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The retirement (food) consumption puzzle revisited - A panel data study from Denmark
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ABSTRACT

The world population is ageing, and as lifestyle-related illnesses and multi-morbidity increase with ageing, prevention with modifiable factors is becoming an increasingly important issue. In the current paper, we revisit the retirement (food) consumption puzzle in a welfare state context and examine how retirement affects food expenditure and energy intake as well as the dietary healthiness of elderly individuals with different marital and labor market status. We use a unique household panel data set covering the period from 2007–2017 with monthly food purchases from a sample of households above 55 years of age. We supplement the purchase data with official register data on income, health-contact days, unemployment, early voluntary and old age retirement at the individual level. The structure of the data set facilitates the identification of any associations between retirement and dietary behavior while controlling for important confounding factors such as the number of health-contact days as a proxy for health shocks and income as a proxy for wealth shocks. We compare the results with the results from estimations using instruments for the retirement decision. We do not find any evidence to support a retirement (food) consumption puzzle. Generally, the healthiness of diets increases at the point of retirement, and even more so for those who had the most unhealthy diets before retirement. Since the diets of individuals outside the labor market are less healthy both before and after retirement compared to other groups, the focus of dietary policy should be directed at this group.

1. Introduction

The proportion of elderly people in the population has increased in recent decades. In 2019, more than one fifth of the population in Europe were 65 years or above, an increase of almost three-percentage points since 2009. This trend is expected to continue in the coming decades and almost one third of the population is expected to be 65 years or above in 2050 (Eurostat, 2020). Similar demographic patterns are seen in most Western countries (WorldBank, 2020). Worldwide, the share of the population above 65 years of age is expected to increase from 9% today to 16% in 2050. As the prevalence of lifestyle-related diseases and multi-morbidity increases with age (Rosendahl Jensen et al., 2018), the overall health of the elderly is, therefore, an important issue for the health authorities. Modifiable actions necessary to counteract lifestyle-related disease and multi-morbidity are part of general health-promoting strategies, including measures to reduce smoking, increase physical activity and improve dietary patterns (Doyle et al., 2009). Maintaining adequate nutritional status during older age is an important strategy for reducing the prevalence of lifestyle-related illnesses as well as for delaying a decline in capacity and frailty conditions (WHO, 2015).

One important aspect of the ageing process is the transition from work to retirement, which for many individuals leads to a decrease in work-related income and, thereby, less money available to spend on food and living (Barrett and Brzozowski, 2012; Smith, 2006). The literature reports that at the time of retirement, people decrease their food expenditure (e.g. Aguila et al. 2011, Allais et al. 2020, Barrett and Brzozowski 2012, José Luengo-Prado and Sevilla 2013, Stephens Jr and Toohey 2018), which at a first glance may appear a logical derivative of a decrease in income. However, if retirement is anticipated, then according to the standard life-cycle model of consumption, individuals should be able to smooth consumption over their lifetime with little decline in food expenditure at the time of retirement. This drop in expenditure at retirement is named the retirement (food) consumption puzzle since the decline in spending is only found to concern two types of consumption; work-related items and food (Battistin et al., 2009; Browning and Crossley, 2001). In this context the decline in consumption of work-related items is anticipated, as the retired individual will no longer need work-related items, while the decline in food expenditure remains a puzzle.

There have been several attempts to explain this puzzle. Leaving the labor market implies that the individual is released from work-related stress and strain (Eibich, 2015) and has more time available to spend on meal activities, including shopping and doing more home cooking (Atalay et al., 2020; José Luengo-Prado and Sevilla, 2013; Velarde and Herrmann, 2014). The observed decrease in food expenditure is generally not found to be associated with a decrease in the quantity...
of food purchased, thus implying that shopping for cheaper foods may be part of the explanation. Food expenditure may also be reduced by increased home production of food instead of purchasing take-away or ready-to-eat meals (Aguirau and Hurst, 2005, 2007; Bonsang and Van Soest, 2015; Hurst, 2008). The heterogeneity in terms of the effect of retirement on food expenditure has, to some extent, been investigated across income groups (Alaïa et al., 2020; Barrett and Brzozowski, 2012; Hurd and Rohwedder, 2013; Hurst, 2008) and across voluntary and involuntary retirement (Barrett and Brzozowski, 2012; Hurst, 2008; Smith, 2006). Another element is the healthiness of the meals and the overall diet consumed. An increase in home production of meals may also lead to a change in the healthiness of the overall diet. Lack of time has been suggested to be a factor contributing to less healthy diets (Jabs and Devine, 2006; Monivais et al., 2014), implying that because retirement leads to more leisure time, it may also lead to increased dietary healthiness. The health aspect has, however, only been analyzed in a few studies (Alaïa et al., 2020; Celidoni et al., 2020; Chen et al., 2017; Eiblich, 2015; Hinnoosar, 2018; Schader and Herrmann, 2017).

