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RETIREMENT AND MENTAL HEALTH: UNDERSTANDING THE PATHWAYS

This thesis examines the pathways through which retirement affects mental health, using data from the American Health and Retirement Study and the Consumption and Activities Mail Survey. I conduct both a classical and causal mediation analysis for several mediators, and I find that physical disease, household income and receiving Medicare benefits have a significant mediating effect in the retirement – mental health relationship. These effects are characterized by heterogeneity, with varying effects over several subgroups of the sample.
This thesis supports the multi-pathway nature of the retirement transition, emphasizing the importance of understanding the pathways through which retirement affects mental health.

Name student: Thijs Oostdijk

Student ID number: 533486

Supervisor: Dr. C.J. Riumallo Herl

Second assessor:

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1. Introduction

Retirement is a big milestone in the lives of elderly people. Whether someone retires completely or only partially, a big time gap will arise in their lives, which can be filled with whatever activity possible. Currently, according to Statista (2023), around 10% of the world population is at a legal retirement age of 64 years and older. In the United States of America, this proportion is even larger, with 16.8% of the population being at a legal retirement age in 2021 (US Census Bureau, 2023). According to the United Nations (2022), the share of elderly population, relative to younger generations, will only increase in the future, increasing the burden of the old age dependency ratio that we already experience.

This increasing ratio comes with several worries, such as how to finance the pensions of these retirees, as well as how to fill the gaps these retirees leave in the labour force (Forbes, 2021). Another issue that arises is the increased demand of care that this increased old age dependency ratio will induce. In the USA, a relatively large share of the top medical spenders is aged 65 years or older. According to Statista (2022), in the top 5% and top 10% percentiles of healthcare expenditures, around 40% is accounted for by the 65+ age group. Furthermore, the whole elderly age group grossed a total amount of around 1.2 trillion dollars in medical expenditures, which adds up to around 35% of the total medical expenditures in 2020 (Centers for Medicare & Medicaid Services, 2020).

With the increase of the old age dependency ratio, the health of elderly people becomes increasingly more important. More elderly people lead to more pressure on the healthcare systems. This will then lead to more pressure on the labor market, via less available workers, as well via the need for more informal care.

Retirement is a big, life changing transition through which all these elderly people go through. It is therefore important to understand what effect this transition has for an individual's health. Retirement is not just a phase of leisure and relaxation. It is also associated with several challenges, such as financial adjustment, the rediscovery of someone's identity and the changes in social roles. For example, the loss of a daily work routine can lead to feelings of isolation and boredom, as well as that more financial insecurity can lead to experiencing more stress, both affecting people's mental health (Weiss, 2005).

The relationship between retirement and health does not only affect people on a personal level, but has also implications for public policy, social welfare programs, healthcare services, etc. By researching the effect of retirement on health, we enable policymakers to develop strategies to better support individuals during their retirement transition, as well as to minimize the negative social effects that retirement might have.

A large aspect of the societal burden of health problems is caused by mental health issues. Oliva-

Moreno et al. (2008) find that reduced mental health does not only have an effect on medical expenditures, but also make a considerable economic impact from a societal perspective. They estimate that in 2002, the total costs of reduced mental health in Spain totalled to around 7,019 million euros, of which almost half was borne by society in terms of reduced labour productivity. The other half was borne by the medical sector, with significant expenses in both formal and informal healthcare services. Furthermore, Sabatini (2014) showed that mental health has a strong correlation with perceived health, using quality of friendships and social trust as instrumental variables. They control for various social and economic factors, resulting to happiness as being a significant determinant of good health. This implies that mental health problems do not only induce direct costs for society and the medical sector, but that it also induces indirect costs through reduced physical health.

Mental health is therefore a significant driver of economic costs and it is important to understand how it is affected. The current literature on the relationship between retirement and mental health is quite inconclusive. There are many papers written on the topic, but these do not all draw unified conclusions on what the effect of retirement on mental health is. For example, Latif (2011) finds positive effects of retirement on mental health status. This applies for all participants, except for very early retirees, retiring between the ages of 45 and 54. For this group, no effect was found. Picchio and Van Ours (2020) also find a positive effect of retirement on mental health, but only for partnered men. The mental health of women and single men is not impacted in their study. Dave et al. (2008), however, find the exact opposite effect. Using data from the United States, they find that for fully retired individuals, mental health status decreases by six to nine percent. The effects are smaller for married individuals, as well as for individuals who engage in a lot of physical activity or who continue to work part-time after retirement. Kim and Moen (2002) find that retirement is related to an increase in depression symptoms, but they suggest that it is important to take various resources and contexts regarding retirement transitions into account, since the relationship between retirement and mental health is likely to be highly heterogenic. Luhmann et al. (2012) find similar results, where retirement has an initial negative effect on cognitive well-being measures such as life satisfaction, but no effect on affective well-being measures such as happiness. They show that the way well-being is measured is a crucial element. This is also confirmed by Henning et al. (2016). In their literature review, they show that studies on retirement and well-being typically use depressive symptoms, happiness or life satisfaction as well-being outcome, and that results vary among different measures. Furthermore, they conclude that most retirees maintain their level of well-being over retirement, although evidence for substantial heterogeneity and dynamic effects has been provided in several studies. Examples of that drive this heterogeneity are socioeconomic status, gender, age at retirement, health, former unemployment and marital status (Pinquart & Schindler, 2007).

Wang and Shi (2014) provide a review of both theoretical developments and empirical findings in research on retirement in the psychology literature. Using American data on health and retirement and a growth mixture modeling technique, Wang (2007) found that around 70% of retirees experience minimal change in phycological well-being. Around 25% of retirees experience a negative change during the retirement transition but show improvements afterwards and the remaining 5% of retirees experience a positive well-being effect. A similar research has been conducted in Germany by Pinquart and Schindler (2007), where around 75% of the retirees do not experience change, 9% suffer a decrease in phycological well-being but recover later and 15% experience an increase in well-being.

While the relationship between retirement and mental health has been researched quite intensively, the underlying mechanisms and pathways remain less explored. There are papers that touch on the subject of potential mediators, such as Henning et al. (2016) and Tran and Zikos (2019). The main focus of these papers lay, however, on other aspects of retirement and health, and the potential pathways are no more than a small contribution to it.
To truly understand the effects of retirement on health, we need to understand the processes that mediate this relationship. This is important for several reasons.
Firstly, identifying specific mechanisms through which retirement affects mental health can provide guidance for the development of interventions and programs that mitigates the negative impacts of retirement and enhances the positive impacts. For example, understanding how social engagement after retirement affects mental health can shape a program that boosts well-being during retirement.
Secondly, understanding the pathways can help shaping retirement planning and preparations when people approach their retirement age. Understanding the factors that can potentially lead to negative well-being in retirement gives individuals the tools to prevent these factors from influencing their mental health, especially in collaboration with retirement planners and the healthcare sector.
Finally, it is important for policymakers to understand through which pathways retirement affect mental health in order to create evidence-based policies, supporting the mental health of retirees and ensuring a smooth transition into retirement.

To my knowledge, only one paper has researched the possible mechanisms through which retirement affects health, using a formal mediation analysis. Tran and Zikos (2019) use data from 14 different waves of the HILDA survey, which is the Australian equivalent to the American Health and Retirement Study. They found that physical activity, social contact, household errands, housework and outdoor tasks are significant mediators in this relationship. However, as I mentioned before, the goal of this paper was not based on the mediation analysis, but rather on providing causal evidence of the relationship between retirement and health. They do not offer a comprehensive methodology section on their mediation analysis and therefore their mediation analysis method remains unclear. Thus,

solid conclusions on mediation effects cannot be drawn from this research.

By reviewing the retirement literature in psychology, Wang and Shi (2014) also provide some insights into the mediating effects in the retirement – mental health relationship. They conclude that the current literature supports the multiple-pathway nature of retirement transition and adjustment, which suggests that a retiree's well-being does not follow a uniform pattern of transition and adjustment, but rather that this pattern can differ per individual. They find that mental health in retirement depends on financial planning preretirement and financial satisfaction. Furthermore, preretirement health is a predictor of postretirement health, as is the quality and accessibility of postretirement health care instances.

Hershey et al. (2007) found that broader circumstances also play a role in retirement decisions. They compared financial planning for near-future retirees in the USA and the Netherlands and found that Dutch workers engage less in retirement planning, mostly due to the fact that they were covered by guaranteed and defined benefit pension plans, whereas the pension plans in the USA were mostly volatile and uncertain. Another difference in the USA is the universal Medicare coverage for people of ages 65 and older. French and Jones (2011) found that a raise in the Medicare eligibility age would lead to a delay in retirement for many elderly workers, especially for employees for who's employer health insurance would terminate after retirement.

The multiple-pathway nature of retirement transition and adjustment also implies that the effects of retirement on mental health are of a heterogenic nature. Wang and Shi (2014) find that married retirees usually experience better well-being than divorced or widowed ones, just as that happier marriages result in improved well-being as well. Attitudes towards retirement also tend to differ per gender, where men are more likely to save more for retirement, as well as to invest in more aggressive financial mechanisms, often leading to an increased financial well-being after retirement. Another important demographic factor that is related to postretirement well-being is education. Highly educated people usually have more capacity and options to maintain their life patterns due to their professional knowledge and skillsets. They are for example more likely to engage in bridge employment (gradually retiring), which leads to a smaller shock in postretirement well-being (Kim & DeVaney, 2005). This also relates to income, where individuals with higher income tend to engage more in formal and informal retirement planning, which can improve retirement satisfaction. Furthermore, individuals with higher income will tend to voluntarily retire sooner, since they have the resources to afford that without facing an impact on their financial well-being (Shultz & Adams, 2018).

This thesis will try to identify the pathways through which retirement affects mental health and define the heterogenic factors underneath it. The current literature on the relationship between retirement and mental health lacks thorough research on the pathways through which retirement affects mental health, and formal mediation analyses have not yet been used correctly to study these pathways. I will estimate the effect of retirement on mental health, and will study through which pathways this effect works. I do this using both the classical and causal approaches of a mediation analysis, using physical disease, physical activity, social support, household income, leisure activity and Medicare benefits as potential mediators, while also exploring heterogenic factors in the mediating relationships. I use longitudinal data from the Health and Retirement Survey and the Consumption and Activities Mail Survey, which provides data on a representative sample of elderly individuals in the United States. The research question and sub question I aim to answer is:

"Through which pathways does retirement affect mental health?"

"What are the key heterogenic factors that influence these effects?"

I find significant mediating effects in the retirement – mental health relationship for physical disease, household income and Medicare benefits, but no significant effects for the physical activity, leisure activity and social support mediators. Furthermore, results prove to be highly heterogenic, supporting the multi-pathway nature that the effect of retirement has on mental health. Some concerns about biased results, however, indicate that these findings should be interpreted with caution.

The remainder of this thesis is organized as follows. In Section 2, the theoretical framework is presented. Section 3 describes the data and methodology and Section 4 present the obtained results of the mediation analyses. Section 5 presents the heterogeneity analyses that are conducted, whereas Section 6 discusses the obtained results of Sections 4 and 5. Lastly, section 7 will conclude this thesis.

2. Theoretical framework

Elder (1994) developed a sociological framework, which aims to understand human development and life experiences across an individual's entire life span. This is the life course perspective theory, which emphasizes the importance of social structures, historical context and individual agency in shaping life trajectories and outcomes. Elder states that someone's life course is not just a collection of individual life events and transitions, but something that is socially constructed and influenced by the broader societal, cultural and historical context of someone's life. The timing of events can therefore be pivotal for someone's life trajectory and well-being. For example, marriage, parenthood and retirement are big events in the course of someone's life, and they can highly influence the paths and choices someone takes. People's lives are interconnected with one another. Family and friends play big roles in shaping someone's life, and life changing decisions or events can highly depend on the people around you. Furthermore, decisions in live accumulate over time. If someone gains an advantage or disadvantage over the course of their life, this will accumulate into bigger advantages or disadvantages when life progresses. Evidence that supports this is found by Wang and Shi (2014), who found that engaging in preretirement planning has a significant positive effect on someone's well-being in retirement. In other words, when someone creates an advantage by engaging in preretirement planning, this advantage will accumulate over time and will be experienced as improved well-being postretirement.

Another theory that predicts mental health outcomes after retirement is the role theory, as introduced by Turner (1962). This theory posits that the role that an individual plays in society shapes their behaviour, expectations and identity. Roles are associated with specific functions, rights, duties and expectations and can be formal, such as a job title, or informal, such as a being a parent. Role theory states that individuals become attached to their societal roles, and that this attachment plays a significant role in shaping their identity. When someone retires, this also means they lose the role of their job title. According to the role theory, the loss of a role means losing a part of your identity, leading to a decreased well-being after retirement.

Opposed to the role theory stands the continuity theory by Atchley (1971). Atchley proposes that work is not as crucial for our identity as the role theory implies. Rather, identity is formed out of multiple sources. Even though the job-related part of your social role is lost after retirement, other sources of your identity remain, such as family and social networks. Furthermore, people want to maintain continuity over their life. In the transition to retirement, individuals do therefore not stop to see themselves as their working self, but rather try to take the important aspects of their former work into their life postretirement. The level of postretirement well-being is maintained if enough of these

aspects can be transferred into new activities in retirement. According to the continuity theory, therefore, retirement should not have to lead to a change in well-being.

The stress process model of Pearlin et al. (1981) can also explain certain pathways through which retirement affects mental health. This model is used to understand how stressors, social support and coping mechanisms interact to influence someone's mental well-being. Retirement can cause a wide range of stressors, such as financial concerns and changes in daily routines. These stressors are then likely to contribute to changes in mental health. This can be mitigated through the use of coping mechanisms. Effective coping mechanisms, such as engaging in social interactions or developing new routines, can prevent the negative effect of the stressors and help maintain well-being. An important factor in this model is social support. When someone has a strong social support network in friends, family and their wider community, this network can provide emotional and instrumental support during the transition in life than causes stress, i.e., retirement. Good social support can mitigate the negative effect of the stressors, leading to better mental health outcomes. Evidence that supports this theory was found by Chen and Feeley (2013), who found that increasing someone's social support after retirement directly and indirectly improves mental health.
Another theory regarding stress is the stress and coping theory, developed by Lazarus and Folkman (1984). They see stress not just as a product of external stressors, but also as something which is influenced by someone's cognitive functioning and coping strategies. According to this theory, an individual appraises an event of situation that has the potential to be a stressor. Depending on this appraisal, a stressor can be perceived as a potential harm. If this is the case, the individual will assess their ability to cope with the stressor. If the individual concludes that they do not have the resources and capability to cope effectively, they will experience stress. The experienced stress and coping results can lead to various outcomes. Effective coping may lead to reduced stress and improved well-being, while failing to cope may lead to increased stress and decreased well-being. This theory therefore suggests that someone's ability to cope with stress might mediate the effect of retirement on mental health. When someone engages in, for example, more leisure activities or social support, they might experience less stress due to the coping mechanisms that are usually behind these activities.

