

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Committee in charge:

Professor Rhee, Inbok, Supervisor

Professor Kim, Taejong

Professor Kim, Joeun

Approval as of December, 2021

ABSTRACT

Does living alone have a negative impact on a person's health? Specifically, do the health outcomes of young adults from single-person households differ from those of young adults from multi-person households? Single-person households are increasing around the world. Yet the evidence linking living alone and one's health is mixed. This study examines the health outcomes of South Koreans in their 20s and 30s in single- and multi-person households, using 15 years of data from the Korea Welfare Panel Study (KoWePS) and individual and time fixed effects regression analysis. This paper examined the case of South Korea, where the number of single-person households follows the pattern of rise like other countries but has a distinct feature that it increased rapidly in a short period of time. The findings suggest a statistically significant association between household type and health outcomes. Young adults living in single-person households were shown to have a lower reported health status, were more likely to visit an outpatient clinic, and were more likely to suffer from depression. The article further examines how the disparities in health status and mental between the two household types develop over time using the Cox Proportional Hazards Model. The results suggest that the health status and mental health hazard of single-person households are larger than that of multi-person households, and the gap of hazard probabilities between two groups is widening over time.

Keywords: Single-person Household, Health outcome, Young adults

ACKNOWLEDGEMENT

Getting a master's degree was part of a process to help me learn and grow. It would have been impossible to go through all of this course without the support and advice of people around me.

Foremost, I would like to express my deepest gratitude to my advisor, Professor Rhee, Inbok, for all of his patience, motivation, guidance and assistance throughout this work, as well as for his warm remarks that encouraged me anytime I had concerns. I would also like to express my sincere gratitude to Professor Kim, Taejong, for his insightful comments and encouragement on how to develop this paper when I initially decided to write a paper on this topic.

I am grateful for the friendship and memories I shared with my lab-mates from across the world, as well as those from South Korea, whom I met during my master's degree program. Conversations and discussions with them have enriched my insight and been a source of ideas. Also, I have to thank to all my friends for their affection and support outside of school to make it a good finish.

Last but not the least, my sincere thanks goes to my family, who has always supported and believed in me.

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1. Introduction

Single-person households account for a large number of overall household types and composition ratios in industrialized societies, and they are on the rise. Data show that the number of single-person households is quickly growing, even in nations that have more recently begun to grow their economies (Ortiz-Ospina, 2019; Statistical Handbook of Japan, 2021; Office for National Statistics UK, 2021; U.S. Census Bureau, 2019; Juong, 2019). Some argue that the rise in single-person households is an inevitable phenomenon that occurs along with economic development (Joung, 2019).

One drawback of this phenomenon is that the rise in single-person households can lead to social isolation of members (Giddens, 1991; Beck, 1999, as cited in Lee et al., 2014). Isolation and loneliness, in turn, are commonly associated with mental and physical health problems, including illness and chronic disease, as well as lower quality of life (Snell, 2017). On the other hand, some argue that there is no difference between who lives alone and who lives with others on their life satisfaction and loneliness (Mellor et al, 2008), and also people who live alone show their satisfaction with single-person household life as they can be immersed in free life and decision-making, no burden of family support, and concentrate on their work and study (Jung & Kim, 2018).

Does living alone worsen one's health outcomes? Specifically, do people who live in single-person households differ in their health status, mental health, or number of hospital visits, compared to those who live in multi-person households?

This study attempts to fill this gap by using the example of South Korea to investigate the influence of household type on individual health, specifically focusing on the relationship

between living alone and health status. The goal of this study is to compare the health outcomes of single-person households to those of multi-person households, in order to answer the above questions:

One distinguishing aspect of the South Korea is that the growth rate of single-person households is faster than in other developed countries and the case study of South Korea can be a valuable reference point to understand other countries with similar patterns. In the South Korea, the number of single-person households has nearly doubled in 20 years, rising from 15.5% in 2000 to 31.7% in 2020 (Statistics Korea, 2021). The number of single-person households is rising at a higher rate than in other nations such as the United States and Japan (Esteban Ortiz-Ospina, 2019; Statistics Bureau of the Ministry of Foreign Affairs, 2019, as cited in Kim, 2019) Recently, there have been countries such as China and India where single-person households have increased rapidly as their economies have expanded (Juong, 2019), and analyzing the case of South Korea can be a useful starting point for understanding the impact of single-person households on individual health.

Comparing individual health outcomes based on household type is meaningful as household size is a social determinants of health. World Health Organization (WHO) Social Determinants of Health explains the environment and socioeconomic factors that surrounding an individual can affect to one's health. There has also been an increase in recent research on the impact of individual socioeconomic factors such as education level, employment, working environment, and living community on health (Braveman & Gottlieb, 2014; Patwardhan et al., 2015; Paradies et al., 2015; Kirtchuk & Wylie, 2021; Barrie, 2014). The household setting is an important social factor that plays a role in an individual's basic quality of life, including food, clothing, resource assistance, and emotional support. However, there is very little research

exploring how household type and individual environment may impact an individual's health (Deatrick, 2017).

Studies have shown differences in the rates of smoking, drinking, and diet between single-person households and multi-person households in South Korea, and that differences have an adverse effect on the health of single-person households (Kim & Park, 2020; Lee et al, 2019). Single-person households are associated with greater feelings of loneliness and depression. In South Korean society, resources are often shared by families, making the rise in single-person households especially crucial to lowering the support and resources that individuals may be able to obtain, which has been linked to an increase social isolation and the severance of important social connections (Lee et al, 2014).

A significant feature of single-person households in South Korea is that the number of people in their 20s and 30s living in single-person households is relatively high. However, existing health studies mostly focus on middle-aged and elderly single-person households, who are thought to be physically fragile (Lee, 2013; Park et al., 2016; Choi, 2008; Kim, 2011; Lee, 2010; Lee, 2016). Perhaps because young adults are perceived to be healthier in general, the impact of the rise in single-person households among young adults has received little attention.

Despite this, data suggest that young people still experience health issues, though they may grapple with different health problems than older people do. Studies have shown that young adults living in single-person households have greater rates of smoking, drinking, chronic disease, depression, and suicide than multi-person households in South Korea (Kang & Lee, 2016), as well as higher poverty rates (Kim & Choi, 2017), and higher unemployment rates (Kang & Lee, 2016). Young people in single-person households also had lower medical resource

use than those in multi-person households (Lim et al, 2019), suggesting that there may be a difference in reactions to health concerns when they do occur. Although people may assume that young adults are healthier than middle-aged or older adults, this data suggests that there is a need for empirical research to better understand actual differences in health outcomes among young adults due to differences in their environmental conditions, such as household type.

This study examines the effects of living alone on health among young, single-person households in South Korea. Using the data from the Korea Welfare Panel Study (KoWePS), from 2005 to 2019, the article examines the differences in health outcomes for those respondents in their 20s and 30s. The key independent variable is household type: Single- and multi-person household. The dependent variables are proxies for health outcome: self-reported health status, mental health status (CES-D; depression test), and outpatient hospital visits. Education level and work status as well as age are also included to regression model as control variables. A key feature in the analysis is the within-subject comparison exploiting the individual and time fixed effects of single- and multi-person households.

The findings show that living alone was negatively associated with health outcomes. First, in terms of health status, those living in a single-person household had a 5% higher likelihood of reporting poor health than those living in a multi-person household. In terms of mental health, single-person households were roughly 3% more likely than multi-person households to experience signs of depression. Finally, in the first analysis for quartiles of the distribution of all outpatient hospital visits, there was a statistically positive association between single-person households and hospital visits. The hospital visit analysis based on dichotomous variable, which 0 denotes visiting hospital less than median number of total hospital visit distribution and 1 denotes visiting hospital more than median, also yielded consistent findings

in the same direction.

Furthermore, using the panel data over time, the Cox proportional hazards model was utilized to evaluate variations in health status and mental health hazards between single-person households and multi-person households over the 15-year period. This analysis showed that respondents living in single-person households had a larger risk of hazard than respondents living in multi-person households, and the difference between the two groups has grown over time.

This study adds three significant contributions to the current literature. First, it focuses on young adults, who make up a growing number of single-person households, and uses relevant data on their health outcomes. This study contributes to growing literature about the health of young people living in single-person households, which is a global trend correlated with economic development. It also ensures generational variety in health research by incorporating study findings on the health of younger adults into current research on the health of middle-aged and older adults. Second, this empirical study was conducted to assess the influence of household type, one type of social health variable, on individual health outcomes. It is significant in that it examines the impact of household type directly on health using regression analysis, going beyond previous studies that assess lifestyles, diet, and other risk factors that might emerge as a result of variances in household types. Finally, utilizing 15 years of South Korean public health data, this research falls within an important time period in South Korea, in which the number of single-person households nearly doubled, from 2000 to 2020, and shows the changes over time in the data.

The next section of this paper outlines theoretical background about the topic, and

Section 3 provides data and descriptive statistics. Section 4 describes the methodology used for analysis, and the results follow in Section 5. Section 6 discusses the results, and Section 7 concludes the paper.