In the current paper, we revisit the retirement (food) consumption puzzle in a welfare state with a flexible and advanced pension scheme, and examine how retirement affects food expenditure and energy intake as well as dietary healthiness for elderly individuals with different marital status. We focus on possible differences in the effects depending on whether the individual enters retirement from employment or from a position outside the labor market. Our contribution to the literature is three-fold. The first contribution is an analysis of how retirement affects food consumption in a welfare state, with different retirement schemes and income replacement compared to many other countries. The second contribution concerns the heterogeneous effects of retirement. We combine home scan data with register data, which allows us to analyze the effect of the retirement transition dependent on pre-retirement labor market status. Furthermore, the richness of the data allows us to use proxies for health and wealth status, which are often unavailable in other empirical studies. We compare this approach with the results from an IV approach using the ages eligible for retirement as instruments for the retirement decision. The inclusion of income as a proxy for wealth shocks in the model implies that our analysis addresses if the increased time available, at the point of retirement, can explain the decline in food expenditure. However, as we also estimate models without the income variables and models using an IV approach for comparison, these will directly test for the retirement (food) consumption puzzle. More knowledge about the effect of retirement on dietary healthiness is an important aspect in preventing the prevalence of lifestyle-related illnesses in the elderly population. Our last contribution to the literature is therefore that we focus on the effect of retirement on the overall healthiness of diets. The remainder of the paper is structured as follows: Section 2 describes the institutional setting of retirement in Denmark. Section 3 describes the data and methods. Section 5 presents the results and Section 6 discusses the results and the policy implications of the findings.

2. The retirement settings in Denmark

Retirement in Denmark can take two forms; early voluntary retirement (Efterløn) or old age retirement (Folkepension). Early voluntary retirement is a planned retirement that can take place from the age of 60 years and until the official age of old age retirement is reached. In 2011, the period that an individual could receive early voluntary pension was reduced from 5 years to 3 years and the starting age was raised to 61.5 years and then to 62 years in 2019. To be eligible for early voluntary retirement, the individual needs to be a member of an unemployment fund and needs to have paid contributions to the retirement scheme for a certain number of years. Not everyone who is eligible for early retirement chooses to retire early, but the proportion who do decide to retire early increases with age from 34 percent of those eligible at age 61, to 73 percent of those eligible at age 64 (STAR, 2020). Everybody is eligible to receive old age pension from 65 years. Regardless of income and marital status, everybody receives a standard pension, while low-income households and singles can receive bonuses and other additional financial support. Delaying the payment of the public pension results in a financial bonus. On top of the public pension, individuals can save for their retirement through private or employer-paid retirement savings while working. These savings are paid out when the official retirement age has been reached on top of the public payment without any reduction in the public payment. It is possible to work to some degree while receiving public pension benefits. For the early voluntary retirement, the wage income earned is, to some extent, deducted from the pension payment. While receiving old age retirement, the individual can earn up to 122,004 DKK per year without experiencing reductions in payments. If a low-income individual has a wage income on top of the pension payment, the additional grants (e.g. help for medication payment or rent) may disappear since these depend on total income. Individuals can receive a disability pension (Førtidspension) if they are unable to work at a younger age due to permanent disability or poor health. When the official age of retirement has been reached, the disability pension transforms into old age pension. Individuals receiving disability pension are not eligible to take early voluntary retirement.

3. Methods and data

3.1. Data and sample

In this study, we use panel data from GfK panel services Scandinavia (hereafter abbreviated to GfK) covering the period from January 2007 to December 2017. The main shopper in the household registers prices and quantities for all purchased food products and sends in a weekly report to the company. The reported purchases cover household purchases in supermarkets, small stores, etc., but not restaurants, cafes and take-aways. Additionally, each year, the households fill in a questionnaire that collects, among other things, socio-demographic information, i.e., the person in the household mainly responsible for shopping, the highest level of education for the members of the household and whether it is a single or couple household. Furthermore, the respondents note how many adults in the household consume homemade lunch (eat lunch at home or take a homemade lunchbox to work or school), how many days in an average week the household cooks at home as well as how many hours the individual who is mainly responsible for shopping exercises in an average week. The panel is unbalanced, implying that some households leave the panel each month and are replaced by similar types of household. GfK strives to maintain the age of old age retirement was raised with the retirement reform in 2011. The change in retirement age came into effect in 2019 and will gradually increase up to 67 years of age, depending on the year of birth of the individual. However, the extended retirement age is outside the data period used in this project.