Another model that emphasizes the importance of social support is the social convoy model by Antonucci (1985). In this model, a social convoy represents an individual's social network and the impact this network has on their well-being. The model recognizes that the composition and strength of the social convoy changes over time. Relationships can enter, exit or evolve, reflecting transitions, life events and the changing needs of the individual. The convoy of an individual often consists of a core, which is built up out of close relationships such as with family and friends, and a peripheral,

which is built up out of people who play a less central, but still important role, such as colleagues. The convoy of a person can provide support during times of transition or crisis, mitigating the effects that this transition or crisis might have on someone's well-being. This model sees social support as a key source of emotional and practical support, and suggests that the factor social support is likely to be a mediator in the retirement – mental health relationship, due to its effect on well-being.

Another theory that predicts the mediators in the retirement – mental health relationship is researched by Adams et al. (2010), who provided a critical review on the literature on the activity theory of ageing. This theory suggests that staying socially and mentally active contributes to a higher quality of life and well-being as individuals grow older. Adams et al. (2010) find that social, leisure and productive activities all have a significant effect on mental well-being of older adults. This is in line with the activity theory of ageing, which states that activity is central to the ageing process. Engaging in a variety of activities, both mentally and physically, leads to maintaining a sense of purpose, social connections and overall well-being later in life. The theory follows the continuity theory of Atchley (1971), as continuity in societal roles also implies continuity in activities that someone enjoys throughout his life. Being physically and mentally active stimulates social engagement, as well as the cognitive functioning of the brain and the physical fitness. This theory is also interconnected with the stress process model. Maintaining physical health prevents the arising of stressors such as physical limitations or the need of healthcare. Furthermore, engaging in more activity can act as a coping mechanism, mitigating the effect that other stressors can have on someone's mental health. The activity theory of ageing therefore suggests that engaging in more physical and leisure activities mediate the effect that retirement has on mental health.

Another aspect that predicts a mediating relationship in the retirement – mental health relationship is illustrated by the health selection theory (Moen & Chermack, 2005). This theory explores the relationship between someone's health and their social and economic status. It suggests that someone's health can influence their life choices, opportunities and social outcomes. Healthier individuals are likely to have better access to education, employment and social resources than those with worse health. This selection effect is caused by both biological and behavioural mechanisms. For example, people with better health have more energy to perform well at school or at work than people with chronic illnesses. Following the life course perspective, health selection can occur at different stages in someone's life, as well as that health disadvantages accumulate over time. For example, when a child drops out of education due to his or her poor health, this disadvantage will accumulate over time and result in poorer job opportunities later in life. The same applies to adults who drops out of the job market due to bad health. This can, for example, accumulate to financial issues in retirement due to not having built enough pension money. Health issues can therefore be a

distinct mediator in the retirement – mental health relationship.

This theory relates closely with the social determinants of health (Wilkinson & Marmot, 2003). These are the conditions in which people are born, live and age and the broader set of factors that influence someone's life. These include, among others, social and economic factors, physical environment, access to healthcare, social support, individual health behaviours, education, employment, culture and early childhood experiences. This therefore suggests that many aspects in life can affect someone's health. Affecting health through any of these factors might therefore also act as a mediator in the retirement – mental health relationship.

This theoretical framework provides a foundation on understanding of how various factors, such as social roles, coping mechanisms, social support and health, can mediate the relationship between retirement and health. In the following section, I will describe the data that I use to analyse these relationship, and I formulate hypotheses on the effect of various mediators in the retirement – mental health relationship.

3. Data & Methodology

3.1 Data

I use data from the Health and Retirement Study (HRS) and the Consumption and Activities Mail Survey (CAMS). I use these datasets because they provide information on various potential mediating factors in the retirement – mental health relationship, as well as containing many observations for a representative sample of American citizens. The choice of which mediators to research is based on the literature and the available data in these datasets. These choices will be discussed in section 3.2. Both the datasets used are products of the University of Michigan and are sponsored by the National Institute of Ageing (NIA). Both surveys are conducted by the Institute for Social Research (ISR) at the University of Michigan.

The HRS is a longitudinal survey of a representative sample of over 20,000 US citizens aged fifty or older, conducted once every two years. The sample is based on a multistage area probability design with geographic stratification and clustering and oversampling of African-American and Hispanic individuals (Sonnega et al., 2021). The survey involves conducting a detailed interview, typically taking about two to three hours. Since 2006, half of the interviews are conducted face-to-face, whereas the other half of the interviews are conducted by telephone. Since 2018, the survey has also been conducted online, as alternative to the telephone survey. The collected data contains personal information on a large range of topics, with data on demographics, health, health insurance, social security, pensions, family structure, retirement plans, retirement expectations, employment history, income, assets and medical expenditures (RAND, 2021). Currently, the HRS consists out of 15 biannual waves of data, where the first wave of the survey was conducted in 1992 and the last available wave in 2020.

The CAMS is a longitudinal survey of which the first wave was conducted in 2001. The sample in 2001 consisted of 5,000 randomly selected individuals who participated in the HRS 2000 survey. In later waves, the sample consisted of individuals who participated in the last CAMS survey and were not yet omitted from the HRS database, complemented with a random subset of new participants, again randomly selected from participants of the previous HRS survey. The survey is distributed to the participants via e-mail and participants individually fill out the survey at home. The survey consists of three parts, where the first part contains data on the activities of the participant, such as the weekly time spent on watching tv or doing house chores. The second part contains data on the actual spendings of the participants, varying in over 30 categories, among which changes in spending after retirement. The last part contains data on the current labour force status and other demographics of the participant (RAND, 2020). Participants received either the full questionnaire containing all three parts or a partial questionnaire containing only the first part on activities. Currently, the CAMS consist

of 10 biannual waves, with the first wave conducted in 2001 and the last available wave conducted in 2019.

3.2 Variables

3.2.1 Dependent variable

In this thesis, the main variable of interest is someone's mental health. The HRS and CAMS datasets do not contain a defined 'mental health' variable, but the HRS dataset does include a variable called the CESD-score. The CESD-scale is designed by the Center of Epidemiologic Studies and is used as an indicator for depressive symptoms. In research by Radloff (1977), the scale was proven to have very high internal consistency and concluded to be a valid scale to assess someone's mental health. In this research, the CESD-scale varies between a score of zero and eight, where zero means the best mental health and eight means the worst mental health. This score is calculated by the sum of six negative indicators plus the inverse of two positive indicators (one minus the variable value), where the negative indicators include whether the respondent experienced the following feelings all or most of the time in the week prior to the interview: 'depression', 'everything feels like an effort', 'restless sleep', 'felt alone', 'felt sad' and 'could not get going'. These take value one when the respondent experienced the feeling and zero otherwise. The positive indicators included 'felt happy' and 'enjoyed life'. For example, if a person experienced four of the negative indicators and only one of the positive indicators, his/her CESD score would add up to a value of five.

3.2.2 Retirement variable

In order to conduct an analysis of the effect of retirement on mental health, a variable that represents retirement is also needed. Both the CAMS and the HRS datasets contain such a variable. In the CAMS dataset, the variable can take value zero if not retired and value one if retired. In the HRS dataset, the variable can take value zero if not retired, value one if completely retired and value two if partly retired. Unfortunately, this means that individuals can give different answers on their retirement status in both surveys. I have chosen to use the HRS retirement variable as the independent variable for my analysis. In contrast to the CAMS survey, the HRS survey includes follow-up questions about retirement status. This reduces the potential confusion in a respondent's answer, making this the more reliable variable for someone's retirement status. Furthermore, this variable is more detailed in the answer someone can give, allowing me to test if there is a difference in mediating effects for complete retirement and partial retirement.

3.2.3 Mediators

As outlined in section 2 of this thesis, several factors have theoretical bases as potential mediators in the retirement – mental health relationship. Firstly, based on the life course perspective, the advantages or disadvantages accumulated before retirement should act as a mediator in the retirement – mental health relationship. However, acquiring data on the advantages and disadvantages accumulated in someone's life is challenging. Whether something serves as an advantage or disadvantage that accumulates over time is hard to determine, and factors like retirement planning, which is likely to be an advantage that accumulates over time, are not included in the HRS or CAMS data. This is therefore not a mediator I can test for, so the mediating effect of accumulated advantages and disadvantages over someone's life falls outside the scope of this thesis. This also applies to the potential loss of someone's social role after retirement. Role theory suggests that the transition to retirement may lead to a decrease in mental health due to identity loss. However, quantifying this relationship is challenging and the HRS and CAMS datasets do not include information on this phenomenon. The mediating effect of someone's potential identity loss postretirement therefore also falls outside the scope of this thesis.

I do have data on social support, which is theorised to be another mediator in the relationship between retirement and mental health. The stress process model, as well as the stress and coping theory and the social convoy model, all suggest that social support is crucial in the relationship between retirement and mental health. Both the HRS and CAMS dataset do not contain a specific variable that quantifies someone's social support network, but the CAMS dataset does contain variables on weekly time use on various activities. Of these activities, several can be seen as social support activities. Summing the weekly hours spent on these activities creates the variable weekly hours spent on social support activities. I use the following activities as social support activities: weekly hours spent on 'visiting someone in-person', 'communicating via phone or social media', 'caring for pets', 'physically showing affection', 'helping others', 'religious attendance' and 'attending meetings of clubs'. These use of these activities are based on the work of Kelly et al. (2017), who use similar activities as social activities in their research.

The dataset also contains a variable hours spent 'taking care of grandkids', but this variable only contains information for two waves in total. Using this variable would reduce the number of observations for the social support variable with more than 80%. This would greatly reduce the power of my analysis, which is the reason why I do not use this variable in the calculation of someone's time spent on social support activities. Based on my data and the stress process model, the stress and coping theory and the social convoy model, I hypothesize that the weekly hours spent

on social support activities has a significant mediating effect in the retirement – mental health relationship.

The stress process model and the stress and coping theory also suggest that factors that serve as stressors mediate the relationship between retirement and health. Essentially everything can be seen as a potential stressor, since whether something is experienced as a stressor can differ per individual. There are, however, several universal stressors which are likely to be experienced by most retirees. The first of these is financial concern. When someone retires, he/she will lose the steady income that came with his/her job. For many retirees, this leads to an income shock, reducing their income significantly after retirement. This is likely to induce stress, which in its place is likely to affect mental health. I will therefore use household income as a potential mediator in the retirement – mental health relationship. The HRS dataset contains a variable which denotes the yearly household income in dollars. Based on the data, the stress process model and the stress and coping theory, I hypothesize that household income has a significant mediating effect in the retirement – mental health relationship. Furthermore, I expect that these effects are driven by the low income share of the population. I therefore hypothesize that the value of household assets is a factor of heterogeneity in the mediation effect of household income, yielding significant effects only for the lower income group.

Another interesting stressor to explore is whether someone receive Medicare benefits. This can be considered not as a stressor, but rather as a solution to a stressor. In the United States, it is not a given that someone is sufficiently covered by their healthcare insurance. This is something that can induce a lot of stress, since receiving healthcare services could lead to catastrophic financial consequences. However, when someone turns 65, they automatically become eligible to receive Medicare benefits, effectively alleviating the potential stressor of inadequate healthcare coverage for this specific group of people. The HRS dataset contains a dummy variable on whether someone receives Medicare benefits or not. Based on the data and the stress process model and the stress and coping theory, I hypothesize that receiving Medicare benefits has a significant effect in the retirement – mental health relationship. Furthermore, I expect that yearly out-of-pocket medical expenses is a source of heterogeneity in the mediating effect of receiving Medicare benefits. Individuals with higher out-of-pocket medical expenses experience a larger increase in their disposable income due to the receiving of Medicare benefits. I therefore hypothesize that this effect is only significant for the high out-of-pocket medical expenses group in the sample.

In addition to stressors potentially mediating the relationship between retirement and mental health, coping mechanisms, as discussed in the stress process model and the stress and coping theory, may

also serve as mediators in this relationship. However, whether something acts as a coping mechanism depends on the individual. Something which helps for one person could serve as a stressor for another. Something which is often brought up as a universal coping mechanism is engaging in leisure activity. Since leisure activity is, per definition, something which people enjoy, this should act as a coping mechanism for the average person. Furthermore, activity theory of ageing also suggests that engaging in leisure activity after retirement is beneficial for someone's health. Both theories therefore suggest that engaging in leisure activity acts as a mediator in the retirement – mental health relationship. Unfortunately, the HRS and CAMS dataset do not include a variable which indicates leisure activity engagement. Just as with the social support variable, however, I can create a leisure activity variable using the weekly amount of time spent on leisure activities, using the activities variables in the CAMS dataset. I sum the weekly amount spent on leisure activities variable using the following activities: weekly hours spent on 'watching tv', 'reading papers or magazines', 'reading books', 'listening to music', 'praying or meditating', 'going to concert or movies', 'singing or playing music', 'playing games' and' doing arts and crafts'. The use of these certain activities is based on the works of Brajša-Žganec et al. (2010), who used these activities, among some others, as leisure activities in their research. The activities I use are the ones that are both available in the CAMS data and are included in the research of Brajša-Žganec et al.
Based on the data, the stress process model, the stress and coping theory and the activity theory of ageing, I hypothesize that the weekly hours spent on leisure activity has a significant mediating effect in the retirement – mental health relationship.

The activity theory of ageing does not only predict engaging in leisure activity to have a beneficial effect on someone's health after retirement. Engaging in physical activity should exert similar effects, and therefore act as a mediator in the relationship between retirement and mental health. Similar as with the social support and leisure activity variables, I need to create the physical activity variable using the activity data of the CAMS dataset. The variables which I sum to create weekly hours spent on physical activity are 'weekly hours spent walking' and 'weekly hours spent exercising'. The use of only these two activities is based on the works of Berger et al. (2005). These are the only two activities in the CAMS dataset that definitely imply that the respondent was physically active, so these are the only two variables used in the creation of this variable. Based on the data and the activity theory of ageing, I hypothesize that the weekly hours spent on physical activity has a significant mediating effect in the retirement – mental health relationship.