2. Theoretical Background

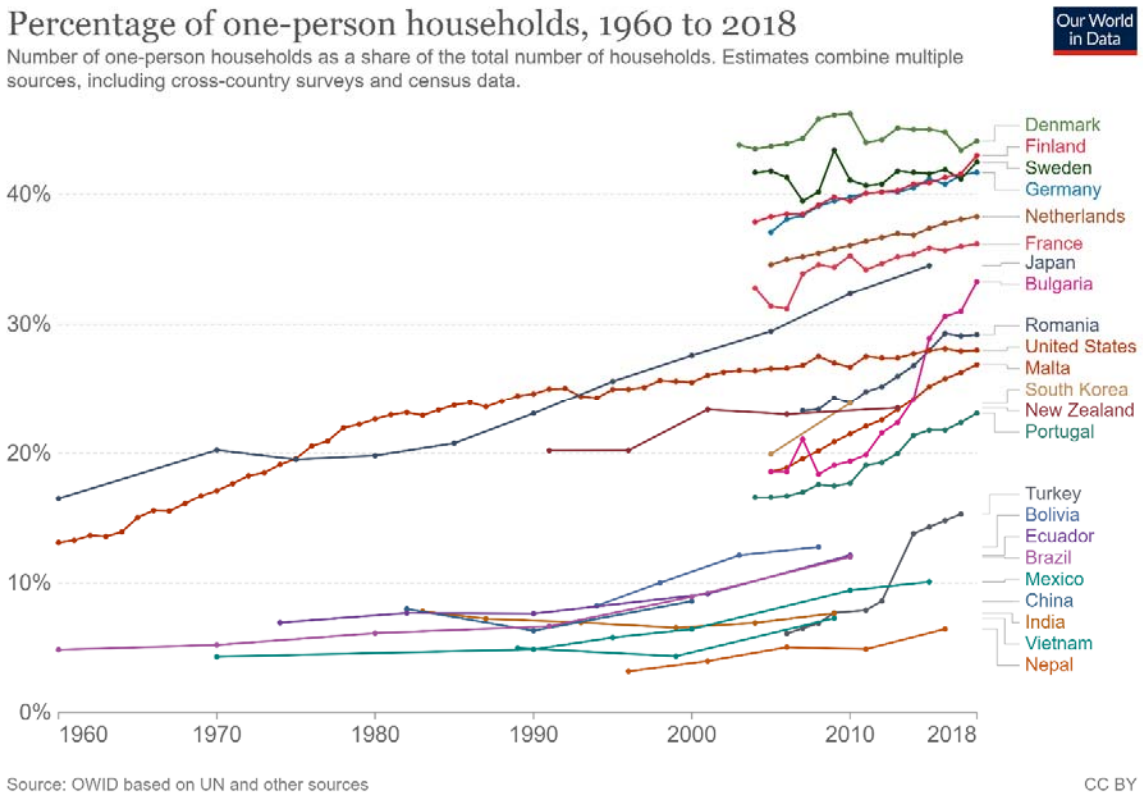
An Increasing Number of Single-Person Households Around the World and the Impact on Health Outcomes

The rise of single-person households is a worldwide phenomenon (Ortiz-Ospina, 2019). According to Ortiz-Ospina (2019), this trend appears in economically prosperous developed nations, with an increase in single-person households being particularly noticeable in Europe, the United Kingdom, the United States, and Japan. From 2010 to 2020, the overall number of households in Europe rose by 7.2%, but the number of single-person households increased by about 19.5% (Eurostat, 2021). In 2018, the proportion of single-person households in Europe was 33.9%. In Sweden, 54% of households were single-person households, and in Denmark, Finland, and Germany, 40% of households were single-person households (Kim, 2019). Single-person households account for around 35% of all households in Japan (Statistical Handbook of Japan, 2021). In 2019, 29.5% of people in the United Kingdom lived in single-person households (Office for National Statistics UK, 2021), whereas the 28.3% of people in the United States lived in single-person households (U.S. Census Bureau, 2019).

It should also be emphasized that the pace of fast growth, as well as the composition of single-person households, are both on the rise. In eight out of 31 European countries, including Cyprus (10.5%), Latvia (12.9%), Malta (9.6%), Romania (8.6%), Sweden (11.8%), and Turkey (7.8%), the number of single-person households grew by more than 5% in the previous decade, from 2009 to 2018 (Kim, 2019). The proportion of single-person households is increasing in countries that have experienced rapid economic growth in recent years, such as China, India, and Brazil (Juong, 2019). This implies that the share of single-person households is growing not just in developed countries, but also in countries with active economic development.

Although the rate and pattern of rise vary by nation, the fact that the number of single-person households is growing globally is irrefutable.

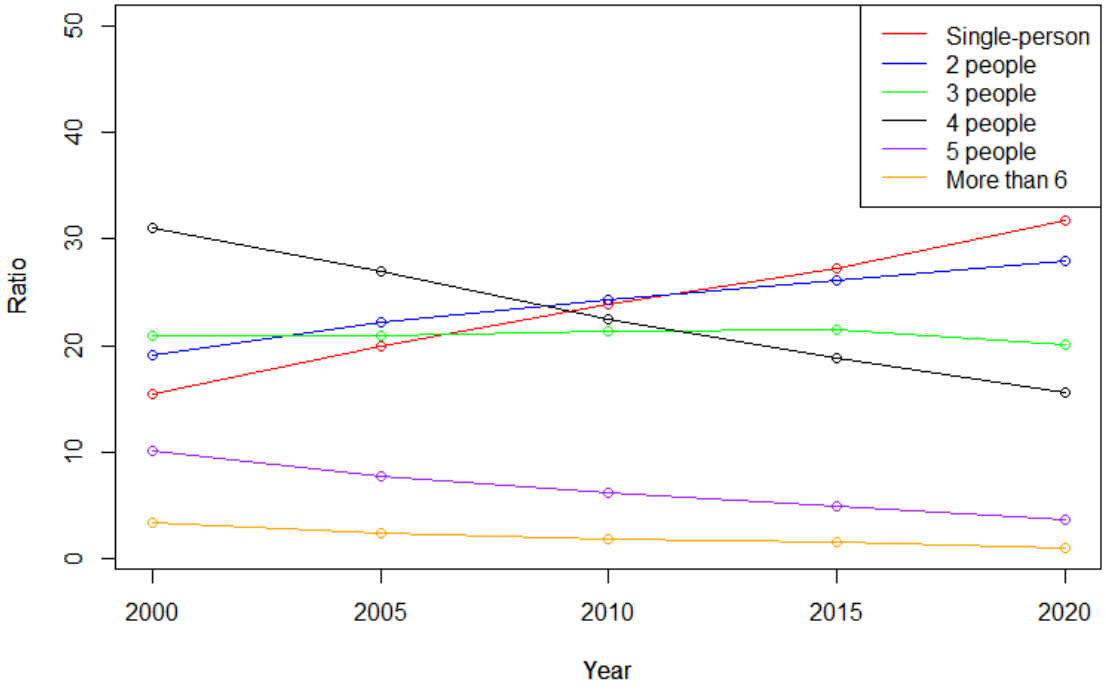
Figure 1. Percentage of Single-Person Households, 1960 to 2018



Source: Our World in Data, based on UN and other sources (Ortiz-Ospina, 2019)

South Korea is no different, as the number of single-person households continues to rise. As seen in Figure 2, South Korea's single-person households rose from 19.96% in 2005 to 23.89% in 2010, similar to the trend that has been observed in countries around the world. According to data released by Statistics Korea in 2021, single-person households composed 31.7% of all general households in South Korea in 2020.

Figure 2. Ratio of Households by Year in South Korea



Source: Statistics Korea (2021). Complied by the Author.

In South Korea, the trend of changing household types began in the year 2000 (Sung, 2020). In 2000, the share of single-person households was just 15.5% of all households. However, the proportion of single-person households has steadily increased since 2000, to ascend to the top around 2015 and become the most popular household type in South Korea. Four-person households, which accounted for the greatest share of all general households, decreased from 31.1% in 2000 to 15.6% in 2020, while single-person households nearly doubled.

The present composition of single-person households in South Korea is high, and the pace of increase is quick and compressed, which is similar to trends in other nations. According to data from Statistics Korea, the number of single-person households in South Korea is expected to reach 35.7% in 2037. This is lower than predictions for Japan (39% in 2037), but

greater than predictions for the United Kingdom (33.1% in 2041), Canada (30.2% in 2036), New Zealand (27.8% in 2038), and Australia (26.5% in 2037) (Statistics Korea, 2019).

In Japan, it took 30 years to grow from 20.8% of single-person households in 1985 to 34.5% in 2015 (Statistics Bureau of the Ministry of Foreign Affairs, 2019, as cited in Kim, 2019), which is similar to the current figure. In the case of the United States, it took almost 50 years to double from approximately 15% in 1965 to approximately 29.5% in 2019 (Ortiz-Ospina, 2019). In South Korea, meanwhile, it took 20 years to double from 15.5% in 2000 to 31.7% in 2020 (Statistics Korea, 2021). South Korea's pace of increase is especially rapid when compared to other countries. These figures suggest that the rapid rise in the number of single-person households globally is a societal issue that countries should carefully consider.