If your hourly wage is 259.80 DKK/hour or above, the pension payment decreases by the same amount as your wage income. If your wage is below 259.80 DKK/hour, the deduction is adjusted accordingly. Low wage earners, therefore, have a small income advantage from working while on retirement. However, this advantage can only be obtained until the individual has earned 41,164 DKK per year. Thereafter, the pension payment is decreased 1:1 with the pension payment per hour worked.

GfK is a private company specializing in the construction of consumer panels and analysis for market research purposes. The firm provides households with a hand-scanner device, which they use to scan all purchases of food with a bar-code. Purchased food without a bar-code has to be entered manually in a weekly scan log. The log is then sent to the company. The respondents note how many adults in the household consume homemade lunch (eat lunch at home or take a homemade lunchbox to work or school), how many days in an average week the household cooks at home as well as how many hours the individual who is mainly responsible for shopping exercises in an average week. The panel is unbalanced, implying that some households leave the panel each month and are replaced by similar types of household. The latter is, however, only available for households with more than one adult.

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5 The replacement rate is around 20 percent each year.
In total, 8064 households were identified in the data set in the period 2007–2017. Deleting households where the main shopper is younger than 55 years results in a data set with 2620 households. The argument for choosing this age limit for the households is that it allows the construction of a reasonable control group to control for time-specific trends not related to retirement. In the data set, we have 524 main shoppers who retired during the period we observed them, while 1038 had already retired before the start of the observation period and 1058 who did not retire in the observed period. We deleted the households that had retired before we observed them and only kept the households for which we observed the transition into retirement and those that did not retire. The final sample consisted of 1582 households with 74,622 monthly observations. Of these, we have 378 households who retired from employment and 146 who retired while outside the labor market. If a household has multiple entries into retirement, e.g., are on early voluntary retirement for a couple of months, then work for a couple of years and finally enter old age retirement, we use the most recent of these, i.e., in this case, old age retirement. It should be noted that retirement from employment is the most common path into retirement (Larsen and Pedersen, 2008).

3.2. Important control variables

We include information from the national patient register about the number of days per month that the individuals in the data set have contact with a hospital or healthcare center as a proxy for the health status of the individuals in the household. The patient register includes both routine check-ups in relation to chronic diseases (e.g. dietary guidance and tests in relation to diabetes, cancer, or cardiovascular disease), hospitalization admissions and emergency visits. From the register-data, we also have a measure of annual equalized disposable income, which is generated for the household by adding the disposable income of all household members and then dividing this amount by a weighted average number of people in the family using the OECD equivalence scale. Disposable income includes salary, profit from own business, property income, public and private pensions and other transfers, interest income and dividends from securities, etc. To this is added a calculated rental value of own house. Taxes, interest expenses, paid alimony, etc., are deducted from this income variable. This variable is used as a proxy of sudden income changes for the households. The purchase data only cover in-house consumption. This is not considered a major problem as long as the households do not change their eating out of home consumption due to retirement status. However, we might expect that especially the number of lunches eaten at home will increase when no longer working. From the annual questionnaires sent to the panel, we collected information about the number of adults in the household that eat lunch at home or bring homemade lunchboxes to work or school, eat lunch at work canteens or at restaurants/cafes. This variable is re-coded so that it is 1 if 2 (/1) or more adults in a couple (/single) household eat lunch at home or eat a homemade lunchbox, 0.5 if 1 out of 2 eat lunch at home, 0 otherwise. Furthermore, for couple households, we have information about the number of days in an average week that the household cooks dinner at home (never/seldom, 1–2 days a week, 3–4 days a week, 5–7 days a week). This variable is re-coded 1 if the respondents answer 5–7 days a week, 0 otherwise. Finally, the individual who is mainly responsible for shopping provides information on the number of hours they exercise in an average week. This variable is also included as a control.

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6 A female aged 55 has a recommended daily energy intake of 9200 kJ and a male of the same age has 11800 kJ. This implies that a single household with a female head aged 55 has weight of 1. A single household with a male head aged 55 has weight of 1.28 (11800/9200), and a couple household with a female and a male both aged 55 has weight of 2.28 ((11800+9200)/9200).

7 The potential implications of this adjustment for the results are tested in a robustness analysis, which is discussed in Section 4.3 and the results are presented in appendix B.