The last theory discussed in the theoretical framework is the health selection theory. This theory implies that physical health issues can have a mediating effect in the retirement – mental health relationship. The HRS dataset contains a variable on self-reported health, as well as for various

diseases an individual might be experiencing. As self-reported health is more a health status, and the mediating relationship is more likely to exist due to health issues, I will use the diseases someone suffers from as a physical health variable. The dataset contains yes or no variables on whether a respondents reports to suffer from 'high blood pressure', 'diabetes', 'cancer', 'lung disease', 'heart problems', 'stroke' and 'arthritis'. Summing all these variables creates a variable which indicates how many health issues someone suffers from. Based on the data and the health selection theory, I hypothesize that the amount of serious physical diseases someone suffers from has a significant mediating effect in the retirement -mental health relationship.

3.3 Sample

In order to create a working dataset, all the HRS and CAMS waves have been combined into one dataset, where each CAMS wave corresponds to the HRS wave conducted in the previous year. Each unique respondent is matched by their household id and person number to ensure that all data corresponds to the same individual. Since this thesis uses the data from both surveys, only respondents that have participated in both surveys are eligible for this research. This omits wave one through four and wave fifteen of the HRS survey, since they cannot be linked to a CAMS survey year.

This results in a dataset with 49,813 observations across 10,851 unique individuals. In table 1, row one illustrates the number of unique respondents each HRS wave contained, whereas row two illustrates the number of unique respondents each CAMS wave contained. Row three represents the number of unique respondents I was able to merge from both datasets, whereas row four illustrates how many respondents each wave also participated in the previous wave.
The number of merged respondents in each wave is somewhat lower than the total number of respondents that participated in the CAMS research. Ideally, these numbers should match because each respondent who completes the CAMS survey is expected to fill out the HRS survey as well. The difference in CAMS respondents and merged respondents can be attributed to cases where respondents only completed the CAMS survey in a given wave, and skipped the corresponding HRS survey. To ensure consistency, only respondents who completed both surveys for the corresponding waves are included in this dataset. When either the HRS dataset or the CAMS dataset has not been completed, this observation is omitted from the dataset.

Table 1: *The number of participants of both the HRS and the CAMS survey*

	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	
Number of respondents HRS	12,652	19,642	17,991	21,384	19,578	18,165	20,129	
Number of respondents CAMS	-	-	-	-	3,866	3,254	5,815	
Number of merged respondents	-	-	-	-	3,789	3,203	5,613	
Carryover from previous wave	-	-	-	-	-	3,203	4,742	
	Wave 8	Wave 9	Wave 10	Wave 11	Wave 12	Wave 13	Wave 14	Total
Number of respondents HRS	18,469	17,217	22,034	20,554	18,747	20,912	17,146	42,233
Number of respondents CAMS	5,612	5,330	6,531	6,000	5,423	5,029	4,666	11,067
Number of merged respondents	5,401	5,163	6,346	5,852	5,290	4,874	4,282	10,851
Carryover from previous wave	5,351	5,123	4,715	5,784	5,248	4,348	4,242	-

Descriptive statistics at baseline

Table 2 shows the descriptive statistics of the full sample at baseline, i.e., the descriptive statistics of the sample, measured at the first wave a respondent enters the dataset. The first variables presented paint a demographic picture of the sample. Firstly, the dataset contains 10,851 unique respondents. The female variable also contains 10,851 observations. This is a dummy variable that takes value zero when the respondent is male and value one when the respondent is female. The mean value of the female variable is 0.582, which means that 58.2% of the sample is female and the remaining 41.8% of the sample is male.

The age variable also contains 10,851 observations. The age is calculated by subtracting the respondent's birth date from the ending interview date and then converting the result into years by dividing the number of months by twelve and considering the integer portion. The mean age at baseline is 61.627 years old, with a standard deviation of 10.498 years. The minimum age is 20 years old, whereas the maximum age is 97 years old.

The education variable contains 10,819 observations, representing the total number of years a respondent has completed education. The mean years of education is 12.665 years, with a standard deviation of 3.158. The minimum years of education is zero, whereas the maximum is 17 years.

The dataset also contains 10,851 observations on the self-reported health variable. This variable ranges from one to five, where one means excellent health and five means poor health. For the sake of interpretation, the variable has been transformed to the dummy variable self-reported bad health, which takes value one if the respondent reports poor or fair health and zero if the respondent reports good, very good or excellent health. The mean of this variable is 0.267, which means that 26.7% of the sample reported bad health at baseline.

Variable	Number of observations	Mean	Standard deviation	Minimum	Maximum
Female	10,851	0.582	0.493	0	1
Age	10,851	61.627	10.498	20	97
Years of education	10,819	12.665	3.158	0	17
Reports bad health	10,851	0.267	0.442	0	1
Marital status					
Married	10,851	0.675	0.469	0	1
Divorced	10,851	0.137	0.344	0	1
Widowed	10,851	0.134	0.331	0	1
Never married	10,851	0.053	0.224	0	1
Ethnicity					
Caucasian	10,851	0.743	0.437	0	1
African American	10,851	0.180	0.384	0	1
Other	10,851	0.075	0.263	0	1
Mediators					
Yearly household income in dollars	10,851	68,677.38	124,105.10	0	5,537,080
Value of all household assets in dollars	10,851	359,272.30	837,927.60	-1,999,200	23,300,000
Weekly hours spend on leisure activities	9,864	46.465	30.180	0	168
Weekly hours spend on social support activities	9,947	29.464	26.553	0	168
Number of physical diseases	10,356	1.551	1.277	0	7
Weekly hours spend on physical activities	10,510	9.487	14.205	0	168
Receives Medicare	10,819	0.395	0.489	0	1
Yearly out of pocket medical expenditures in dollars	10,851	1,364.95	4,468.89	0	202,100
Dependent and independent variables					
Mental health score	10,382	1.585	2.011	0	8
Retired	10,851	0.398	0.490	0	1

Table 2: Descriptive statistics of the sample at baseline

The variable marital status is also categorical and has therefore been split up into four different dummy variables. All four categories have 10,851 observations and the first category, being married, has a mean value of 0.675, which means that 67.5% of the sample was married at baseline. The mean value of the divorced category is 0.137, whereas the mean value of the widowed category is 0.134. This means that in the sample, 13.7% was divorced an of 13.4% of the respondents had a deceased partner. Lastly, the category never married has a mean value of 0.053, which means that around 5.3% of the sample never has been married.

Furthermore, the categorical variable ethnicity has also been split up into three dummy categories, with a total of 10,851 observations for each category. The mean value of the Caucasian category is 0.743, which indicates that 74.3% of the sample is Caucasian/white. The mean value of the African American category is 0.180, which indicates that 18.0% of the sample is of African American heritage. Lastly, the mean variable of the 'other' category is 0.075, which means that 7.5% of the sample is of any other ethnicity.

The descriptive statistics of the mediators I will use in the analysis are also presented in table 2. Firstly, the variable yearly household income contains 10,851 observations. The mean income of the sample is $68,677.38 per year, with a standard deviation of $124,105.10. The minimum yearly income was $0.00, whereas the maximum yearly income was $5,537,080. Next, I have included the value of all household assets, since this might be a factor of heterogeneity in the mediating relationship. The mean value of household assets is $359,272.30, with a standard deviation of $837,927.60. The minimum value is $-1,999,200, indicating that the respondent with the lowest asset value had a debt of almost two million dollars. The maximum value of assets is $23,300,000.

The next variable is the weekly amount of time spent on leisure activities. This variable has somewhat fewer observations, with information on 9,864 individuals. This is because this variable was derived from nine other variables in my dataset. If any one of these variables had a missing value, the leisure activity variable would also receive a missing value. The mean amount of time spent on leisure activities is 46.465 hours per week, with a standard deviation of 30.180 hours. The minimum time spent was zero hours, whereas the maximum time spent is 168 hours. The actual maximum in the dataset was 761 hours, but this is an impossible value, for one week only contains 168 hours. I have therefore decided to drop all observations for this variable with a value above 168 hours. This led to an extra 736 missing values for this variable. It is still very unlikely that spends 168 of 168 hours per week on leisure activities, but it is hard to set a realistic boundary without tempering with the data. I have therefore decided to keep all observations that are technically possible and omit everything that is not possible, resulting in the 9,864 observations.

The same problem arises for the weekly amount of time spent on social support activities. Firstly, since this variable is a sum of the value of seven other variable is my dataset, the variable contains somewhat more missing values. Secondly, the maximum weekly hours spent on social support activities was originally 750 hours. Again, I chose to omit all observations with values of higher than 168, for the same reasons as sketched above. This led to an extra 559 missing values for the social support variable. The variable now contains 9,947 observations with a mean of 29.464 hours and a standard deviation of 26.553 hours. The minimum hours spent on social support is zero, whereas the maximum hours spent is 168.

The next described variable is the physical diseases variable. This variable ranges from zero to seven, adding one if the respondent reports to have any of the diseases of high blood pressure, diabetes, cancer, lung disease, heart problems, stroke of arthritis. Again, this leads to somewhat fewer observations for this variable, since the variable is created using the sum of the value of these seven disease variables. The variable contains 10,356 observations and the mean number of diseases that someone suffers from is 1.551, with a standard deviation of 1.277 diseases. The minimum number of diseases someone suffers from is zero, whereas the maximum number is seven.

Just as for the leisure activity and social support variable, the physical activity variable also contains some impossible values. The original maximum hours spent on physical activities was 200 hours. I again dropped all observations of more than 168 hours, leading to a total of 10,356 observations for the physical activity variable. The mean weekly hours spent on physical activities was 9.487 hours, with a standard deviation of 14.205 hours. The minimum hours spent on physical activities is zero hours per week, whereas the maximum equals 168 hours per week.

The last mediator that is described is whether someone receives Medicare benefits. This variable takes value zero if someone does not receive Medicare and value one if someone does receive the benefits. This variable contains 10,819 observations, with a mean value of 0.395. This means that at baseline, 39.5% of the sample received Medicare benefits.
The variable yearly out of pocket medical expenditures is also described, since this might be a factor of heterogeneity in the Medicare mediation effect. This variable contains 10,851 observations, and the mean out of pocket medical expenditures is $1,364.95 per year. The standard deviation is $4,468.89, with a minimum of $0.00 yearly expenditures and a maximum of $202,100 per year.

The last two variables described are the dependent and independent variable I use in my analysis. Firstly, the mental health score variable contains 10,382 observations. This variable ranges from values zero to eight, where zero means the best mental health and eight means the worst mental health. The mean mental health score is 1.585, with a standard deviation of 2.011. At baseline, the

minimum mental health score was 0, which is the best score possible, and the maximum was eight, the worst score possible.

The last variable is the retired variable. This is a dummy variable with 10,851 observations, taking value zero if someone is not yet retired and value one if someone is partially or completely retired. At baseline, the mean value was 0.398, which means that at on entering the sample, 39.8% of all individuals was either partially or completely retired.

3.4 Methodology

As mentioned earlier, the goal of this thesis is to establish through which pathways retirement affects mental health. In other words, the aim of this thesis is to see through which mediators retirement affects mental health. Baron and Kenny (1986) designed an analysis method through which a mediation analysis can be conducted using three sets of regressions. The intuition behind this is best illustrated using figure 1 and the three fitted regressions:

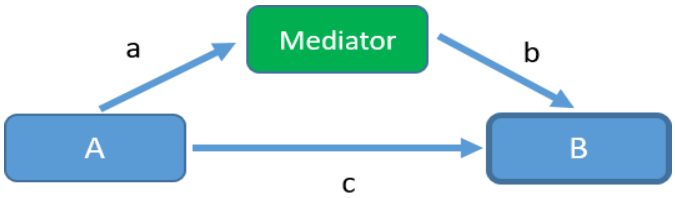

Figure 1: illustration of a mediation analysis as proposed by Baron and Kenny (1986)

$$M = \beta_1 + aX + \varepsilon_1 \quad (1)$$

$$Y = \beta_2 + c + \varepsilon_2 \quad (2)$$

$$Y = \beta_3 + c'X + bM + \varepsilon_3 \quad (3)$$

Equation (1) estimates the effect of the treatment variable on the mediator, representing path a in figure 1. Equation (2) estimates the effect of the treatment variable on the outcome variable, representing path c in figure 1 and Equation (3) captures the mediation effect, representing paths a and b in figure 1.

Evidence for mediation is considered to be found if three conditions hold. Firstly, coefficient *a* in equation (1) must be significant, providing evidence of a linear relationship between the treatment variable and the mediator. Secondly, coefficient *c* in equation (2) must be significant, providing evidence of a linear relationship between the treatment variable and the outcome variable. And thirdly, coefficient *b* in equation (3) must be significant, indicating that the mediator helps predict the outcome variable, as well as that coefficient *c'* becomes significantly smaller in size relative to coefficient *c* in equation (2). The mediated effect is then computed by taking the product of coefficients *a* and *b.*

The significance the reduction in effect size is tested with Sobel's z-test (Sobel, 1982):

$$z = \frac{a \times b}{\sqrt{b^2 s_a^2 + a^2 s_b^2}}$$

Where *a* and s_a^2 are obtained from equation (1) and b and s_b^2 from equation (3). Coefficient *a* and *b* are used in the calculation of the z-statistic, since the mediation effect can be given by the product of coefficients *a* and *b*. There is therefore no difference between testing the difference of coefficients *c* and *c'* or the difference between the mediating path *a* x *b* and zero.

After conducting these tests, three possible conclusions can be drawn:

1. No mediation, where either coefficients *a* or *b* are not significant.
2. Partial mediation, if both the mediating path *a* x *b* and coefficient *c'* (the direct path) are significant
3. Full mediation, if the mediating path *a* x *b* is significant and the direct path *c'* is not significant.