Because the internal causes of the rise in single-person households are linked with diverse and complicated variables such as economic changes and changes in family culture and values, categorizing the causes into one category is challenging (Kim, 2019). External reasons include young adults moving to cities in pursuit of studies and jobs, increasing rates of late marriage and divorce, and death of family members (Sung, 2020; Kim, 2019).

Various socioeconomic concerns have been raised as a result of changes in household type and the rise in single-person households. However, as a more essential issue, the rise in single-person households can lead to “individualization” and “personalization,” resulting in social isolation of individuals (Giddens, 1991; Beck, 1999, as cited in Lee et al., 2014). It is more than just a change in household type. Isolation and loneliness are linked to mental and physical health problems, and they have a direct impact on people's quality of life. Loneliness has been linked to an increased risk of heart attack, stroke, cancer, depression, anxiety, early

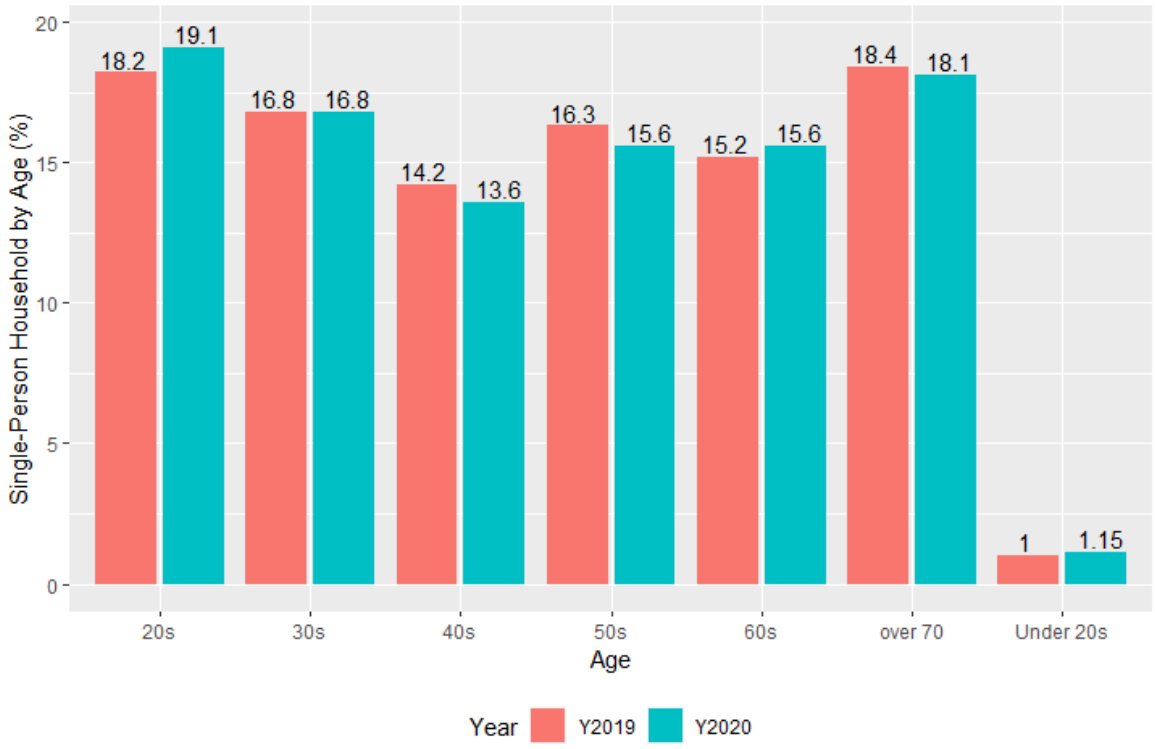
mortality, alcoholism, an unhealthy diet, lack of exercise, lack of sleep, substance abuse, Alzheimer's disease, high blood pressure, accelerated aging, and eating disorders (Snell, 2017).

As shown in earlier research in countries that have undergone societal changes as a result of a rise in single-person households, studies in South Korea also indicate increases in smoking, drinking, and eating behaviors in single-person households as compared to multi-person families (Lee et al., 2019; Kim & Park, 2020). In terms of mental health, respondents in single-person families have reported higher levels of loneliness and depression (Lee et al., 2014). In particular, in the South Korea, where social networks, safety nets, and emotional and instrumental support resources are shared among family, the increase in single-person households could reduce support and resources that individuals obtain, as well as generate social isolation and sever familial ties (Lee et al., 2014). Because South Korea's growth has been so rapid, there are also cases of single-person households that arise involuntary because of socioeconomic conditions (Lee et al., 2011; Lee, 2017). Thus, more research should be done on the effect of living in a single-person household.

The goal of this study is to evaluate how living in a single-person household impacts health outcomes in South Korea, when compared to living in a multi-person household. This research focuses on the health outcomes of young adults living in single-person households. Those in their 20s and 30s make up a greater share of single-person households in South Korea than other age groups. According to Statistics Korea, individuals in their 20s accounted for 19.1% of all single-person households in 2020, followed by those in their 70s at 18.1% and those in their 30s at 16.8%. Young adults in their 20s and 30s thus make up 35.9% of all single-person households. Even though in 2020, the share of single-person households after the age of 40 dropped compared to the previous year, the number of adults in their 20s and 30s in these

households continued to rise (Statistics Korea, 2021).

Figure 3. Single-Person Household Percent by Age Group in South Korea, 2019 to 2020



Source: Statistics Korea (2021). Complied by the Author.

In general, young adults are thought to be healthier. Previous studies about single-person households and health have mostly concentrated on middle-aged and older adults, and only a few have considered young adults (Lee, 2013; Park et al., 2016; Choi, 2008; Kim, 2011; Lee, 2010; Lee, 2016). Kang & Lee (2016) found that among young adults in South Korea, single-person households had a higher smoking and alcohol use rate, as well as a higher risk of chronic illness, depression, and suicide than multi-person households. Furthermore, young single-person households have a higher poverty rates than multi-person households (Kim & Choi, 2017), and the working poverty and unemployment rates are also higher (Kang & Lee, 2016).

Socioeconomic factors, along with lifestyle behaviors, may induce illnesses, and since chronic diseases arise cumulatively over a lifetime (Kim, 2013), economic poverty experienced by young single-person households can contribute to health degradation. In terms of medical usage, the finding that young individuals in single-person households used less healthcare than young people in multi-person households (Lim et al, 2019) suggests that it could be more difficult to respond appropriately when health concerns arise.

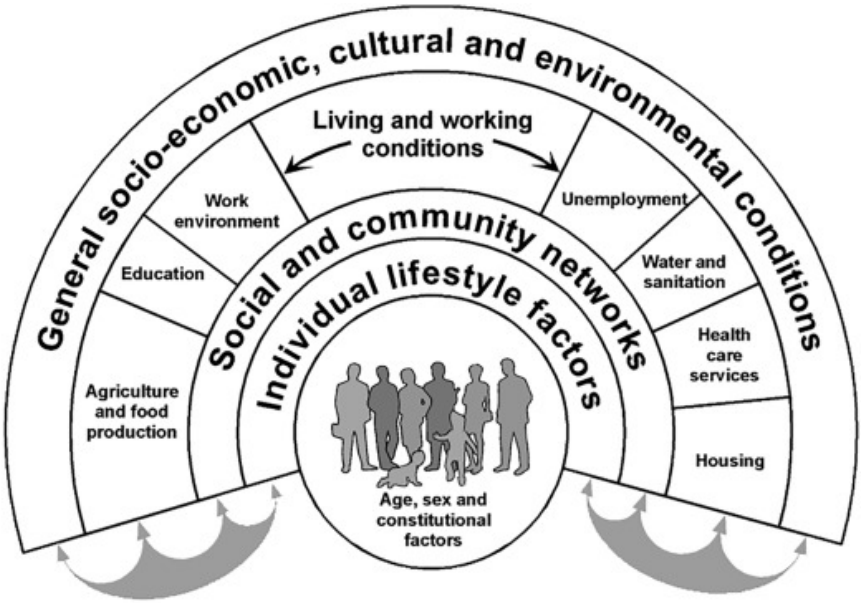
Household Size as a Social Determinant of Health

A "household" is defined as a living unit in which one individual earns a livelihood alone or two or more people assemble to live together. The terms "household" and "family" are frequently confused, yet the people who make up a household are people with whom they are presently living, thus they may or may not be family (Eurostat, 2017). Households, together with government and businesses, are the three primary economic players, and their importance has been stressed mostly in the consumption sector. Households may also share resources such as food, clothing, and everyday life activities.

Household size is an important factor to study because it can determine the physical locations in which people live, the resources they share, and the responsibilities they have. For example, a single-person household requires one person to take care of all needs, yet in a multi-person household, its members may share responsibilities. While living with someone might be tiring at times, it also allows people to get emotional support, sanction others for hazardous conduct, and get crisis help from household members. Thus, the household is not only a unit that dictates the size of consumption, but it also has vital meaning for individual social and economic life.