This approach of Baron and Kenny (1986) has since been analysed and modified by various researchers. Two different studies have had the most relevant impact on the mediation analysis of Baron and Kenny. Firstly, Iacobucci et al. (2007) compared mediation models using regression analyses and structural equation modelling, concluding that SEM models will never be outperformed by regression models in mediation analyses, resulting in the general use of SEM models in the mediation analysis literature. Secondly, Zhao et al. (2010) had some critical remarks on the Baron and Kenny approach. Firstly, Baron and Kenny claim that mediation is strongest when in equation (3), the direct effect *c'* is not significant and the indirect effect *b* is significant. Zhao et al. (2010), however, state that the strength of mediation should be measured by the size of the indirect effect, not the absence of a direct effect. Secondly, Zhao et al. (2010) do not believe that coefficient *c* in equation (2) must be significant. Only the indirect effect *a* x *b* must be significant in order to speak of a mediation effect. Lastly, the Sobel test is low in power compared to a bootstrap test. This should therefore be the measure to indicate whether the mediation is significant. For this analysis, however, the Monte Carlo test is used instead of the bootstrapping method. According to Jose (2013), this method is less time-consuming as the bootstrapping methods, while still as acceptable.
This different view on mediation also leads to some different definitions of types of mediation. Zhao et al. (2010) define five types of mediation in total:

1. Complementary mediation: mediated effect (*a* x *b*) and direct effect (*c'*) both exist and point in the same direction. (Partial mediation under Baron and Kenny)
2. Competitive mediation: mediated effect (*a* x *b*) and direct effect (*c'*) both exist and point in opposite directions. (Partial mediation under Baron and Kenny)
3. Indirect-only mediation: mediated effect (*a* x *b*) exists, but direct effect (*c'*) does not exist. (full mediation under Baron and Kenny)
4. Direct-only nonmediation: direct effect (*c'*) exists, but mediated effect (*a* x *b*) does not exist. (no mediation under Baron and Kenny)
5. No-effect nonmediation: Neither direct effect (*c'*) nor indirect effect (*a* x *b*) exists. (no mediation under Baron and Kenny).

Where Zhao et al. (2010) and Iacobucci et al. (2007) expanded upon the Baron and Kenny method, Robins and Greenland (1992) and Pearl (2001) developed another type mediation analysis, based on counterfactuals.

This approach relies on four critical assumptions: firstly, there is no unobserved confounding in the treatment-outcome relationship, and observed confounders are included as covariates in the outcome model (Pearl, 2001). In the framework of this thesis, this means that there are no unobserved or uncontrolled confounders between retiring and the mental health score.

Secondly, there is no unobserved confounding in the mediator-outcome relationship, and observed confounders are included as covariates in the outcome model (Pearl, 2001). In the framework of this thesis, this means that there are no unobserved or uncontrolled confounders between the used mediator and the mental health score.

Thirdly, there is no unmeasured confounding in the treatment-mediator relationship, and observed confounders are included as covariates in the mediator model (Pearl, 2001). In the framework of this thesis, this means that there are no unobserved or uncontrolled confounders between retiring and the used mediator.

Fourthly, there are no confounders in the mediator-outcome relationship that are caused by the treatment. No variable exists that affects both the mediator and the outcome that itself is caused by the treatment (Pearl, 2001). In the framework of this thesis, this means that there must be no factors, neither observed or unobserved, that are caused by retiring and have an effect on both the used mediator and on the mental health score. This can also be illustrated with figure 2, where A denotes retirement, M the mediator, Y the mental health score and C_1, C_2 and C_3 the confounders of the first three assumptions. As illustrated, confounders need to be controlled for in the model in order to be able to prove a causal relationship. The yellow line in the figure however, which denotes assumption 4, represents a relationship that cannot be controlled for. If there are confounders in the mediator-outcome relationship that are caused by the treatment, the relationship found can per definition not be causal. C_2 therefore must not be caused by the treatment variable in order to be able to prove causality.

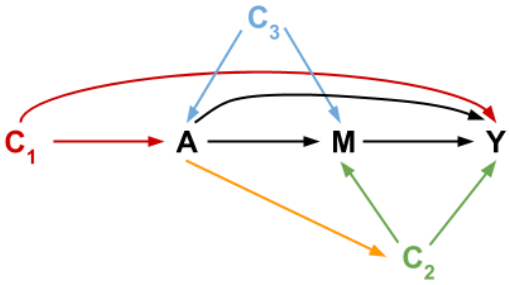

Figure 2: Graphical illustration of the 4 critical assumptions (Myint, 2020)

To estimate the mediation effect, I follow the works of Imai et al. (2010). They created the proposed equation, where the potential-outcome means are the result of the integral of the conditional expectation of the outcome with respect to the conditional distribution of the mediator.

$$E\big[Yi\big(t, Mi(t)\big)\big|Xi = x\big] = \int E[Yi|Mi = m, Ti = t, Xi = x]dF[m|Ti = t, Xi = x] \qquad (4)$$

In this equation, Y_i represents the potential outcome mean of the mental health variable. T_i represents the treatment variable, which, in this case, is the retirement variable. M_i represents the mediator used and X_i represents a set of covariates, which are the various confounders that need to be controlled for in the outcome and mediator equations that are estimated. The results of the direct, indirect and total effects will then be estimated as the sample average.

The following equations are used to estimate the mediating effect, using the potential-outcome means that result from equation 4. Equation 5 represents the outcome model and equation 6 represents the mediator model.

$$\eta_i^Y = \beta_0 + \beta_1 T_i + \beta_2 M_i + \beta_3 T_i M_i + W_i \quad (5)$$

$$\eta_i^M = \alpha_0 + \alpha_1 T_i + Z_i \quad (6)$$

In equation 5, η_i^Y represents the mental health score, whereas T_i represents the treatment of retiring, M_i represents the used mediator and T_iM_i represents the interaction between the treatment and the mediator. Wi represents the set of confounders used as controls in this model.

In equation 6, η_i^M represents the used mediator, where T_i represents the treatment variable and Z_i the set of confounders which are used as controls.

The mediation effect is computed by taking the product of coefficients β_2 and α_1, which is similar to the computation of the mediation effect in the classical mediation analysis method. The key difference between the methods lies in the fact that, in the causal method, the input values used in equations 5 and 6 are obtained using equation 4, which is based on the potential-means outcome model, designed to address the issue of causality.

As described in section 3.2, I will use the following variables as the potential mediators in the analysis: 'yearly household income', 'number of physical diseases', 'weekly hours spent on physical activities', 'weekly hours spent on leisure activities', 'weekly hours spent on social support activities' and 'whether someone receives Medicare'. In order to obtain causal estimates, all possible confounders in the relationships between retirement and mental health and the mediator and mental health must be controlled for in the outcome equations. These equations are represented by equation 3 for the classical mediation analysis approach, as proposed by Baron and Kenny (1986) and Zhao et al. (2010), and equation 5 for the causal mediation analysis method, as proposed by Imai et al. (2010). Furthermore, all confounders in the relationship between retirement and the mediator must be controlled for in the mediator equations. These equations are represented by equation 2 for the classical approach and equation 6 for the causal approach.

I have therefore carefully gone over my data to identify the confounders I will use per mediator. These are presented in tables 3 to 8. The selection of confounders is based on a careful overview of

the available data. I do not want to control for confounders that do not indeed represent a confounding relationship, since this would bias the resulting estimates. I have therefore chosen to use rather less confounders, which, based on logical reasoning, represent a confounding relationship, than more confounders of which the confounding relationship is not typically clear. Common demographic controls might therefore be absent as confounders, since the confounding relationship is not typically clear.

Table 3: Retirement – Mental health, Retirement – Physical disease and Physical disease – Mental health confounders

Outcome equation physical disease	**Mediation equation physical disease**
Cognition score	Cognition score
Limitations in activities of daily life	Limitations in activities of daily life
Physical activity	Physical activity
Self-reported health	Self-reported health
Marital status	BMI
Gender	Whether a current drinker
Race	Whether a current smoker
Age	Marital status
Years of education	Gender
Household income	Race
	Age
	Years of education

Table 4: Retirement – Mental health, Retirement – Physical activity and Physical activity – Mental health confounders

Outcome equation physical activity	**Mediation equation physical activity**
Cognition score	Cognition score
Physical disease	Physical disease
Self-reported health	Self-reported health
Marital status	BMI
Gender	Whether a current drinker
Race	Whether a current smoker
Age	Marital status
Years of education	Gender
	Race
	Age
	Years of education

Table 5: Retirement – Mental health, Retirement – Social support and Social support – Mental health confounders

Outcome equation social support	**Mediation equation social support**
Cognition score	Cognition score
Physical disease	Physical disease
Limitations in activities of daily life	Limitations in activities of daily life
Self-reported health	Self-reported health
Marital status	Marital status
Gender	Gender
Race	Race
Age	Age
Years of education	Years of education
Household income	Religion
	Whether a current drinker
	Whether a current smoker
	Number of living children
	Number of living siblings
	Yearly amount spent on vacations
	Yearly amount spent on contributions
	Yearly amount spent on gifts
	Yearly amount spent on dining out
	Weekly time spent on leisure activities

Table 6: Retirement – Mental health, Retirement – Household income and Household income – Mental health confounders

Outcome equation household income	**Mediation equation household income**
Cognition score	Cognition score
Physical disease	Physical disease
Limitations in activities of daily life	Limitations in activities of daily life
Self-reported health	Self-reported health
Marital status	Marital status
Gender	Gender
Race	Race
Age	Age
Years of education	Years of education
	Weekly time spent on money management

Table 7: Retirement – Mental health, Retirement – Leisure activity and Leisure activity – Mental health confounders

Outcome equation leisure activity	**Mediation equation leisure activity**
Cognition score	Cognition score
Physical disease	Physical disease
Limitations in activities of daily life	Limitations in activities of daily life
Self-reported health	Self-reported health
Marital status	BMI
Gender	Whether a current drinker
Race	Marital status
Age	Gender
Years of education	Race
Household income	Age
	Years of education
	Religion
	Weekly time spent on social support activities
	Yearly amount spent on vacations
	Yearly amount spent on contributions
	Yearly amount spent on dining out

Table 8: Retirement – Mental health, Retirement – Medicare and Medicare – Mental health confounders

Outcome equation Medicare	**Mediation equation Medicare**
Cognition score	Age
Physical disease	
Limitations in activities of daily life	
Self-reported health	
Marital status	
Gender	
Race	
Age	
Years of education	
Household income	

For each analysis, I will present estimates from both the classical mediation analysis method and the causal mediation analysis method. The reason I do this is because I want to come as close to causal results as possible. However, both methods rely on OLS regressions and do not inherently support the use of techniques like fixed effects analyses to estimate the mediator and outcome models. To address this limitation, I have time-demeaned the data myself. This allows me to run fixed effects regressions using OLS, effectively eliminating all time-invariant confounders and leaving only time-variant confounders that need to be controlled for. This overcomes this limitation for the classical method, however, for the causal method, another challenge arises. This method requires a binary or categorical independent variable to estimate the mediation effect. Time-demeaning the retirement variable, however, transforms it into a continuous variable, rendering it unsuitable for use in the causal mediation analysis method.

Furthermore, I cannot add an individual fixed effects dummy to the equation, because this takes too much computational power. The device I run the analysis on is not able to run such a large analysis, so the use of individual fixed effects dummies is unfortunately not an option as well for the causal method. Reducing my sample to reduce the computational power needed was not an option as well, as this would mean I would estimate more parameters than available observations, which is not possible. Improving on using an OLS regression in the causal mediation method is therefore not an option for this thesis.

Both methods have its up and down sides to use as my definitive method. The causal method provides the most causal estimates when controlled for all confounders. Controlling for all confounders is not likely to be possible in this research. The causal method does, however, provide the most causal estimates of the indirect effect, because of its foundation on the potential-outcome means model.

Where the causal model will provide the most causal estimates for the indirect effect, the classical model will provide the most causal estimates for the total effect. This is because the classical method estimates the total effect using a fixed effects model, whereas the causal model uses a simple OLS regression. While the main goal of this thesis is to identify the indirect effects, the total effect of retirement on mental health is interesting for this research as well. I will therefore present the estimates using both the classical mediation model using time-demeaned data and the causal mediation model using the original data.

4. Results

4.1 Mediation analysis

4.1.1. Physical disease

Table 9: Meditation analysis results for the mediating effect of physical disease in the Retirement – Mental health relationship

	Completely retired		Partially retired	
	Classical method with fixed effects	Causal method	Classical method with fixed effects	Causal method
Total effect	0.028 (0.024)	-0.037 (0.028)	-0.021 (0.040)	-0.025 (0.043)
Direct effect	0.027 (0.023)	-0.049 (0.027)	-0.021 (0.039)	-0.031 (0.042)
Indirect effect	0.001 (0.001)	0.012* (0.004)	0.000 (0.001)	0.007 (0.005)
Observations	26,456	26,456	10,050	10,050
Individuals	8,587	8,587	5,678	5,678

Standard errors in parentheses
**p<0.05*

Table 9 provides the results of both the classical and the causal mediation analysis methods for the mediating effect of physical disease in the retirement – mental health relationship. Row one represents the total effect of retirement on mental health. Row two represents the direct effect of retirement on mental health, whereas row three represents the indirect effect of retirement on mental health. This row represents the mediating effect of the used mediator, so in this case, it represents the effect of retirement on mental-health, mediated through physical disease. Column one and two represent the classical and partial mediation analysis with completely retired as the independent variable, whereas column three and four represent the classical and causal mediation analysis with partially retired as independent variable.

The first row shows that the total effect of completely retiring, using the classical method, is an increase of 0.028 points on the CESD-scale, ceteris paribus, indicating a small decrease in mental health. This effect is, however, not significant at a 5% level. The total effect using the causal method reduces the CESD-score with 0.037, ceteris paribus, indicating a small increase in mental health. This effect is, however, also not significant at a 5% level. The total effect of partially retiring is, for both the classical and causal method, also negative but insignificant at a 5% level.

As mentioned in section 3.4, the difference in effect magnitudes and signs for the total effect differs because the classical method estimates this using a fixed effects regression, whereas the causal method using an OLS regression. This leads to different results, where the OLS regression is likely to be more biased on this aspect.

The coefficients of main interest are the coefficients in row three. These coefficients indicate whether there is a mediating effect in place. Using the classical method, when someone retires completely, his/her change in mental health is for 0.001 point due to the change in physical disease postretirement, ceteris paribus. This effect is however not significant at a 5% level. For the causal method, this effect equals 0.012, indicating that of the -0.037 point increase in CESD-score due to completely retiring, 0.012 points are explained through to the mediating effect of physical disease, ceteris paribus. This effect is significant at a 5% level, indicating that, while completely retiring does not have a significant effect at mental health, an increase in physical disease postretirement does. I can, however, not conclude that this effect is causal, since I cannot be sure that I have controlled for all potential confounders in the retirement – mental health, physical disease – mental health and retirement – physical disease relationships. When partial retirement is used as independent variable, the indirect effect is again small and not significant at a 5% level, ceteris paribus.

As discussed in section 3.2, I hypothesized that physical disease has a significant mediating effect in the retirement – mental health relationship. This is expected because of the health selection theory, which predicts that worse health affects social outcomes that in place affect mental health. The hypothesis holds for complete retirees, but not for partial retirees. Keeping the health selection theory in mind, it makes sense that the indirect effect through physical health is not significant for partial retirees. Worse health often comes with age, and people who claim to be partially retired are typically younger than retirees who have retired completely. Furthermore, it is also more likely that people who are completely retired have made that decision due to health reasons, when after retirement, these health issues worsen, it is likely that this effect only occurs for complete retirees. The effect I find using the causal method is therefore in line with the existing theory.

4.1.2 Physical activity

Table 10 provides the results of both the classical and the causal mediation analysis methods for the mediating effect of physical activity in the retirement – mental health relationship. Row one represents the total effect of retirement on mental health. Again, this effect is not significant for any of the equations I estimated, ceteris paribus. Furthermore, for both the causal and classical, using both complete and partial retirement as independent variable, the indirect effect of retirement on mental health is very small and not significant at a 5% level, ceteris paribus.

In section 3.2, I hypothesize that physical activity has a significant mediating effect in the retirement – mental health relationship. This is based on the activity theory of ageing, which sees physical activity as a vital aspect of keeping up physical and mental health after retirement. Physical activity is also likely to serve as a coping mechanism to deal with stressors and might prevent the occurrence of

Table 10: Meditation analysis results for the mediating effect of physical activity in the Retirement – Mental health relationship

	Completely retired		Partially retired	
	Classical method with fixed effects	Causal method	Classical method with fixed effects	Causal method
Total effect	0.030 (0.024)	-0.031 (0.028)	-0.025 (0.041)	-0.054 (0.043)
Direct effect	0.030 (0.024)	-0.032 (0.028)	-0.025 (0.040)	-0.054 (0.043)
Indirect effect	0.000 (0.000)	0.001 (0.001)	0.000 (0.001)	0.000 (0.001)
Observations	26,460	26,460	10,054	10,054
Individuals	8,587	8,587	5,679	5,679

Standard errors in parentheses
**p<0.05*

certain stressors, such as physical health issues. The fact that physical activity frequency does not affect mental health postretirement is therefore an unexpected outcome of this analysis, and this does not support my hypothesis. The reason that I do not find any significant effects is possibly be due to the measurement of physical activity in this thesis. The physical activity variable includes hours spent on walking and exercising, whereas physical activity could include other things as well. The built up of this variable might differ per individual, since everyone might interpret what falls under physical activity differently. Furthermore, the are some unlikely values included in this variable, which might influence the results. I am, however, not able to set a 'range of likely values', without tempering with the data. Taking the logarithm of the physical activity variable does not change the resulted estimates significantly, so this does not solve the problem as well. This is therefore something that limits the results on the mediating effect of physical activity.

4.1.3 Social support

Table 11 provides the results of both the classical and the causal mediation analysis methods for the mediating effect of social support in the retirement – mental health relationship. Again, all methods find no significant effects for the total effect of retirement on mental health, ceteris paribus. Using the fixed effects method, I find a negative effect on the CESD-score, or a positive effect on mental health, and using the causal method, I find positive effects on the CESD-score, or negative effects on mental health, ceteris paribus. These effects are, however, not significant at a 5% level.

As well as for the physical activity mediator, I find no or very small indirect effects through social support, ceteris paribus. All these effects are also not significant at a 5% level.

In section 3.2, I hypothesize that social support has a significant mediating effect in the retirement – mental health relationship. This is strongly supported by several microeconomic theories, such as the

stress process model, the stress and coping theory and the social convoy theory. These theories suggest that social support should be one of the most vital, if not the most vital, mediators in the retirement – mental health relationship. Finding no significant mediating effects for social support is therefore unexpected.

Table 11: Mediation analysis results for the mediating effect of social support in the retirement – mental health relationship

	Completely retired		Partially retired	
	Classical method with fixed effects	Causal method	Classical method with fixed effects	Causal method
Total effect	0.014	-0.063	0.029	-0.019
	(0.033)	(0.037)	(0.055)	(0.059)
Direct effect	0.014	-0.063	0.029	-0.014
	(0.033)	(0.037)	(0.053)	(0.058)
Indirect effect	0.000	0.000	0.000	-0.005
	(0.000)	(0.001)	(0.002)	(0.006)
Observations	14,239	14,239	5,330	5,330
Individuals	5,351	5,351	3,246	3,246

Standard errors in parentheses
**p<0.05*

The reason that I find no significant mediating effects is again possibly due to the way the social support variable is built up. This variable is created using several time use variables, which can be interpreted as time use during which someone feels social support. Whether something is experienced as a social support activity is, however, very subjective, and asking the question: 'how well would you rate your social support?', might produce more reliable data. Furthermore, the time use data contains several unlikely values. I have omitted all impossible values, but some observations still contain more than 100 hours of weekly social support activities, which is likely to influence the results. I am, however, just as with the physical activity variable, not able to set a 'range of likely values', without tempering with the data. Again, taking the logarithm did not solve any of the issues, so this is something that limits the results on the mediating effect of physical activity.

4.1.4 Household income

Table 12 provides the results of both the classical and the causal mediation analysis methods for the mediating effect of household income in the retirement – mental health relationship. As well as for the previous mediators, the total effect of retirement on mental health is not significant in all the analyses. This is not surprising, since the same fixed effects and OLS-regressions are done to estimate this total effect, only differing in a small number of confounders controlled for. The total effect of retirement on mental health is therefore similar with all mediators: small and not significant at a 5%

level, ceteris paribus.

To estimate the mediating effect of household income, I have used the logarithm of the household income variable, in order to be able to interpret the results. The coefficient of the total effect of complete retirees, using the classical method, is 0.023. This means that complete retirement leads to a 0.023 increase in CESD-score, or decrease in mental health, ceteris paribus. Of this 0.023, 0.006 can be explained with the indirect effect through household income, ceteris paribus. This effect is significant at a 5% level. For the causal method, the indirect effect is significant at a 5% level as well.

Table 12: Mediation analysis results for the mediating effect of household income in the retirement – mental health relationship

	Completely retired		Partially retired	
	Classical method with fixed effects	Causal method	Classical method with fixed effects	Causal method
Total effect	0.023	-0.033	-0.025	-0.029
	(0.024)	(0.027)	(0.055)	(0.043)
Direct effect	0.017	-0.044	-0.027	-0.033
	(0.022)	(0.037)	(0.056)	(0.042)
Indirect effect	0.006*	0.011*	0.002	0.003
	(0.002)	(0.004)	(0.001)	(0.002)
Observations	27,379	27,379	10,376	10,376
Individuals	8,760	8,760	5,811	5,811

Standard errors in parentheses
**p<0.05*

While the total effect of retirement on the CESD-score is negative using the causal method, the signs of the indirect effects through household income point in the same, positive direction. This means that, while the total effect of retirement on mental health is not significant, a change in household income postretirement is. The same does not hold up for partial retirees, where the indirect effect of both the classical and the causal method are insignificant.

Something that is important to note here is that the positive coefficients for the indirect effects do not mean that an increase in household income has a positive effect on someone's CESD-score, and therefore a negative effect on their mental health. The intuition here is illustrated with figure 3, which is the same figure as figure 1 in section 3.4. As explained in that section, the indirect effect is estimated by multiplying path a and path b. In this case, the coefficient of the effect of retirement on household income (path a) is multiplied with the coefficient of the effect of household income on mental health (path b). The coefficient of 0.006 can therefore be discomposed in the coefficient of path a, -0.151, and the coefficient of path b, -0.039. This indicates that retirement has a negative

effect on household income, and an increase in household income has a negative effect on the CESD-score. A negative coefficient multiplied with a negative coefficient equals a positive coefficient, which is why the coefficient of the indirect effect is positive in table 12. Intuitively, this is the case because postretirement, someone's income tends to decrease, increasing someone's CESD-score, hence, the positive coefficient.

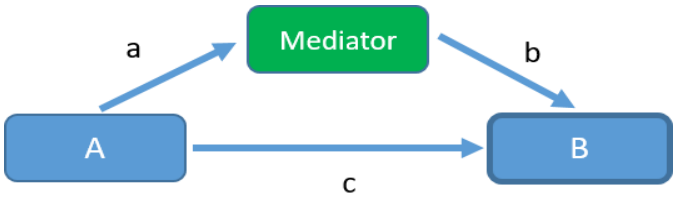

Figure 3: illustration of a mediation analysis as proposed by Baron and Kenny (1986)

The significant mediating effects of household income in the relationship between retirement and mental health confirm the hypothesis I formulate in section 3.2. This hypothesis was based on the stress process model and the stress and coping theories assuming that income can be a significant stressor in someone's life, which in its turn can affect someone's mental health. Income was therefore expected to have a significant, negative mediating effect on someone's mental health. It is also not surprising that this is not the case for partial retirees. These retirees experience less of an income drop, and are likely to be a partly retiree because they do not want to face such a large income drop. The effect of partial retirement on income is therefore not significant, resulting in no mediating effects as well.

4.1.5 Leisure activity

Table 13: Mediation analysis results for the mediating effect of leisure activity in the retirement – mental health relationship

	Completely retired		Partially retired	
	Classical method with fixed effects	Causal method	Classical method with fixed effects	Causal method
Total effect	0.012 (0.032)	-0.061 (0.037)	0.022 (0.054)	-0.019 (0.058)
Direct effect	0.011 (0.031)	-0.062 (0.037)	0.024 (0.057)	-0.019 (0.058)
Indirect effect	0.001 (0.001)	0.001 (0.004)	-0.002 (0.003)	0.000 (0.001)
Observations	14,590	14,590	5,434	5,434
Individuals	5,416	5,416	3,279	3,279

Standard errors in parentheses
**p<0.05*

Table 13 provides the results of both the classical and the causal mediation analysis methods for the mediating effect of leisure activity in the retirement – mental health relationship. Again, the total effect of retirement on mental health is small and not significant at a 5% level for all analyses, ceteris

paribus. The indirect effects of complete retirement and partial retirement on mental health are in both the classical and the causal method not significant at a 5% level as well.

In section 3.2, I hypothesize that leisure activity has a significant mediating effect in the retirement – mental health relationship. This was based on the stress process model and the stress and coping theory, which suggest that leisure activity is very likely to act as a coping strategy, which will reduce the negative effect that certain postretirement stressors have on someone's mental health. This would indicate that increasing someone's time spent on leisure activities would have a positive effect on someone's mental health. Furthermore, the theory of ageing suggests that by engaging in many physical and leisure activities postretirement, someone's mental health will benefit from this, again suggesting a positive mediation effect. The results I find do not support this hypothesis. The reason for this is possibly due to the reasons I do not find mediating effects through physical activity and social support as well. The measurement of leisure activity is quite subjective, since the activities that fall in the category leisure might differ for each person. Furthermore, the data is constructed using various time use variables, of which some contain several unlikely values. I have omitted all impossible values, but some observations still contain more than 100 hours per week spent on leisure activities, which is likely to influence the results. I am, however, again not able to set a 'range of likely values', without tempering with the data. Again, taking the logarithm of the leisure activity variable did not lead to a solution of the problem as well, so this is something that limits the results on the mediating effect of leisure activity.

4.1.6 Medicare

Table 14: Mediation analysis results for the mediating effect of receiving Medicare in the retirement – mental health relationship

	Completely retired		Partially retired	
	Classical method with fixed effects	Causal method	Classical method with fixed effects	Causal method
Total effect	0.030	-0.053	-0.020	-0.004
	(0.024)	(0.028)	(0.041)	(0.017)
Direct effect	0.038	-0.041	-0.017	0.059
	(0.027)	(0.031)	(0.035)	(0.050)
Indirect effect	-0.008*	-0.012	-0.003	-0.062*
	(0.003)	(0.011)	(0.006)	(0.017)
Observations	27,667	27,667	10,470	10,470
Individuals	8,795	8,795	5,845	5,845

Standard errors in parentheses
**p<0.05*

Table 13 provides the results of both the classical and the causal mediation analysis methods for the mediating effect of leisure activity in the retirement – mental health relationship. The total effect of retirement on mental health is again not significant at a 5% level for both fully and partial retirees, in both the complete and partial mediation analysis methods.

Something interesting does happen, however, in the estimation of the indirect effects. The sign of the indirect of receiving Medicare is negative in all four estimations. The intuition here is that retirement increases the likelihood that someone receives Medicare, whereas receiving Medicare decreases someone's CESD-score. For the typical retiree, Medicare therefore has a negative effect on their CESD-score, and therefore a positive effect on their mental health. This effect is significant at a 5% level, only in the classic method for complete retirees and in the causal method for partial retirees. Furthermore, the mediated effect through Medicare is relatively high for partial retirees. This reason for this is likely due to that partially retired individuals tend to be younger than fully retired individuals, on average. Many people who partially retire do this before receiving their Medicare benefits, putting pressure on their access to healthcare. Once the individual starts receiving Medicare benefits, this pressure relieves, which brings positive mental health outcomes with it.

The reason that for complete retirees, the effect is significant as well, is likely due to similar reasons. The effect is smaller, however, since these complete retirees often retire around the same time they start receiving Medicare benefits. This increase pressure on their access to healthcare is therefore absent, since they immediately switch from employee healthcare benefits to Medicare benefits.

4.2. Heterogeneity analyses

As discussed in section 1, existing literature supports the theory that the retirement transition and adjustment has a multiple-pathway nature, suggesting that a retiree's well-being does not follow a uniform pattern of transition and adjustment, but rather that this pattern can differ per individual. In this section, I discuss which factors are likely to contribute to the heterogenic nature of the effect of retirement on mental health. These include socioeconomic status, gender, age at retirement, health, former unemployment and marital status, as suggested by Pinquart and Schindler (2007). Additionally, in section 3.2, I hypothesize that the value of household assets and yearly out of pocket medical expenditures represent heterogenic factors in the retirement – mental health relationship.