The WHO Commission on Social Determinants of Health defines Social Determinants of Health (SDH) as “the non-medical factors that influence health outcomes,” as well as “the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life.” That is, an individual's education level, economic status, job stability, food, housing, and basic comforts, as well as the environment, all have a role in determining health. Research on the relationship between social factors and health over the past 20 years also supports that social factors act as important aspects in determining health outcomes. (Braveman & Gottlieb, 2014; Patwardhan et al., 2015; Paradies et al., 2015; Kirtchuk & Wylie, 2021; Barrie, 2014).

Figure 4. Health Determinants Model (Dahlgren & Whitehead, 1991)



Dahlgren and Whitehead's social determinants of health model (1991) explains factors

affecting health through successive, multidimensional layers. At the center are an individual's genetic factors, age, and sex. An individual's lifestyle factors, such as diet, smoking, and drinking, are the next level. Next are social and community networks, which include families, neighbors, and communities. Then there are the material and social conditions in which people live and work, such as housing, education, work environment, and health care. The structural environment surrounds the individual as the fourth layer. These four layers mutually influence each other and affect the individual's health.

The model is based on a report conducted in 1991 at the request of the WHO Regional Office for Europe to provide "a policy-friendly report on policies and strategies to improve equity in health" (Dahlgren & Whitehead, 2021). It has primarily been used as an analytical framework for predicting health determinants. Among these, household is part of social and community networks, which interacts with individual lifestyle factors and living and working conditions, and as a social factor has an impact on health. The household serves as a link between society and the individual, and is an environmental component that influences an individual's life and health. Despite the key role of households in health-related research, studies on household type and their impacts are still scarce (Deatrick, 2017).

Previous studies have explored how household type, social relationships, contexts within households, and lifestyle influence an individual's health, and these are found to be important factors in the social etiology of health (Hughes & Waite, 2002). Culture, social norms, social policies, and the political system, in particular, are all social determinants of health that have an impact on households and household functions to socialize and protect members within wider sociocultural and political environment. Simultaneously, difficulties affecting an individual's ecological world have an impact on the health of family members (Deatrick, 2017).

The household is the most fundamental unit of social economics and welfare that surrounds an individual, and the type of household to which an individual belongs is directly connected to an individual's health. As a result, there is a need to study the impact of different household types on individual health.

Based on this theoretical foundation and framework, it is hypothesized that single-person households and multi-person households may provide individuals with different lifestyles and physical and emotional environments, and that the health outcomes of young adults living in single-person households may differ from those living in multi-person households. While also considering other socioeconomic factors that may impact health status, such as education, employment status and age, the purpose of this study is to investigate the effect of household type on young people's health outcomes in South Korea.

3. Data and Descriptive statistics

Data

For data analysis, the first through 15th data sets of KoWePS were used. The Korea Welfare Panel Study is conducted from 2006 by the Korea Institute for Health and Social Affairs and the Institute of Social Welfare at Seoul National University on a yearly basis. The goal of the panel data survey is to help to policy development and improve the efficacy of policy assistance by recognizing changes in the size and living circumstances of various economic groups in real time. In addition to the yearly survey of households and household members, supplementary surveys are done every three years on children, welfare awareness, and disability. The general and low-income households were divided into 3,500 households from each of the two floors for a total of 7,000 households based on income data from the households that completed the final survey of the '2006 National Living Condition Survey,' which is extracted in a probabilistic proportion from the '2005 Population and Housing Census data.' However, the retention rate of the original sample households decreased after the sixth year survey, therefore 1800 households were added to the panel from the seventh year survey using the same sampling procedure as in the first year.

The data sets used in this paper span 15 years, from 2005 to 2019, and include 50,833 data entries. Because the present study is focused on young adults, only respondents aged 20 to 39 at the time of the survey were included in the sample data. The unit of observation is individual, by household.

Dependent Variables

Three dependent variables are used in this study: reported health status; number of

hospital visits (visits to an outpatient clinic); and mental health, measured as depression. These serve as the proxies to measure the health outcomes of respondents. To cover both physical and mental health, these three are contained as dependent variables.

The first independent variable is the response to a self-evaluation of one's own health status. The KoWePS study asked participants to report their "Health status as of December 31, 20NN (the last day of the previous year (20NN))." Participants could select from the following responses: Very Good, Good, Fair, Bad, and Very Bad. In the present study, these options were treated as dummy variables. "Very Good" and "Good" were considered positive health status and assigned a value of "1," while the three options "Fair," "Bad," and "Very Bad" were considered negative health status and assigned a value of "0."

The "hospital visit" variable, which investigates the "frequency of use of medical institutions," is the second dependent variable, contained to the model as a proxy for health outcome. The KoWePS study asked participants to respond with the number of times they received outpatient treatment at a legal medical institution in the previous year. If the same hospital treated different medical subjects twice or more, it was marked as one time, and if two or more hospitals were used, it was marked as two times. The number of outpatient visits reported did not include routine health checkups. For the purposes of this study, responses to the "hospital visit" variable were divided into four categories, numbered one through four. "1" denotes no outpatient visits in the previous year, "2" denotes 1-2 visits, "3" denotes 3-6 visits, and "4" denotes 7 or more visits. The category criteria were determined by dividing the distribution into quartiles. Finally, values of "0" or "1" were assigned as dummy variables, based on the data point falling below or above the median of distribution.

The third independent variable is the "mental health" variable, which assesses depression. Depression is evaluated using the CES-D (Center of Epidemiological Studies Depression Scale). This scale, designed by the U.S. Center for Epidemiology of the National Institute of Mental Health, measures an individual's psychological attitude and behavior over the past week by asking participants eleven self-reported questions (Radloff, 1977, as cited in Jun, 2015). The original questions were translated from English to Korean for the KoWePS study (Figure A1). The CES-D scale asks participants to select a value of 0 to 3 to assess their feelings of depression in the eleven questions: "0" represents rarely or none of the time (less than 1 day), "1" represents some or a little of the time (1 to 2 days), "2" represents occasionally or a moderate amount of time (3 to 4 days) and "3" represents most or all of the time (5 to 7 days). According to the CES-D scale, if the value obtained by multiplying the total score by 20/11 is greater than 16, the person is considered depressed; if it is less than 16, the person is considered not depressed. For this study, only the final outcomes of the CES-D results were considered. The variables used in this study were: "0" denotes that the individual was depressed, and "1" denotes that the individual was not depressed.

Key Independent Variable

"Household type" is regarded as a key independent variable of interest, and it is divided into two categories: "single-person household" and "multi-person household." Households that answered "single" to the question of "household type" were classified as single-person households, while those who answered other options were classified as multi-person households. Because the primary goal of this study is to compare the health status of single-person households to that of multi-person households, a dummy variable was assigned: a value of "0" represents multi-person households, and a value of "1" represents single-person households.

Control Variables

The WHO's Social Determinants of Health, such as education, economic status, and employment stability, likely influence health. These related variables were thus included in the regression model. To control for biological and other socioeconomic factors that may influence health status, four control variables were added to the model: "age" (continuous variable), "education" (1 = no education or did not complete high school, 2 = some junior college or completed junior college, 3 = some university or completed university, 4 = graduate degree or higher) and "work status" (0 = unemployed, 1 = employed). Table 1 summarizes these variables.

Table 1. Information of Variables

<table>
<tr><th colspan="3">Variables</th><th>Definition</th></tr>
<tr><td rowspan="4">Dependent Variables</td><td colspan="2">Health Status
(Self-reported)</td><td>0 = Unhealthy
1 = Healthy</td></tr>
<tr><td colspan="2" rowspan="2">Hospital Visit
(Visits to an outpatient clinic)</td><td>1 = 0 times
2 = 1-2 times
3 = 3-6 times
4 = more than 7 times</td></tr>
<tr><td>0 = Less than median
1 = More than median</td></tr>
<tr><td colspan="2">Mental Health
(CES-D Depression)</td><td>0 = Unhealthy (Depression)
1 = Healthy (No Depression)</td></tr>
<tr><td>Main Independent Variables</td><td colspan="2">Household Type</td><td>0 = Multi-person household
1 = Single-person household</td></tr>
<tr><td rowspan="2">Control Variables</td><td rowspan="2">Predisposing Factors</td><td>Age</td><td>Continuous Variable</td></tr>
<tr><td>Education</td><td>1: High school dropout/graduate
2: Junior college enrolled/dropout/graduate
3: University enrolled/dropout/graduate
4: Graduate school or higher (Masters/PhD)</td></tr>
</table>

		Work Status	0 = Unemployed 1 = Employed

Descriptive Statistics

Table 3 summarizes the variable statistics. The total number of data entries used from KoWePS was 50,833, which included 2,854 respondents from single-person households and 47,979 respondents from multi-person households. If a respondent did not answer a particular the question, the relevant variable was coded as "missing," and the data was not included in this analysis by listwise deletion. "Missingness" was assigned to 14 of the "health status" variables, 3,918 of the "mental health" variables, and 536 of the "work status" variables, and they were removed from the data for analysis. Table 2 shows the total number of responses for each variable.