I run my heterogeneity analyses using the following heterogenic factors: gender, marital status, education, income, retirement age and out of pocket medical expenses. For these heterogeneity analyses, I limit myself to the analysis of completely retired individuals. The reason for this is that I test for six different factors, for each of my six mediators. The size of this extra analysis would therefore simply become too large. For the sake of readability, I will therefore reduce my heterogeneity analysis to full retirees, and the heterogenic factor for partial retirees fall out of the scope of this thesis.

4.2.1 Gender

The results of the heterogeneity analysis for each mediator, with gender as the heterogenic factor, is presented in table 15. While the coefficient for physical disease was significant for all complete retirees in the main results, it is now only significant at a 5% level for males and not significant for females.

The coefficient of the mediation effect of physical disease for males is 0.018, ceteris paribus. The mediating effect of physical disease is likely linked to the worsening of social outcomes, experienced by individuals with more health issues after retirement. In this context, males tend to experience more of these worse social outcomes, which in place negatively affects their mental health.

A possible reason for this are societal norms that are in place. Men are usually more likely to carry the financial responsibility of their household, and when their physical health deteriorates, they might no longer be able to provide for their household, resulting in worse mental health outcomes. This is also represented in the data, where men report significantly higher income numbers than women do.

Table 15: Heterogeneity analysis of gender for each mediator

Physical disease	**Female**		**Male**	
	Classical method with fixed effects	Causal method	Classical method with fixed effects	Causal method
Total effect	0.026	-0.060	0.041	0.000
	(0.032)	(0.037)	(0.034)	(0.049)
Direct effect	0.024	-0.067	0.040	-0.018
	(0.031)	(0.037)	(0.033)	(0.042)
Indirect effect	0.002	0.007	0.000	0.018*
	(0.001)	(0.005)	(0.001)	(0.005)
Observations	15,507	15,507	10,949	10,949
Individuals	5,009	5,009	3,578	3,578

Physical activity	**Female**		**Male**	
	Classical method with fixed effects	Causal method	Classical method with fixed effects	Causal method
Total effect	0.023	-0.056	0.049	0.012
	(0.033)	(0.038)	(0.035)	(0.040)
Direct effect	0.023	-0.056	0.049	0.010
	(0.033)	(0.037)	(0.034)	(0.040)
Indirect effect	0.000	0.000	0.000	0.002
	(0.000)	(0.001)	(0.001)	(0.002)
Observations	15,511	15,511	10,949	10,949
Individuals	5,009	5,009	3,578	3,578

Social support	**Female**		**Male**	
	Classical method with fixed effects	Causal method	Classical method with fixed effects	Causal method
Total effect	-0.011	-0.083	0.064	-0.024
	(0.044)	(0.050)	(0.049)	(0.053)
Direct effect	-0.011	-0.083	0.064	-0.024
	(0.043)	(0.050)	(0.047)	(0.053)
Indirect effect	0.000	0.000	0.001	0.000
	(0.001)	(0.001)	(0.002)	(0.000)
Observations	8,835	8,835	5,404	5,404
Individuals	3,310	3,310	2,041	2,041

Household income	**Female**		**Male**	
	Classical method with fixed effects	Causal method	Classical method with fixed effects	Causal method
Total effect	0.023	-0.058	0.045	0.011
	(0.032)	(0.037)	(0.034)	(0.038)
Direct effect	0.017	-0.065	0.039	-0.013
	(0.029)	(0.037)	(0.029)	(0.037)
Indirect effect	0.006*	0.007*	0.006	0.024*
	(0.003)	(0.003)	(0.004)	(0.009)
Observations	16,197	16,197	11,182	11,182
Individuals	5,137	5,137	3,623	3,623

Leisure activity	**Female**		**Male**	
	Classical method with fixed effects	Causal method	Classical method with fixed effects	Causal method
Total effect	-0.015	-0.079	0.064	-0.024
	(0.043)	(0.050)	(0.048)	(0.052)
Direct effect	-0.015	-0.078	0.061	-0.030
	(0.041)	(0.050)	(0.046)	(0.053)
Indirect effect	-0.001	-0.001	0.003	0.006
	(0.002)	(0.004)	(0.002)	(0.007)
Observations	9,008	9,008	5,582	5,582
Individuals	3,341	3,341	2,075	2,075

Medicare	**Female**		**Male**	
	Classical method with fixed effects	Causal method	Classical method with fixed effects	Causal method
Total effect	0.018	-0.069	0.036	-0.028
	(0.032)	(0.038)	(0.034)	(0.039)
Direct effect	0.023	-0.061	0.049	-0.010
	(0.031)	(0.043)	(0.033)	(0.043)
Indirect effect	-0.005	0.008	-0.013*	-0.018
	(0.001)	(0.016)	(0.005)	(0.014)
Observations	16,384	16,384	11,283	11,283
Individuals	5,161	5,161	3,634	3,634

Standard errors in parentheses
**p<0.05*

Regarding the leisure activity, physical activity and social support variables, there are no differences between genders. As well as in the main results, all coefficients for these mediators do not significantly differ from zero at a 5% level. There are no differences for the income variable between genders as well, yielding significant mediation effects for both males and females.

Lastly, the coefficient of the indirect effect of Medicare is significant for males, but not for females. The reason that Medicare is more beneficial for the mental health of male retirees than of female retirees is likely to be caused by the risk attitudes that differ per gender. Males are more likely to be risk-seekers in life (Weber et al., 2002). One of these risks is purchasing more risky health insurance packages, leading to a worse access to healthcare for males. When someone then receive Medicare, their access to healthcare also increases, leading to more positive mental health outcomes.

4.2.2 Marital status

To test for the heterogeneity caused by someone's marital status, I estimate the mediation analyses for each mediator again, limiting the sample to married individuals, to divorced individuals and to widowed individuals. The results of this heterogeneity analysis can be found in table 16.

Where in the main results, physical disease had a significant mediating effect for complete retirees, this is in this analysis only the case for married retirees. For divorced and widowed retirees, an increase in physical health issues does not have a mediating effect in the retirement – mental health relationship. The reason that this effect is only present for married retirees is likely due to the fact that they have a partner to be taken into account. When someone suffers increasingly from physical issues, this increases the likelihood that this individual will be demanding more healthcare services. This puts a big burden on the partner, which in its turn influences the mental health of the individual.

For the physical activity mediator, there are no changes in the mediating effects for each category of marital status. In the married category, however, the total and direct effect do now yield significant effects. This does not only happen for physical activity, but also for other mediators. Coefficients become larger, standard errors become smaller and, in some cases, the total and direct effects are significant at a 5% level. This happens for both married and divorced individuals, but not for widowed individuals. The effect for married individuals is, however, positive, indicating a negative effect of retirement on mental health. For divorced individuals, this effect is reversed. These effects are the opposite of what Wang and Shi (2014) found. The reason for this is possibly related to the timing of someone's retirement. If married couples do not retire at the same time, a lonelier time gap arises for the retired individual, which he/she would likely rather spend with their working partner. This does not apply for divorced individuals, who can spend their time as they like, without having to take a partner into account, which is more likely to have a positive effect on mental health.

Table 16: Heterogeneity analysis of marital status for each mediator

Physical disease	**Married**		**Divorced**		**Widowed**	
	Classical method	Causal method	Classical method	Causal method	Classical method	Causal method
Total effect	0.066	-0.018	-0.148	-0.023	0.006	-0.105
	(0.029)	(0.031)	(0.072)	(0.091)	(0.055)	(0.062)
Direct effect	0.065	-0.033	-0.147	-0.046	0.005	-0.104
	(0.028)	(0.031)	(0.075)	(0.090)	(0.054)	(0.061)
Indirect effect	0.001	0.014*	-0.001	0.023	0.000	0.001
	(0.001)	(0.04)	(0.003)	(0.014)	(0.001)	(0.007)
Observations	16,356	16,356	2,855	2,855	6,290	6,290
Individuals	5,769	5,769	1,250	1,250	2,109	2,109

Physical activity	**Married**		**Divorced**		**Widowed**	
	Classical method	Causal method	Classical method	Causal method	Classical method	Causal method
Total effect	0.066*	-0.004	-0.136	0.046	-0.002	-0.111
	(0.029)	(0.032)	(0.078)	(0.091)	(0.055)	(0.062)
Direct effect	0.065*	-0.005	-0.136	0.045	-0.001	-0.112
	(0.029)	(0.032)	(0.076)	(0.091)	(0.053)	(0.063)
Indirect effect	0.000	0.001	0.000	0.001	-0.001	0.000
	(0.000)	(0.001)	(0.002)	(0.003)	(0.002)	(0.001)
Observations	16,358	16,358	2,855	2,855	6,292	6,292
Individuals	5,769	5,769	1,250	1,250	2,111	2,111

Social support	**Married**		**Divorced**		**Widowed**	
	Classical method	Causal method	Classical method	Causal method	Classical method	Causal method
Total effect	0.063	-0.023	-0.159	-0.075	-0.002	-0.130
	(0.042)	(0.044)	(0.092)	(0.105)	(0.065)	(0.075)
Direct effect	0.063	-0.022	-0.159	-0.076	-0.001	-0.130
	(0.042)	(0.044)	(0.092)	(0.105)	(0.065)	(0.075)
Indirect effect	0.000	0.001	0.000	0.001	-0.001	0.001
	(0.001)	(0.001)	(0.003)	(0.005)	(0.001)	(0.002)
Observations	7,018	7,018	2,156	2,156	4,337	4,337
Individuals	2,729	2,729	1,068	1,068	1,683	1,683

Household income	**Married**		**Divorced**		**Widowed**	
	Classical method	Causal method	Classical method	Causal method	Classical method	Causal method
Total effect	0.067*	-0.016	-0.151*	-0.011	0.000	-0.097
	(0.030)	(0.031)	(0.065)	(0.088)	(0.048)	(0.061)
Direct effect	0.060*	-0.030	-0.169*	-0.033	-0.013	-0.099
	(0.028)	(0.031)	(0.076)	(0.088)	(0.053)	(0.061)
Indirect effect	0.007*	0.013*	0.018	0.022	0.013*	0.003
	(0.003)	(0.005)	(0.011)	(0.018)	(0.005)	(0.003)
Observations	16,881	16,881	2,939	2,939	6,567	6,567
Individuals	5,882	5,882	1,264	1,264	2,169	2,169

Leisure activity	**Married**		**Divorced**		**Widowed**	
	Classical method	Causal method	Classical method	Causal method	Classical method	Causal method
Total effect	0.057	-0.031	-0.184*	-0.082	0.023	-0.110
	(0.041)	(0.044)	(0.087)	(0.102)	(0.065)	(0.075)
Direct effect	0.057	-0.038	-0.183*	-0.082	0.021	-0.104
	(0.041)	(0.044)	(0.086)	(0.103)	(0.064)	(0.075)
Indirect effect	0.000	0.007	-0.001	0.000	0.002	0.006
	(0.002)	(0.005)	(0.004)	(0.010)	(0.003)	(0.006)
Observations	7,165	7,165	2,226	2,226	4,467	4,467
Individuals	2,763	2,763	1,091	1,091	1,725	1,725

Medicare	**Married**		**Divorced**		**Widowed**	
	Classical method	Causal method	Classical method	Causal method	Classical method	Causal method
Total effect	0.060*	-0.424	-0.161*	-0.031	-0.010	-0.094
	(0.024)	(0.032)	(0.077)	(0.093)	(0.055)	(0.061)
Direct effect	0.070*	-0.032	-0.163*	0.033	-0.001	-0.100
	(0.028)	(0.035)	(0.077)	(0.114)	(0.053)	(0.062)
Indirect effect	-0.010*	0.011	0.002	-0.064	-0.009	0.006
	(0.004)	(0.010)	(0.015)	(0.050)	(0.007)	(0.014)
Observations	17,013	17,013	2,980	2,980	6,669	6,669
Individuals	5,908	5,908	1,275	1,275	2,176	2,176

Standard errors in parentheses
**p<0.05*

The indirect effects of the physical activity, leisure activity and social support activities are not significant for each category, similar as to the effects found in the main results. The mediating effect of household income, however, is significant for both married and widowed retirees, but not for divorced retirees, ceteris paribus. This is likely due to the fact that the total effect of retirement is larger for divorced retirees than for married or widowed retirees, while the magnitude of the mediated effect is roughly equal. The mediated share through income is therefore much lower for divorced retirees, implying that their mental health is mediated through other stressors, such as loneliness or increase in leisure time, dominating the mediating effect of household income.

Lastly, the mediation effect of receiving Medicare is significant for married retirees. This is similar as the mediation effect for complete retirees in the main results, where receiving Medicare is beneficial for someone's mental health. The reason that only married individuals experience this effect is likely again due to their partner. Receiving Medicare is likely to increase someone's access to healthcare services, which reduces the burden of care their partner faces when they fall ill. Reducing this burden on someone's partner is likely to increase their own mental health, resulting in a significant mediating relationship of receiving Medicare for married retirees.

4.2.3 Education

In order to be able to perform a heterogeneity analysis with education, I divide my sample into two groups. Individuals who have graduated college are considered higher educated individuals and individuals who did not graduate college are considered lower educated individuals. The results of this heterogeneity analysis can be found in table 17.

Physical disease is again significant at a 5% level for only one group. An increase in physical health issues postretirement has a significant negative effect on the mental health of lower educated retirees, but not for higher educated retirees. This is not a surprising result, since higher educated individuals tend to be more physically healthy (Ross & Wu, 1995). They therefore experience much less physical health issues due to retirement, which then cannot yield mediating effects. People who are lower educated tend to be less informed and also less financially capable to maintain a healthy lifestyle, leading to more physical issues postretirement, which then influences their mental health.