Table 2. Summary Statisitcs

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
Health Status	50819	0.883	0.321	0	1	1	1
Hospital Visits	50833						
... 1	16658	32.8%					
... 2	9252	18.2%					
... 3	13409	26.4%					
... 4	11514	22.7%					
Hospital Visits (Dummy Variable)	50833	0.49	0.5	0	0	1	1
Mental Health (Depression)							
Single-person Household	50833	0.056	0.23	0	0	0	1
Age	50833	30.464	5.844	20	26	36	39
Education	50833						
... 1	15839	31.2%					
... 2	12585	24.8%					
... 3	20607	40.5%					
... 4	1802	3.5%					
Work Status	50297	0.617	0.486	0	0	1	1

4. Methodology

The main purpose of this research is to investigate whether living alone affects young adults' health differently than the health of those who live with others. This study analyzes this question by estimating the health outcome of respondents from single-person households and comparing them with responses from multi-person households. To answer this question, proxies for health outcomes (health status, hospital visits, and mental health) were used on the left side of a regression model as dependent variables. The key independent variable, "Household Type," and the control variables, "Age," "Education," and "Work Status," were used on the right side of the regression equation.

$$HealthStatus_{i,t} = \beta_0 + \beta_1 SinglePersonHouseholdx_{i,t} + \beta_2 Educationx_{i,t} + \beta_3 WorkStatusx_{i,t} + \beta_4 Agex_{i,t} + \alpha_i + \tau_t + \varepsilon_{i,t}$$

Since there are three dependent variables, the left side of the equation was also written as: $Hospital\ Visit_{i,t}$ and $Mental\ Health_{i,t}$, and the right side remains the same as the baseline model shown above.

$HealthStatus_{i,t}$ is the health status outcome of individual i in year t;

$Hospital\ Visit_{i,t}$ is the frequency of visiting an outpatient clinic of individual i in year t;

$Mental\ Health_{i,t}$ is the mental health status of individual i in year t;

$SinglePersonHouseholdx_{i,t}$ denotes whether or not individual i belongs to a single-person household in year t;

α_i represents individual fixed effect;

τ_t represents time fixed effect;

$\varepsilon_{i,t}$ represents the error term.

As the primary model for the study, a two-way fixed effect model was utilized, which removes the omitted variable bias induced by relevant but unobserved time-invariant individual characteristics and time-varying trends for all individuals. The terms α_i and τ_t control for the unobserved but relevant time-invariant individual specific and individual-invariant time specific effect, respectively.

For data analysis, Ordinary Least Squares (OLS) linear regression was used. Since the dependent variables are mostly dichotomous variables, represented by "0" and "1" values, linear probability model was used, and the regression results were interpreted by percentages. OLS linear regression provides a consistent theory and methods with minimal assumptions. OLS is also stable with fixed effect and straightforward to interpret with relatively minimal assumptions.

However, if it is examined by extrapolating outside of the range of "0" and "1," it may have an unintended bias. As such, additional analysis using negative binomial and Poisson regression models are also presented for robustness. In addition, as the number of samples differed greatly between the two household types, it was necessary to consider over-dispersion. Thus the negative binomial regression model was utilized with a generalized linear model (GLM). In addition, because of the minimal likelihood of over-dispersion, the Poisson regression model was also employed for analysis. For example, among the 50,833 sample data entries, there was a large difference in the number of respondents living in different household types: There were 2,854 respondents from single-person households and 47,979 respondents from multi-person households. Therefore, Poisson and negative binomial regression were used in conjunction with OLS regression to account for the bias introduced by the large difference in

the number of observations and to increase the robustness of the regression model. Finally, ordinal logistic regression with fixed effects was used, as the hospital visit categorical variable is an ordered dependent variable. The interpretation of the results referred Baetschmann et al (2019).

5. Results

Health Status

The findings of the regression analysis on reported health status are shown in Table 3. The columns show the various analysis results: OLS regression results without control variables, OLS regression results with control variables, OLS regression results with control variables and fixed effects, Poisson regression results with controls and fixed effects, and negative binomial regression results with controls and fixed effects.

Overall, all five outcomes show consistent results. Living in a single-person household was shown to have a significantly more negative association with an individual's health. In the absence of additional control factors, living in a single-person household may worsen health status by roughly 3% compared to living in a multi-person household, according to the results of OLS regression without control variables. In all other analyses, coefficients of single-person households were -0.05 ($p < 0.001$). There was no evidence of over-dispersion when negative binomial analysis was conducted, indicating that the Poisson regression analysis model and results are reliable. The odds ratios of the Poisson and negative binomial estimates are both 0.95, indicating that there is no significant difference between these and the OLS analysis.

"Work Status" and "Age" are two of the three control variables that demonstrated a statistically significant association with individual health status. Employed people were more likely than unemployed people to have a relatively high health status, and age has a statistically negative association with health status.[1]

[1] The effect of including the age variable to health status is given in Table 3. Since there was an expectation that the effect of age would not increase linearly, regression with Age-square variable was conducted. However, there was no substantive change in results. (Table A2)

Table 3. Health Status Regression Results

	(1) OLS	(2) OLS with Control	(3) OLS with Control (FE)	(4) Poisson (FE)	(5) Negative Binomial (FE)
(Intercept)	0.89***	0.93***			
	(0.00)	(0.01)			
Single Person Household	−0.03***	−0.05***	−0.05***	−0.05***	−0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Education		0.03***	0.00	0.00	0.00
		(0.00)	(0.01)	(0.01)	(0.01)
Work Status		0.05***	0.01**	0.01**	0.01**
		(0.00)	(0.00)	(0.00)	(0.00)
Age		−0.00***	−0.01**	−0.01**	−0.01
		(0.00)	(0.00)	(0.00)	(0.01)
Individual FE	N	N	Y	Y	Y
Year FE	N	N	Y	Y	Y
AIC	28733.30	25809.41	21881.83	115025.16	115029.31
BIC	28759.80	25862.36	105008.67	195020.39	195024.54
Log Likelihood	−14363.65	−12898.71	−1521.92	−48434.58	−48436.66
Deviance	5236.64	4917.72			
Observations	50819	50284	50284	49612	49612
R^2			0.38		
Adj. R^2			0.23		
Sigma			0.28		
pseudo.r.squared				0.02	0.02

Note :*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Hospital Visits

Table 4 presents the findings of ordinal logistic regression with fixed effects for hospital visits with quartile variable classifications. Ordinal logistic regression was used, since there are four categories and the variables are ordered based on the number of hospital visits. The distinction between columns (1) and (2) is whether the method takes the threshold into account. In the case of column (1), only individuals with variation in their dependent variables were useful for fitting the model parameters. Individuals who had only been seen once or who consistently had the same hospital visit numbers throughout time were eliminated by the statistics tool. This criterion was satisfied by 6,811 participants, resulting in 45,770 total observations. People in the estimate sample were observed approximately three times on average. Because the ordered dependent variable contains four categories, three distinct dichotomizations were available. However, because not all dichotomizations resulted in copies

with variations in the binary dependent variable, the final result was 109,025 copies that contribute to the estimate method. In the case of column (2), however, the cutoff point within a probability contribution could shift. As a consequence, even if the ordered dependent variable remained constant, the dichotomized dependent variable with various cutoff points could fluctuate. This brings the total number of individuals in the estimate sample to 7,020 and the total number of observations to 46,281. The estimator contains all of the estimator's contributions as well as three duplicates of each individual with random variation in the cutoff point. As a result, the total number of included copies rose to 526,438.

Data for hospital visits demonstrated that household type and hospital visits were statistically related. The exponentiated coefficients of household type in columns (1) and (2) are both 1.45 ($p < 0.001$), which means that increasing the regressor by one (from multi-person household (0) to single-person household (1)) increases the odds ratio by 1.45 (or 45 percent) for all categories except the first.

Because the "Hospital Visit" variable has four categories and the first infinite threshold/cut "1" is normalized to "0," the result displays the estimates for the second and third thresholds. The difference between thresholds indicates that there is a modest likelihood for marginal differences to rise toward the top. The difference between the first and second is 0.948, while the difference between the second and third is 1.529. It suggests that for low numbers of hospital visits, independent factors have a greater influence on the observed ordered dependent variable than for high numbers of hospital visits.

Table 4. Hospital Visit (4 Quartile) Ordinal Logistic Regression Results

	(1) Hospital Visit	(2) Hospital Visit(with Threshold)
Single Person Household	0.370*** (0.072)	0.375*** (0.073)
Education	-0.086 (0.052)	-0.095 (0.052)
Work Status	-0.026 (0.031)	-0.020 (0.031)
Age	0.055*** (0.004)	0.054*** (0.004)
cut1		0 (.)
cut2		0.948*** (0.014)
cut3		2.477*** (0.021)
N	109025	526438

Note: t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5 displays the findings of a regression analysis based on data transformed from hospital visit factors to dummy variables. Columns (1) through (5) show the OLS regression results without control variables, OLS regression results with control variables, OLS regression results with control variables and fixed effects, Poisson regression results with controls and fixed effects, and negative binomial regression results with control variables and fixed effects. The table contains the findings of the most basic analysis, OLS regression, changes in results by adding control variables, and fixed effect analysis, as well as the results of further Poisson and negative binomial analysis.

All five coefficient outcomes show consistent results in the same direction. Outpatient hospital visits are significantly associated with living in a single-person household. Looking at the OLS findings in columns (1) to (3), living in a single-person household increases the number

of hospital visits by 4% to 7%, compared to living in a multi-person household. In columns (4) and (5), single-person household coefficients in both Poisson and negative binomial are 0.14, which are 1.16 in odds ratio ($p < 0.001$). When negative binomial analysis was performed, there was no indication of over-dispersion, showing that the Poisson regression analysis model and findings are reliable.

The "Age" variable is the only control variable that had a statistically significant and consistent relationship with individual hospital visits other than the main independent variable of interest. Age was found to have a positive correlation with hospital visit as it rises.[2]

Table 5. Hospital Visit (Dummy) Regression Results[3]

	(1) OLS	(2) OLS with Control	(3) OLS with Control(FE)	(4) Poisson (FE)	(5) Negative Binomial (FE)
(Intercept)	0.49***	0.26***			
	(0.00)	(0.01)			
Single Person Household	0.04***	0.05***	0.07***	0.14***	0.14***
	(0.01)	(0.01)	(0.02)	(0.03)	(0.03)
Education		0.00	−0.01	−0.03	−0.03
		(0.00)	(0.01)	(0.02)	(0.02)
Work Status		−0.06***	−0.00	0.00	0.00
		(0.00)	(0.01)	(0.01)	(0.01)
Age		0.01***	0.48***	9.57***	6.83***
		(0.00)	(0.01)	(0.01)	(1.00)
Individual FE	N	N	Y	Y	Y
Year FE	N	N	Y	Y	Y
AIC	73760.66	72478.78	68391.22	86687.94	86689.61
BIC	73787.17	72531.73	151520.49	149288.95	149290.61
Log Likelihood	−36877.33	−36233.39	−24776.61	−36153.97	−36154.80
Deviance	12699.84	12439.11			
Observations	50833	50297	50297	44653	44653
R^2			0.37		
Adj. R^2			0.23		
Sigma			0.44		
pseudo.r.squared				0.08	0.08

Note :*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

[2] The effect of including the age variable to hospital visit is given in Table 5. Since there was an expectation that the effect of age would not increase linearly, regression with Age-square variable was conducted. However, there was no substantive change in results (Table A3).

[3] Even though median is used for standard for dummy variable in the main analysis, the 1st quartile and the 3rd quartile based dummy variable regression are also conducted in a case of different result. The results are consistent with the main result (Table A5).

Mental Health

Table 6 shows the findings of a regression analysis on mental health. Similar to the health status analyses and the hospital visit dummy variable analyses, columns (1) through (5) display the results of the OLS analysis without control variables, the results of the OLS regression with control variables, the results of the OLS regression with control variables and fixed effects, the results of the Poisson regression with control variables and fixed effects, and the results of the negative binomial regression with control variables and fixed effects.

Overall, consistent results were found in all five analyses. Living in a single-person household was found to have a significantly negative impact on individual mental health. In the absence of additional control factors, living in a single-person household could deteriorate mental health by 3% compared to living in a multi-person household, according to the results of OLS analysis without control variables. For all other analyses, coefficients were -0.03 ($p < 0.001$). When negative binomial regression was conducted, there was no evidence of over-dispersion, thus the Poisson regression analysis model and findings are reliable. The odds ratios of the Poisson and negative binomial estimates were both 0.97, indicating no difference from the OLS results.

Regression results of "Work Status" and "Age," among the four control variables, indicated a statistically significant association with individual mental health. Employed people were more likely than unemployed people to have less depression, and there was a negative

correlation between age and mental health.[4]

Table 6. Mental Health Regression Results

	(1) OLS	(2) OLS with Control	(3) OLS with Control(FE)	(4) Poisson (FE)	(5) Negative Binomial (FE)
(Intercept)	0.90***	0.80***			
	(0.00)	(0.01)			
Single Person Household	−0.03***	−0.04***	−0.03***	−0.03***	−0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Education		0.04***	0.01	0.01	0.01
		(0.00)	(0.01)	(0.01)	(0.01)
Work Status		0.04***	0.01*	0.01*	0.01*
		(0.00)	(0.00)	(0.01)	(0.01)
Age		0.00	−0.04***	−0.04***	−0.03
		(0.00)	(0.00)	(0.00)	(0.01)
Individual FE	N	N	Y	Y	Y
Year FE	N	N	Y	Y	Y
AIC	18802.59	18030.15	15725.51	108644.14	108648.12
BIC	18828.86	18082.69	95326.95	185438.63	185442.61
Log Likelihood	−9398.30	−9009.08	1228.25	−45541.07	−45543.06
Deviance	4100.51	4032.99			
Num. obs.	46915	46914	46914	46422	46422
R^2			0.36		
Adj. R^2			0.21		
Sigma			0.26		
pseudo.r.squared				0.02	0.02

Note :*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

4 Similar to health status and hospital visits, there was an expectation that the effect of age to mental health would not increase linearly, thus regression with Age-square variable was conducted. However, there was no substantive change in results (Table A4).

6. Discussion

Missing Data on Mental Health Variable

Within the mental health variable, there were a large amount of missing data points (3,918 missing data points). Though the cause of this missing data is unknown, it is possible that these questions were more emotionally sensitive to participants, and thus less likely to be answered. The number of missing responses is quite large compared to the other variables of health status (14 missing data points) and work status (536 missing data points). Thus, further analysis was conducted to examine the possibility of systematic problems and lack of responses. OLS and binomial regression were used to validate this by turning the response into a dummy variable (missingness = 1, otherwise = 0). Table 7 displays this outcome.

Table 7. Regression Results of Missing Data in Mental Health Variable

	(1) OLS	(2) Logit
(Intercept)	0.22^{***}	-0.34^{**}
	(0.01)	(0.11)
Single Person Household	-0.06^{***}	-3.14^{***}
	(0.00)	(0.35)
Education	0.00^{**}	0.06^{**}
	(0.00)	(0.02)
work Status	-0.03^{***}	-0.37^{***}
	(0.00)	(0.04)
Age	-0.00^{***}	-0.07^{***}
	(0.00)	(0.00)
R^2	0.02	
Adj. R^2	0.02	
Observation	50297	50297
AIC		23568.59
BIC		23612.72
Log Likelihood		−11779.30
Deviance		23558.59

Note :*** $p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Although the estimations in columns (1) and (2) vary, overall findings with comparable tendencies were obtained. A negative sign indicates that these participants were more inclined to answer inquiries about their mental health. Thus, individuals with characteristics such as single-person households, employed, aged were more likely to answer to mental health-related questions. In terms of education level, the results were not statistically significant. This analysis was carried out to perform an extra examination of variables from which a substantial number of missing data are produced, and it is possible that factors other than the relevant variables influenced the reasons for not responding.

More importantly, we could speculate about the direction of the bias due to missingness. Under the condition that single-person household people less likely to be missing, if less mentally healthy multi-person households people responded less, the difference in mental health status evaluated in this study may have been smaller than it actually was. Conversely, if healthier multi-person household people responded less, the difference in mental health status evaluated in this study between single-person households and multi-person households may be bigger than actual.

Survival Analysis of Health Status and Mental Health

To further extend upon this study, Cox proportional hazards analysis was conducted to examine how the variables of health status and mental health changed through time. The Cox proportional hazards model was used to examine the probability of an event if the subject survived up to that particular time point. Since this analysis examines the probability of hazard based on the relativity of health status, no analysis was conducted on the number of hospital

visits.

Table 8 shows the results of this analysis on health status responses. The beta coefficient for single-person household is -0.20 ($p < 0.001$) with and without controls, which indicates that people living in multi-person households had lower risk of negative health status than those who were living in single-person households. The exponentiated coefficient for the estimate -0.20 is 0.82, which indicates that living in a multi-person household reduced the hazard by a factor of 0.82 or 18%.

Table 8. Survival Analysis Results of Health Status Between Single and Multi-Person Households

	Survival Analysis	Survival Analysis with Controls
Single Person Household	-0.20^{***}	-0.20^{***}
	(0.02)	(0.02)
Education		-0.09^{***}
		(0.01)
Work Status		-0.00
		(0.01)
Age		0.01^{***}
		(0.00)
AIC	883581.67	877085.93
R^2	0.00	0.01
Max. R^2	1.00	1.00
Num. events	44887	44632
Num. obs.	50819	50284
Missings	14	549
PH test	0.44	0.00

Note :*** $p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Figure 5 shows the comparison between multi-person households and single-person households of their hazards each year if they survived until that particular year. The graph spans

15 years, reflecting the 15-year data from KoWePS. For the first 2 years, no significant difference appears in the graph. However, after 2 years, the hazard probability of single-person households becomes higher than that of multi-person households, and the gap between them grows each year thereafter. Living alone for more than 2 years, thus, appears to worsen health status compared to living with others. Noticeably, in the fourteenth and fifteenth years, the gap appears to lessen again.