For the physical activity, leisure activity and social support mediators there are no significant heterogenic results. Both higher and lower educated retirees do not experience an effect on their mental health through these factors. There is, however, a significant indirect effect for household income for lower educated people, whereas this effect is not significant at a 5% level for higher educated individuals. This is again not a surprising outcome, since higher educated individuals are expected to have earned much more income than lower educated individuals over the course of their

Table 17: Heterogeneity analysis of education for each mediator

Physical disease	**College graduate**		**Not a college graduate**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.055	-0.113*	0.023	-0.021
	(0.043)	(0.050)	(0.028)	(0.032)
Direct effect	0.055	-0.110*	0.021	-0.037
	(0.043)	(0.050)	(0.024)	(0.032)
Indirect effect	0.000	-0.003	0.002	0.016*
	(0.001)	(0.005)	(0.001)	(0.005)
Observations	5,843	5,843	20,650	20,650
Individuals	1,958	1,958	6,656	6,656

Physical activity	**College graduate**		**Not a college graduate**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.060	-0.102*	0.021	-0.016
	(0.042)	(0.051)	(0.029)	(0.033)
Direct effect	0.062	-0.099*	0.021	-0.017
	(0.043)	(0.050)	(0.029)	(0.033)
Indirect effect	-0.002	-0.003	0.000	0.001
	(0.001)	(0.003)	(0.000)	(0.001)
Observations	5,845	5,845	20,652	20,652
Individuals	1,958	1,958	6,656	6,656

Social support	**College graduate**		**Not a college graduate**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.039	-0.126	0.008	-0.051
	(0.059)	(0.070)	(0.039)	(0.043)
Direct effect	0.039	-0.127	0.008	-0.051
	(0.059)	(0.069)	(0.039)	(0.043)
Indirect effect	0.000	0.001	0.000	0.000
	(0.003)	(0.002)	(0.000)	(0.001)
Observations	3,048	3,048	11,207	11,207
Individuals	1,178	1,178	4,184	4,184

Household income	**College graduate**		**Not a college graduate**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.058	-0.110*	0.020	-0.017
	(0.045)	(0.049)	(0.031)	(0.032)
Direct effect	0.050	-0.104*	0.015	-0.032
	(0.043)	(0.049)	(0.028)	(0.031)
Indirect effect	0.008	-0.006	0.005*	0.014*
	(0.006)	(0.008)	(0.002)	(0.004)
Observations	5,986	5,986	21,431	21,431
Individuals	1,988	1,988	6,799	6,799

Leisure activity	**College graduate**		**Not a college graduate**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.028	-0.129	0.009	-0.049
	(0.058)	(0.069)	(0.038)	(0.043)
Direct effect	0.024	-0.230	0.009	-0.050
	(0.057)	(0.069)	(0.038)	(0.043)
Indirect effect	0.003	0.001	0.000	0.001
	(0.005)	(0.009)	(0.001)	(0.004)
Observations	3,130	3,130	11,476	11,476
Individuals	1,192	1,192	4,235	4,235

Medicare	**College graduate**		**Not a college graduate**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.051	-0.119*	0.014	-0.042
	(0.042)	(0.053)	(0.027)	(0.032)
Direct effect	0.058	-0.117	0.022	-0.025
	(0.043)	(0.062)	(0.028)	(0.035)
Indirect effect	-0.007	-0.001	-0.008*	0.017
	(0.006)	(0.021)	(0.004)	(0.012)
Observations	6,028	6,028	21,677	21,677
Individuals	1,993	1,993	6,829	6,829

Standard errors in parentheses
**p<0.05*

career. While the income drop that a higher educated individual experiences postretirement is much higher, they are more likely to have built a financial buffer to overcome this income shock. This buffer is much smaller or non-existent for lower educated individuals, who therefore value their income more and feel the consequences of the loss of that income more. This is also supported by the data, as the mean value of household assets is more than twice as high for higher educated individuals than for lower educated individual. It is therefore not surprising that lower educated retirees experience a decrease in mental health after retirement, mediated through their household income.

Lastly, for the Medicare mediator, the mediating effect of receiving Medicare is significant at a 5% level using the classical method. This, again, is not a surprising result, since it is likely that lower educated individuals have worse healthcare coverage, either because of a lack of information or a lack of financial recourses. A bad healthcare coverage leads to a decreased access to healthcare services, which might have an influence on someone's mental health. When an individual then receives Medicare benefits, this negative effect disappears and he/she experiences an increased access to healthcare, leading to an increase in their mental health.

Something which is also worthwhile to note is that for the higher educated individuals, none of the mediators yield significant effects. The reason for this is possibly that higher educated people tend to engage more in retirement planning preretirement. In the literature, this has proven to generate positive mental health effects, which happen because people can prepare themselves for the challenges to come. They built some resilience towards the negative factors, mitigating or even preventing the effect these might have on their mental health. Furthermore, this also supports the continuity theory of Atchley (1971), which predicts that people take important parts of their working life with them into retirement life, maintaining their levels of mental health. This is something that can be achieved through retirement planning, which indicates that it is expected to see no effects for highly educated individuals.

4.2.4 Retirement age

The timing of someone's retirement can also be of importance when analysing the effect that retirement has on someone's mental health. In order to perform a heterogeneity analysis, I use the age on which people first reported to be retired as retirement age. I consider people who retired at age 60 or earlier to be early retirees and people who retire at age 70 or later to be late retirees. The results of this heterogeneity analysis can be found in table 18.

Table 18: Heterogeneity analysis of retirement age for each mediator

Physical disease	**Retirement age > 70**		**Retirement age < 60**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.125	-0.102	-0.080	-0.205*
	(0.065)	(0.106)	(0.056)	(0.068)
Direct effect	0.123	-0.097	-0.069	-0.225*
	(0.064)	(0.106)	(0.055)	(0.068)
Indirect effect	0.001	-0.005	-0.011	0.020*
	(0.012)	(0.010)	(0.006)	(0.009)
Observations	2,486	2,486	6,735	6,735
Individuals	907	907	2,351	2,351

Physical activity	**Retirement age > 70**		**Retirement age < 60**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.155	-0.048	-0.022	-0.208*
	(0.073)	(0.107)	(0.058)	(0.069)
Direct effect	0.157	-0.057	-0.022	-0.209*
	(0.073)	(0.0106)	(0.058)	(0.069)
Indirect effect	-0.002	0.009	0.000	0.001
	(0.003)	(0.006)	(0.001)	(0.002)
Observations	2,486	2,486	6,735	6,735
Individuals	907	907	2,351	2,351

Social support	**Retirement age > 70**		**Retirement age < 60**	
	Classical method	Causal method	Classical method	Causal method
Total effect	-0.019	-0.296*	-0.075	-0.174
	(0.086)	(0.138)	(0.079)	(0.095)
Direct effect	-0.018	-0.299*	-0.075	-0.176
	(0.086)	(0.138)	(0.079)	(0.094)
Indirect effect	0.000	0.003	0.000	0.002
	(0.004)	(0.005)	(0.001)	(0.003)
Observations	1,409	1,409	3,707	3,707
Individuals	586	586	1,497	1,497

Household income	**Retirement age > 70**		**Retirement age < 60**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.095	-0.078	0.058	-0.217*
	(0.063)	(0.104)	(0.054)	(0.069)
Direct effect	0.094	-0.093	0.058	-0.220*
	(0.063)	(0.104)	(0.054)	(0.069)
Indirect effect	0.001	0.015	0.001	0.003
	(0.014)	(0.017)	(0.001)	(0.006)
Observations	2,546	2,546	6,987	6,987
Individuals	928	928	2,399	2,399

Leisure activity	**Retirement age > 70**		**Retirement age < 60**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.014	-0.312*	0.069	-0.171
	(0.084)	(0.135)	(0.077)	(0.093)
Direct effect	0.012	-0.321*	0.069	-0.166
	(0.083)	(0.136)	(0.077)	(0.094)
Indirect effect	0.003	0.010	0.000	0.005
	(0.010)	(0.014)	(0.002)	(0.009)
Observations	1,435	1,435	3,816	3,816
Individuals	592	592	1,528	1,528

Medicare	**Retirement age > 70**		**Retirement age < 60**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.106	-0.077	-0.064	-0.226*
	(0.063)	(0.103)	(0.056)	(0.068)
Direct effect	0.123	-0.081	-0.033	-0.158*
	(0.065)	(0.104)	(0.054)	(0.069)
Indirect effect	-0.017	0.004	-0.031*	-0.068*
	(0.021)	(0.005)	(0.010)	(0.021)
Observations	2,588	2,588	7,058	7,058
Individuals	933	933	2,405	2,405

Standard errors in parentheses
**p<0.05*

For the physical disease mediator, I again find significant effects for only one of the subgroups. People who retire at an earlier age experience significant effects of physical health issues on their mental health. This effect is not significant at a 5% level for late retirees. The reason for this is possibly that people who retire at a younger age are likely to retire voluntarily. People who retire this early probably have the recourses to deal with the income drop that comes with retirement and choose to spend their time on other activities than work. When this individual then starts experiencing limitations due to arising physical health issues, it is likely that they will suffer more than older people who take their health issues with them into retirement. Younger retirees will therefore feel a bigger burden of physical health issues than older retirees, resulting in the significant mediation effect for early retirees.

I do again find no significant mediation effects for both categories for the leisure activity, physical activity and social support mediators. Furthermore, in contrast with what I found in the previous heterogeneity analyses, I find no significant mediating effects for the household income mediator. For the early retirees this can be explained, again, through the probable voluntary retirement of the earlier retirees. They are likely to have built a financial buffer, which allows them to retire earlier. The drop in income is therefore not a source of stress for them, resulting in no stress that affects mental health through income worries. For the late retirees, the reasons are likely to be similar. Either the retiree kept on working while having reached retirement age because they enjoyed the work they did. The monetary factor is then likely to play a small role in the decision to keep on working and will therefore also play a small role when someone retires. Another reason might be that the individual kept working because they needed the income. They are then likely to continue working until they have created a large enough financial buffer to be able to retire without financial worries. Following this logic, it is therefore also expected that the financial aspect does not have a significant mediating role in the retirement – mental health relationship.

Lastly, the mediating effect of receiving Medicare benefits is also only significant for the early retirees. That the effect for late retirees is not significant at a 5% level is expected, because these individuals already receive the Medicare benefits for at least five years before they retire. Extra effects after retirement are therefore not likely to occur. A significant effect for the young retirees is no surprise as well. These people need to pay their healthcare insurance out of their own pocket, since they cannot count on employee benefits anymore postretirement. Especially when someone ages, their access to healthcare services can become a significant stressor in their life, and when they finally receive Medicare benefits, they get relieved from this stressor. The disappearance of these worries is therefore likely to increase their mental health postretirement, once they start receiving the Medicare benefits.

4.2.5 Household assets

Table 19: Heterogeneity analysis of value of assets for each mediator

Physical disease	**High value of assets**		**Low value of assets**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.021	-0.036	0.037	-0.004
	(0.032)	(0.024)	(0.044)	(0.051)
Direct effect	0.021	-0.047	0.034	-0.018
	(0.032)	(0.034)	(0.043)	(0.052)
Indirect effect	0.000	0.010*	0.003	0.013
	(0.021)	(0.004)	(0.002)	(0.008)
Observations	11,400	11,400	9,623	9,623
Individuals	3,791	3,791	4,324	4,324

Physical activity	**High value of assets**		**Low value of assets**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.017	-0.055	0.020	-0.010
	(0.033)	(0.035)	(0.044)	(0.053)
Direct effect	0.017	-0.054	0.022	-0.010
	(0.033)	(0.035)	(0.044)	(0.053)
Indirect effect	0.000	0.001	-0.002	0.000
	(0.00)	(0.001)	(0.001)	(0.003)
Observations	11,403	11,403	9,623	9,623
Individuals	3,791	3,791	4,324	4,324

Social support	**High value of assets**		**Low value of assets**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.032	-0.040	0.004	-0.034
	(0.044)	(0.047)	(0.058)	(0.067)
Direct effect	0.032	-0.039	0.004	-0.037
	(0.044)	(0.047)	(0.058)	(0.067)
Indirect effect	0.000	-0.001	0.000	0.003
	(0.001)	(0.024)	(0.001)	(0.003)
Observations	5,931	5,931	5,519	5,519
Individuals	2,220	2,220	2,780	2,780

Household income	**High value of assets**		**Low value of assets**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.030	-0.036	-0.006	-0.034
	(0.032)	(0.034)	(0.043)	(0.051)
Direct effect	0.027	-0.046	-0.004	-0.038
	(0.032)	(0.034)	(0.043)	(0.051)
Indirect effect	0.004	0.010	0.010*	0.004
	(0.003)	(0.006)	(0.004)	(0.006)
Observations	11,779	11,779	9,892	9,892
Individuals	3,863	3,863	4,403	4,403

Leisure activity	**High value of assets**		**Low value of assets**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.028	-0.048	0.005	-0.031
	(0.045)	(0.047)	(0.056)	(0.067)
Direct effect	0.026	-0.047	0.005	-0.034
	(0.044)	(0.047)	(0.056)	(0.067)
Indirect effect	0.002	0.001	-0.001	0.002
	(0.002)	(0.006)	(0.002)	(0.005)
Observations	6,085	6,085	5,629	5,629
Individuals	2,249	2,249	2,814	2,814

Medicare	**High value of assets**		**Low value of assets**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.026	-0.043	0.012	-0.022
	(0.031)	(0.034)	(0.041)	(0.052)
Direct effect	0.032	-0.038	0.018	0.009
	(0.032)	(0.037)	(0.042)	(0.060)
Indirect effect	-0.006	0.005	-0.006	-0.031
	(0.005)	(0.012)	(0.006)	(0.022)
Observations	11,879	11,879	10,128	10,128
Individuals	3,875	3,875	4,473	4,473

Standard errors in parentheses
**p<0.05*

The next heterogeneity analysis is based on the wealth of the retiree. I could split my sample into high and low income to accomplish this, but I have decided to use total value of household assets as the factor of heterogeneity. I do this because, especially when approaching retirement, people with a lower income could still be quite wealthy, meaning that a drop in income would not be experienced as a stressor for this group. High income individuals will likely fall into the high assets group as well, since a high income is highly correlated with greater wealth as well. Therefore, based on the value of household assets, people will always fall into the 'income' group where they belong, with richer people in the high assets group and poorer people in the low asset group. As formulated in section 3.2, it is expected that the mediation effect of household income is higher for individuals from the low asset group than from the high assets group, due to the lack of a financial buffer postretirement. To create the high and low asset categories, I have taken the upper two quintiles of household assets value as my high assets group, and the lower two quintiles of household assets value as my low assets group. The middle quintile will not be regarded in this analysis. The results of this analysis can be found in table 19.

Firstly, for the physical disease mediator, the mediating effect is only significant for the high asset group. The mediating effect for the low income group is not significant at a 5% level. This is possibly due to the healthier lifestyle that wealthier people tend to maintain. These people are not used to physical health issues, and postretirement, combined with ageing, these issues start to be part of someone's life, which can be experienced as a stressor that influences mental health. The reason that the low asset group does not experience the same effect on mental health is possibly due to the fact that, because of their unhealthier lifestyle, the physical health issues already start before retirement. When the issues increase postretirement, the extra stress induced will be lower than when the issues first emerge postretirement, resulting in lower and non-significant mediating effects for the physical disease mediator.