Figure 5. Survival Analysis Results of Health Status Between Single and Multi-Person Households

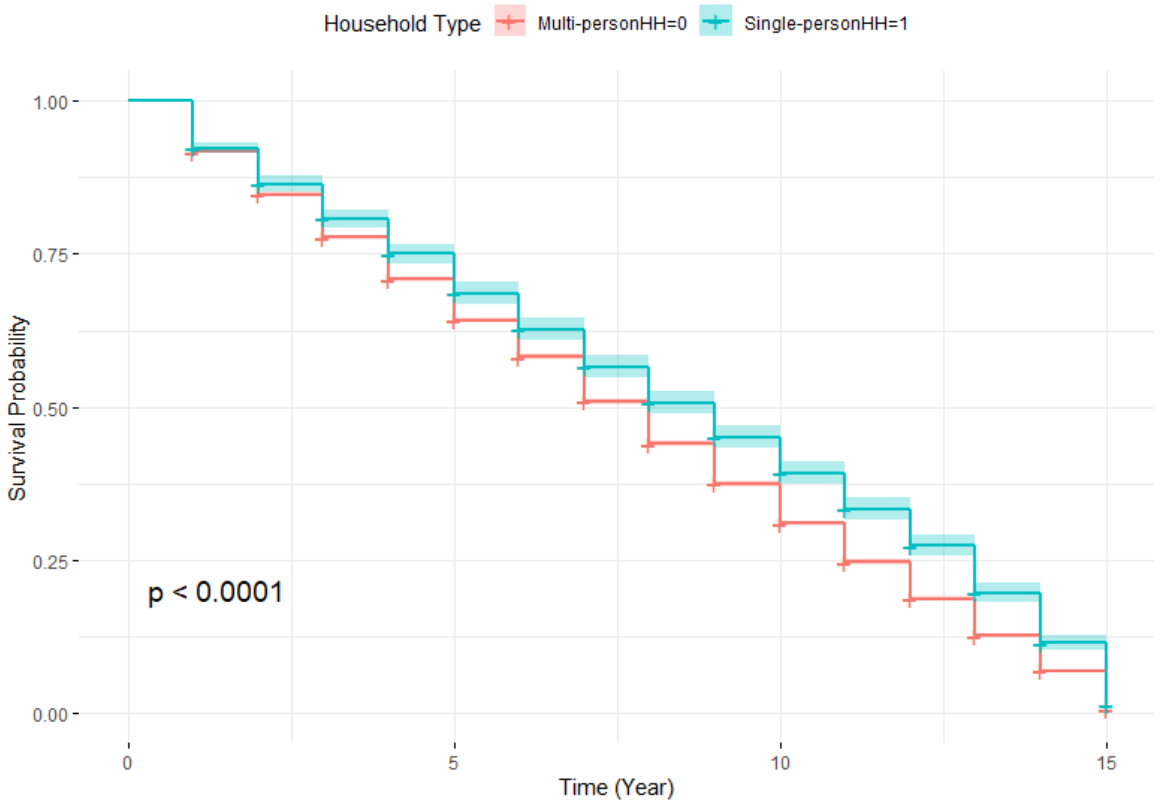


Table 9 shows the results of survival analysis of mental health. The beta coefficients without and with controls are -0.21 and -0.19, respectively. This result indicates that people

living in multi-person households had lower risk of mental health issues and were less likely to be depressed than those who were living in single-person households. The exponentiated coefficient for estimates are 0.81 (19%) without controls and 0.83 (17%) with controls. These results suggest that living in a single-person household increases the possibility of depression by a factor of 0.81 (19%) or 0.83 (17%).

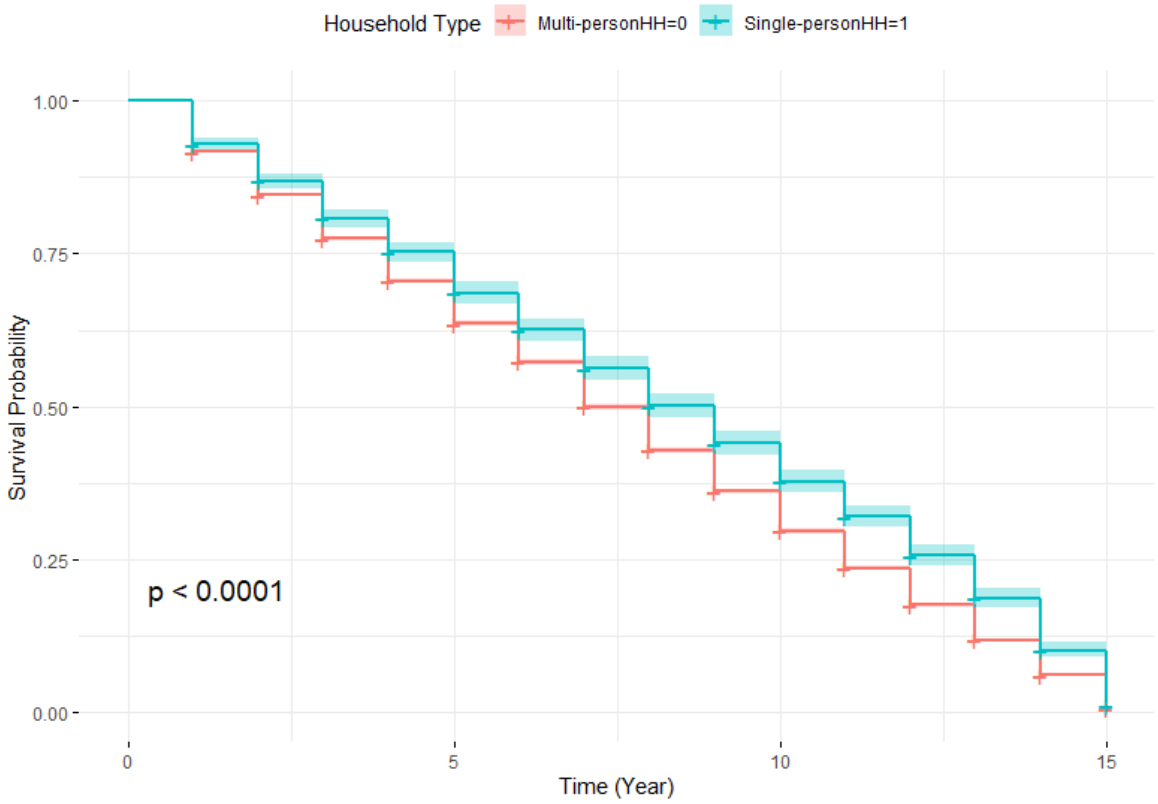
Table 9. Survival Analysis Results of Mental Health Between Single and Multi-Person Households

	Survival Analysis	Survival Analysis with Controls
Single Person Household	-0.21^{***}	-0.19^{***}
	(0.02)	(0.02)
Education		-0.10^{***}
		(0.01)
Work Status		-0.01
		(0.01)
Age		0.01^{***}
		(0.00)
AIC	826163.85	825597.60
R^2	0.00	0.01
Max. R^2	1.00	1.00
Num. events	42373	42373
Num. obs.	46915	46914
Missings	3918	3919
PH test	0.89	0.00

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Figure 6 shows the survival analysis comparison graph of mental health between single and multi-person households. Similar to the graph of health status, people who live in a single-person household have a higher hazard probability of depression compared to those who live in a multi-person household. The gap immediately appears larger than the health status gap, indicating that negative mental health effects of living alone may appear more quickly than negative reported health status.

Figure 6. Survival Analysis Results of Mental Health Between Single and Multi-Person Households



7. Conclusion

This study focuses on the global rise in single-person households and assesses the impact of single-person households on health outcomes in South Korea. Using KoWePS data spanning 15 years, and including 50,833 data entries, this study empirically examines the relationship between household type and health outcomes. Statistical analyses show that living in a single-person household was significantly associated with negative health outcomes. This finding is made robust by controlling individual and year-specific characteristics and mitigating possible endogeneity issues with the fixed effects model.

Health status, outpatient hospital visits, and mental health (depression) were measured as proxies of health outcomes and compared to different household types. The findings indicate that living in a single-person household has a 5% (odds ratio: 0.95) negative influence on a person's reported health status as compared to living in a multi-person household. In the case of outpatient hospital visits, regression results with four categories by quartile and a dummy variable by median were carried out. In the hospital visit regression with four categories, analyses showed that people living in single-person households visit the hospital more frequently than people living in multi-person households. The dummy variable regression result suggested a similar outcome (odds ratio: 1.16): There is a positive association between single-person households and outpatient hospital visits. In terms of mental health, people from single-person households were approximately 3% more likely to be depressed (odds ratio: 0.97) than people from multi-person households.

Additionally, a Cox proportional hazards analysis was performed to evaluate how health status and mental health differed by household type over a 15-year period. The findings suggest that people who lived with others in a multi-person household had a reduced risk of health status

and mental health than those who lived alone. Moreover, the hazard probability disparity between them widened over time.

The overall results indicate that household type can affect health outcomes, as specifically seen with overall health status, number of hospital visits, and mental health. The results make same findings compare to what the literature says about health outcome of young adults in South Korea. This is significant because as the trend of young adults living alone increases, it is possible that worsening health effects may be seen among this population. Therefore, appropriate responses to this phenomenon will be necessary from a public health perspective. This study contributes to existing literature by using statistical analyses to show that there appears to be a negative effect of living in a single-person household on health outcomes among young adults in their 20s and 30s.

This research has its limitations. In this study, there were several variables used to control socioeconomic characteristics: education, employment, and age. However, these factors are limited in truly understanding a person's socioeconomic situation. Adding a variable such as monthly wage could serve as a better control for individual economic factors. Unfortunately, the KoWePS data used in this study only included a monthly wage variable beginning in the eighth data set. Additionally, it would be difficult to use this data point, as the type of employment was not taken into consideration by the KoWePS. These difficulties may be able to be overcome in future studies by incorporating other omitted socioeconomic elements to control variables that might impact health outcome.

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9. Appendix

Figure A1. Korean version of CES-D test with 11 questions

문 8) **(모든 응답자)** 귀하는 **지난 1주일간** 얼마나 자주 다음과 같이 느끼셨습니까?
(※ 조사시점(2020년 조사일 현재)을 기준으로 지난 1주일간에 대해 응답해 주십시오.)

항목	극히 드물다 (일주일에 1일 미만)	가끔 있었다 (일주일에 1~2일간)	종종 있었다 (일주일에 3~4일간)	대부분 그랬다 (일주일에 5일 이상)
㉮ 먹고 싶지 않고 식욕이 없다.	①	②	③	④
㉯ 비교적 잘 지냈다.	①	②	③	④
㉰ 상당히 우울했다.	①	②	③	④
㉱ 모든 일들이 힘들게 느껴졌다.	①	②	③	④
㉲ 잠을 설쳤다.(잠을 잘 이루지 못했다.)	①	②	③	④
㉳ 세상에 홀로 있는 듯한 외로움을 느꼈다.	①	②	③	④
㉴ 큰 불만 없이 생활했다.	①	②	③	④
㉵ 사람들이 나에게 차갑게 대하는 것 같았다.	①	②	③	④
㉶ 마음이 슬펐다.	①	②	③	④
㉷ 사람들이 나를 싫어하는 것 같았다.	①	②	③	④
㉸ 도무지 뭘 해 나갈 엄두가 나지 않았다.	①	②	③	④

Table A1. Korean CES-D test that translated in English (Figure A1)

Questions
I did not have an appetite
I felt that I was just as good as other people
I felt depressed
I felt that everything was difficult
My sleep was restless
I felt lonely, as if I were left all alone
I had no major complaints
I felt everyone was cold to me
I felt sad
I felt people disliked me
I could not get “going”

Table A2. Health Status Regression Result with Age-square variable

	(1) OLS	(2) OLS with Control	(3) OLS with Control (FE)	(4) Poisson (FE)	(5) Negative Binomial (FE)
(Intercept)	0.89***	0.87***			
	(0.00)	(0.04)			
Single Person Household	−0.03***	−0.05***	−0.05***	−0.05***	−0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Education		0.03***	0.00	0.00	0.00
		(0.00)	(0.01)	(0.01)	(0.01)
Work Status		0.05***	0.01**	0.01**	0.01**
		(0.00)	(0.00)	(0.00)	(0.00)
Age		0.00	−0.02*	−0.02*	−0.01
		(0.00)	(0.01)	(0.01)	(0.01)
Age^2		−0.00	0.00	0.00	0.00
		(0.00)	(0.00)	(0.00)	(0.00)
Individual FE	N	N	Y	Y	Y
Year FE	N	N	Y	Y	Y
AIC	28733.30	25808.80	21883.44	115027.13	115031.28
BIC	28759.80	25870.58	105019.10	195031.17	195035.32
Log Likelihood	−14363.65	−12897.40	−1521.72	−48434.57	−48436.64
Deviance	5236.64	4917.46			
Observations	50819	50284	50284	49612	49612
R^2			0.38		
Adj. R^2			0.23		
Sigma			0.28		
pseudo.r.squared				0.02	0.02

Note :*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Table A2 is result of health status regression including Age-square variable. The overall results are consistent with results without Age-square variable. The consistency of results without Age-square variable are the same in Hospital Visit (dummy) and Mental Health regression (Table A3 and A4).

Table A3. Hospital Visit (dummy) Regression Result with Age-square variable

	(1) OLS	(2) OLS with Control	(3) OLS with Control(FE)	(4) Poisson (FE)	(5) Negative Binomial (FE)
(Intercept)	0.49***	0.12			
	(0.00)	(0.07)			
Single Person Household	0.04***	0.05***	0.07***	0.14***	0.14***
	(0.01)	(0.01)	(0.02)	(0.03)	(0.03)
Education		0.00	−0.02	−0.03	−0.03
		(0.00)	(0.01)	(0.02)	(0.02)
Work Status		−0.06***	−0.00	−0.00	−0.00
		(0.00)	(0.01)	(0.01)	(0.01)
Age		0.02***	0.50***	9.63***	5.44***
		(0.00)	(0.01)	(0.02)	(1.00)
Age^2		−0.00*	−0.00*	−0.00**	−0.00**
		(0.00)	(0.00)	(0.00)	(0.00)
Individual FE	N	N	Y	Y	Y
Year FE	N	N	Y	Y	Y
AIC	73760.66	72476.13	68385.10	86684.91	86686.58
BIC	73787.17	72537.91	151523.21	149294.62	149296.29
Log Likelihood	−36877.33	−36231.07	−24772.55	−36151.45	−36152.29
Deviance	12699.84	12437.96			
Observations	50833	50297	50297	44653	44653
R^2			0.37		
Adj. R^2			0.23		
Sigma			0.44		
pseudo.r.squared				0.08	0.08

Note :*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Table A4. Mental Health Regression Result with Age-square variable

	(1) OLS	(2) OLS with Control	(3) OLS with Control(FE)	(4) Poisson (FE)	(5) Negative Binomial (FE)
(Intercept)	0.90***	0.97***			
	(0.00)	(0.04)			
Single Person Household	−0.03***	−0.04***	−0.03**	−0.03**	−0.03**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Education		0.04***	0.01	0.02	0.02
		(0.00)	(0.01)	(0.01)	(0.01)
Work Status		0.04***	0.01*	0.01*	0.01*
		(0.00)	(0.00)	(0.01)	(0.01)
Age		−0.01***	−0.05***	−0.05***	−0.03
		(0.00)	(0.01)	(0.01)	(0.02)
Age^2		0.00***	0.00	0.00	0.00
		(0.00)	(0.00)	(0.00)	(0.00)
Individual FE	N	N	Y	Y	Y
Year FE	N	N	Y	Y	Y
AIC	18802.59	18013.48	15721.60	108645.82	108649.80
BIC	18828.86	18074.77	95331.80	185449.05	185453.03
Log Likelihood	−9398.30	−8999.74	1231.20	−45540.91	−45542.90
Deviance	4100.51	4031.38			
Observations	46915	46914	46914	46422	46422
R^2			0.36		
Adj. R^2			0.21		
Sigma			0.26		
pseudo.r.squared				0.02	0.02

Note :*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Table A5. Hospital Visit (dummy variable) Regression Results Generated by Different Criteria (1st and 3rd quartile)

	OLS at the 1st QR	Poisson at the 1st QR	OLS at the 3rd QR	Poisson at the 3rd QR
Single Person Household	0.09***	0.14***	0.04**	0.17**
	(0.02)	(0.02)	(0.01)	(0.06)
Education	−0.02	−0.03	−0.01	−0.04
	(0.01)	(0.02)	(0.01)	(0.04)
Work Status	0.01	0.02	−0.02***	−0.08**
	(0.01)	(0.01)	(0.01)	(0.03)
Age	−0.19***	−0.21***	0.16***	9.48***
	(0.01)	(0.01)	(0.01)	(0.03)
R^2	0.37		0.35	
Adj. R^2	0.22		0.21	
within.r.squared	0.00		0.00	
Sigma	0.42		0.37	
nobs	50297	48037	50297	32691
AIC	62725.38	102997.98	51524.59	51095.07
BIC	145854.65	175237.57	134653.86	90290.65
Log Likelihood	−21943.69	−43270.99	−16343.29	−20878.53
pseudo.r.squared		0.05		0.10

Note : The variable 'female' has been removed because of collinearity $^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

This table shows the results of the 1st and 3rd quartile based Hospital Visit dummy variable regression. Additional analysis was performed considering the direction of the results or inconsistent results as the criteria change. The results of Table A5 are consistent with the main result (Table 5)