As well as for the previous heterogeneity analyses, I do not find any significant mediating effects for the leisure activity, physical activity and social support mediators, which is in line with my main results. Furthermore, I do not find any significant mediating effect of receiving Medicare benefits for both the high and the low asset groups. It is quite surprising that the effect of Medicare benefits is not significant at a 5% level for the low asset group. It might be the case that lower assets do not mean lower access to healthcare, and that this access to healthcare depends more on factors as risk attitudes and information on healthcare insurance.

Lastly, the mediating effect of household income for the high asset group is not significant at a 5% level. This is according to the expectations, since the high income group is likely to have a large

enough to not have to worry about financial issues. The effect is significant for the low asset group, indicating that one needs a financial safety net postretirement to mitigate the negative effects that retirement has on mental health, mediated through an income drop. This supports the hypothesis that was formulated in section 3.2.

4.2.6 Medical expenses

The last heterogeneity analysis I run is determine whether there is a difference in the mediating effect of receiving Medicare benefits for people who paid a high amount of medical expenses out of their own pocket and for people who paid a low amount of medical expenses out of their own pocket. In section 3.2, I hypothesise that the effect is significant for the high expenses group, since receiving Medicare will reduce the costs this group needs to make on healthcare services, effectively increasing their disposable income. For the low medical expenses group, this is does not apply, so no significant effects are expected.

To create these groups, I used the bottom two quintiles of the yearly out of pocket medical expenses variable for the low expenses group and the top two quintiles for the high expenses group. I run this analysis only for the Medicare mediator, since out of pocket medical expenses is not expected to yield relevant heterogenic effects for this thesis. The results of the analysis can be found in table 20.

Table 10: Heterogeneity analysis of out of pocket medical expenditures for the Medicare mediator

Medicare	**High medical expenses**		**Low medical expenses**	
	Classical method	Causal method	Classical method	Causal method
Total effect	0.047	-0.038	-0.018	-0.058
	(0.038)	(0.042)	(0.038)	(0.042)
Direct effect	0.050	-0.036	-0.008	-0.025
	(0.038)	(0.046)	(0.037)	(0.047)
Indirect effect	-0.003	-0.002	-0.010*	-0.032*
	(0.005)	(0.012)	(0.005)	(0.016)
Observations	11,427	11,427	10,443	10,443
Individuals	5,202	5,202	5,151	5,151

Standard errors in parentheses
**p<0.05*

The mediating effect of Medicare is not significant at a 5% level for the high medical expenses group, but it is significant at a 5% level for the low expenses group. This opposes the hypothesis I formulated in section 3.2. This implies that the costs of healthcare are not the stressor that causes a decrease in mental health. When people who have high medical expenses start receiving Medicare benefits, parts of their expenses will now likely be covered by their Medicare insurance, which will decrease the amount of money they have to spend on health issues and increase their disposable income. This

effect is, however, not significant at a 5% level, which means that this increase in disposable income does not increase someone's mental health.

It is therefore likely that the stressor that causes decreased mental health is the access to healthcare. People with low medical expenses are likely to need medical attention from time to time, but do not seek this attention due to financial reasons. This limits their access to healthcare and decreases their mental health outcomes. When someone starts receiving Medicare benefits, these financial concerns of seeking medical attention disappear, which will increase the access to healthcare for the low medical expense group, which in turn increases mental health outcomes. The stressor that is caused by lack of health insurance is therefore not of financial nature, but rather of a social nature, due to the reduced access to healthcare.

5. Discussion

5.1 Interpretation of results

In this thesis I examine through which pathways retirement affects mental health in the United States. In my main results, I find that physical disease, household income and receiving Medicare benefits have significant mediating effects in the retirement – mental health relationship for complete retirees. For partial retirees, only receiving Medicare benefits yields significant mediating effects. For the mediators physical activity, leisure activity and social support, no significant mediating effect was found for both complete and partial retirees.

Furthermore, I find support for the multiple-pathway nature of retirement transition and adjustment. Performing several heterogeneity tests show that only household income has significant mediating effects for almost every subgroup of the sample, while the mediating effects of physical disease and Medicare benefits highly depend on the characteristics of each subgroup.

Reasons for significance do tend to vary among subgroups. For the physical activity mediator, I find significant mediating effects for men, married individuals, low educated individuals, young retirees and richer retirees. The reason why physical disease is a significant mediator differs for each of these subgroups, as discussed in section 4.2.

Furthermore, I find significant mediating effects of income for both men and women, married and widowed individuals, low educated individuals and poorer individuals. Reasons for significance are possibly due to a low financial buffer postretirement, while reasons for non-significance indicate that for certain subgroups, other stressors are more important in the outcomes of mental health, dominating the mediating effect of household income.

Lastly, for receiving Medicare benefits, the reason for significance is consistent across all subgroups. This can be attributed to the improved access to healthcare services, provided by receiving better health insurance benefits through Medicare. The effect of improved healthcare access dominates the effect of out-of-pocket healthcare expenditures. This leads to a significant mediating effect of receiving Medicare benefits for the low healthcare expenses group, and to non-significant mediating effects for the high healthcare expenses group.

These results are mostly in line with the theory and existing literature. According to the stress process model and the stress and coping theory, specific stressors that emerge postretirement can influence someone's mental well-being, if not coped with well. Physical health issues and a large income drop after retirement have been identified as being part of these potential stressors, and have proven to have a significant mediating effect on someone's mental health. This is in line with a research by Weiss (2005), who showed that more financial insecurity can induce more stress, which in turn affects someone's mental health. The significance of receiving Medicare benefits is also in line with

the stress process model and the stress and coping theory, since this takes away the stressor of a lack of access to healthcare. When someone receives Medicare benefits, they no longer have to worry about the issues that their medical problems will induce, since this will be taken care of by their benefits. This relieves them from stress, which in turn has a positive effect on their mental well-being. The fact that I do not find any significant effects for highly educated individuals is also in line with the theory and current literature. Kim and DeVaney (2005) showed that higher educated individuals are more likely to engage in retirement planning, which should have a positive effect on postretirement well-being. This is in line with the continuity theory, which predicts that retirees take important aspects of their working life with them into retirement life, leading to a maintained mental health level. This is something that is accommodated by adequate planning preretirement.
Furthermore, the life course perspective predicts that advantages that are gained during someone's life accumulate over time. Engaging in retirement planning is such a gained advantage, which then accumulates into retirement and prevents certain negative effects that retirement can have on mental health. This also indicates that possessing adequate information, which is likely to be the case for highly educated individuals, can improve postretirement mental health outcomes, emphasizing the need to educate individuals on the effect that retirement might have on their mental health.

The part of this thesis that deviates from the theory and existing literature is the absence of significant mediating effects for the physical activity, leisure activity and social support variables. According to the stress process model and the stress and coping theory, all these variables should act as coping mechanisms, reducing stress and increasing mental health. Furthermore, the social convoy model predicts that an extensive social support network is beneficial for someone's mental health. The activity theory of ageing suggests that physical activity and leisure activity are significant predictors of physical health, which in its place would improve mental health as well. These effects are, however, absent in the results of this thesis. This is possibly the case due to the way that these variables are measured. Each of these variables is built up from several activities, measured in weekly hours spent. This is arguably not the best way to measure these variables, especially for the leisure activity and social support variables, where it is more important how the activities are perceived by the individual than the absolute time they spend on them. Questions as 'how would you rate your social support status on a scale of one to five' and 'how satisfied are you with the amount of time you can spend on leisure activities on a scale of one to five' are likely to produce more reliable and relevant data, resulting in significant effects for these mediators. This is something that further research can built upon.

5.2 Internal validity

As discussed in the section 3.4, the results represent the causal mediating effect of each mediator when in the mediator and outcome equations, there is controlled for all retirement – mental health, retirement – mediator and mediator – mental health confounders. Furthermore, there must be no confounders in the mediator – mental health relationship, either observed or unobserved, that are caused by retirement.

These assumptions are, however, unlikely to hold in this analysis. I have tried to make the estimates more causal by adding individual fixed effects dummies to the equations, but this was unfortunately not possible. After more than 48 hours of running the analysis of only one mediator, the estimation resulted in an error due to a lack of computational power. To overcome this problem, I have time-demeaned my data for the classical mediation analysis approach, but this was not possible for the causal estimation method. I can therefore not conclude that I have controlled for all possible confounders, and the possibility that there are unobserved confounders that are not controlled for cannot be ruled out. The estimated effects are therefore possibly biased, which prevents me from drawing conclusions on causal relationships.

Furthermore, I cannot rule out the presence of additional biases. Firstly, the physical activity, leisure activity and social support mediators are measured in terms of hours per week. The effect that these variables have is, however, quite subjective. Someone who spends ten hours per week on leisure activities can experience more utility from this than someone who spends 50 hours per week on leisure activities. The units in which these variables are measured therefore do not represent the true effect that these mediators might have in the retirement – mental health relationship, leading to biased estimates for these mediators.

Due to the subjectivity of the respondent, the data could also suffer from measurement bias. For example, the questions that are asked to create someone's CESD-score can be experienced differently for different individuals. If someone gets asked the question 'have you been happy over the past week', their answer depends on what they perceive as happiness, of which levels can highly differ among individuals. Furthermore, this can also be influenced by the time of the interview. If someone, by coincidence, has experienced two very stressful weeks just prior to the interview, but does not experience this stress before and after those two weeks, their CESD-score is likely to not represent their true mental health status. The CESD-score could also be subject to reference bias, as individuals might compare their own well-being with the well-being of people close by. Individuals are likely to report worse CESD-scores if the mental health of someone around them is even worse than theirs, leading to biased values of their CESD-scores.

Another potential bias in the data is due to attrition. By the nature of the data, individuals drop out of the study of time, either due to death or another reason that results in them not being able to

respond. This attrition is, however, unlikely to be related to the treatment, i.e., retirement, since the goal of the study is to follow individuals over the course of their retirement as well. I can, however, not rule out that attrition and retirement are not related, leading to potential biased estimates. The concerns related to the potential biases in this thesis prevent me from interpreting the mediation effects causally, which is a limitation of this study.

5.3 External validity

Since the results of this thesis are possibly biased, there is cause to doubt the internal validity of this study. This decreases the relevance of the external validity. This thesis does, however, produce partly externally valid results. Several aspects, such as the Medicare and income mediators, are not externally valid, since these rely on the underlying characteristics in the United States. Factors such as physical activity, leisure activity and social support, however, rely on universal microeconomic theories, and not on the characteristics of the USA. These results depend on how humans tend to react on several activities, and these reactions are likely to be similar all over the world, resulting in externally valid results for these mediators. Generalising the results of this thesis to other countries should therefore be done with caution, but certain aspects of this thesis do have predictive power on other settings as well.

5.4 Recommendations for further research

As discussed in the previous sections, there are concerns with the assumptions required to interpret the results as causal estimates. Further research should therefore try to attempt to provide a more accurate and unbiased estimation of the mediating effects that are present in the retirement – mental health relationship. As discussed, one of the limitations of this thesis is that I was not able to incorporate individual fixed effects dummies in the causal mediation analysis method. Conducting these analyses with on a device with more computational power would decrease the bias in the estimates, by omitting the time-invariant variation in the data. Causal conclusions might then still be hard to draw, but it would certainly be an improvement over the methodology of this thesis. Furthermore, further research should try to estimate the mediating effects of the physical activity, leisure activity and social support mediators, using different measurement techniques for these variables. Both the microeconomic theories and current literature imply that these factors should have a significant mediating effect in the retirement – mental health relationship. I was, however, unable to find these effects. If further research can use data that use measurements which incorporate the subjectiveness of these factors, it is likely that significant mediating effects of these factors can be found. This can be achieved by designing a survey, specifically tailored to find the mediating effects in the retirement – mental health relationship. Measurement would then be appropriate, as well as data on every mediator of interest could be acquired.

Further research should also try to explore different potential mediators. As discussed in the data section, the theory predicts several potential mediators for which I did not have sufficient data. For example, preretirement planning is very likely to have a significant mediating effect, but I did not have data on whether someone has made detailed plans for their retirement. The same applies for the loss of part of someone's identity after retirement. Survey questions could be asked on this, but these were absent in the HRS and CAMS interviews. Exploring other potential mediators is therefore also something that further research can improve on.

6. Conclusion

With an increasing share of the population transitioning into retirement, the healthcare expenses of this age group become of increasing economic significance. A big driver of these healthcare expenses is mental health, and society should be aware of the effects that someone's retirement has on their mental health. This thesis aims to understand the pathways through which retirement affects mental health. I run both the classical and causal method of a mediation analysis to estimate the mediating effects in the retirement – mental health relationship of physical disease, physical activity, social support, household income, leisure activity and Medicare benefits. Furthermore, I run heterogeneity analyses for gender, marital status, education level, retirement age, value of household assets and medical costs, in order to understand the multi-pathway nature that the effect of retirement has on mental health.

I find significant mediating effects for the physical disease, household income and Medicare benefits mediators, while finding no effect for the physical activity, social support and leisure activity mediators. Furthermore, the results are of a highly heterogenic nature, where reasons for significance differ for each subgroup of the sample. The results suggest that maintained physical health, increased access to healthcare and no financial concerns are the most important factors that mediate the retirement – mental health relationship.
Additionally, I find that there are no significant mediating effects for the highly educated group, whereas these effects do exist for the lower educated group. This suggests that access to information on the potential mental health effects after retirement is an important aspect in maintaining mental health outcomes postretirement. Furthermore, the mediating effect of receiving Medicare benefits is significant for the individuals with low out of pocket healthcare expenditures, and not significant for individuals with high out of pocket healthcare expenditures. This suggests that the effect of reduced out of pocket healthcare costs postretirement is dominated by the increase in access to healthcare postretirement, which is vital information for policy on healthcare insurance.

Further research should focus on reducing the concerns of bias is the mediation analyses. I recommend the use of individual fixed effects dummies in the causal mediation analysis method, which was unfortunately not possible for this thesis. Furthermore, a different type of measurement should be used for the research on physical activity, leisure activity and social support, which includes the subjectivity that is part of these mediators. This way, the true mediating effects can be found for these factors, providing a solid basis for policymakers to design effective mental health policies for the retired population.

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