8 The coupling of the purchase data with the official register data was conducted by Statistics Denmark based on the CPR numbers of the individuals in the household panel. Names, addresses and the dates of birth of the panel members were sent from GIK to Statistics Denmark, where the information was used to retrieve the CPR numbers and match them with the register data. All CPR numbers, names and addresses were then deleted and the household received a unique identification number, which made the households anonymous to us. All data are only available through the protected server at Statistics Denmark and only regression results and average statistics can be exported from the server.

9 We test the robustness of the results to the exclusion of a control group. For a description of the robustness tests, see Section 4.3. The results are presented in appendix B.

10 Note that this variable does not include information on visits to general practitioners.

11 Note that this variable does not divide income into wage income, pension payment or wealth income. We compare the results from the estimations using proxy variables for health status and wealth shocks with the results from using the ages eligible for retirement as instruments (IV-approach) in Section 4.2.
3.3. Definition of retirement

Different definitions of retirement are used in the literature. Hin- nosaar (2018) defines those who do not work for payment as retired, while Allais et al. (2020), Atlay et al. (2020), Barrett and Brozowski (2012), Hurd and Rohwedder (2013), José Luengo-Prado and Sevilla (2013) and Velarde and Herrmann (2014) use self-reported retirement status, and Nielsen (2019) define those who receive a public pension and do not work as retired. We follow Olesen et al. (2015), and define individuals as retired when they receive public pension benefits as a result of either early voluntary retirement or old age retirement. It has been found that people plan their retirement after the age at which they are eligible to receive a public pension, which suggests that public pension payments matter for decisions about when to retire (Gupta and Larsen, 2010), which justifies our definition. Furthermore, not working is considered to be inappropriate as a definition as not working may be due to involuntary unemployment or disability pension. We assume that an individual who wishes to work will postpone retirement even though they are eligible to receive a pension as they have a financial incentive to do so. For the majority of individuals in our data set, withdrawing from work and receiving pension payments overlap, but some individuals continue to work to some degree while receiving pension payments. One year after retirement, 25% of the sample had some work, but 2 years after retirement this had declined to 20%. Initial estimations showed that there were no major differences in the effect of early voluntary and old age retirement on dietary behavior. Therefore, we do not distinguish between these two types of retirement.

3.4. Definition of Out of Labor Market (OLM)

Unemployment may be a factor that influences the decision to retire. Early voluntary retirement benefits are often claimed following a long period of unemployment for elderly individuals (Quaade et al., 2002), especially for unskilled and manual workers (Qvist, 2020). Additionally, unemployment has been found to be associated with poorer diets (Milicic and DeCicca, 2017; Smed et al., 2017). This may have two implications: (1) the transition from outside the labor market to retirement may not lead to major decreases in income or to more time available for cooking as these people already have more leisure time and a relatively low income, and (2) the effect of the transition to retirement from outside the labor market may differ from the effect of transitioning from work because those involved in the former may have had a poorer diet before they retired. We define a variable that indicates whether the individual is outside the labor market, i.e., they receive either social benefit or unemployment benefit, disability pension or other kinds of social payment. We decided to include those receiving a disability pension and other social benefits since both the unemployed and those on some types of early pension have more time available than working individuals and they often also have a low income. The OLM variable is used to control for the effect of temporary outside the labor market status on the variables of interest, and it is also used to identify whether the retirement transition is from a position outside the labor market or from employment. We define those that are not retiring from OLM as retiring from work.

Fig. 1(a) shows the share of retired where the definition of OLM includes all individuals receiving social benefits (def. 1). As those that receive a disability pension are not eligible for early voluntary retirement, the share of retired is lower for OLM households compared to employed households up to the old age retirement age. In Fig. 1(b), only households on unemployment benefit or social benefit are included in the OLM definition (def. 2). This latter figure supports the findings of Quaade et al. (2002) and Qvist (2020) that unemployed individuals tend to retire earlier than employed individuals. In Figs. 2(a) and 2(b), the average number of health-contact days are plotted as a function of age for the two distinct definitions of OLM. If those receiving a disability pension or other types of social benefit are included in the OLM definition, the number of health-contact days is considerably higher for the OLM group than the employed group. The number of health-contact days generally increases with age. We use the broader definition of OLM (def. 1) in the estimations.

3.5. Measurement of dietary healthiness

Similar to Schader and Herrmann (2017), we assess dietary quality by constructing a Healthy Eating Index (HEI), which is a combined nutrient and food index (Gil et al., 2015). The HEI indicates how closely households follow the official Danish dietary guidelines from 2013. The guidelines summarized in Table 1 recommend minimum and/or maximum intake of various nutrients and foods in energy shares and grams per 10 MJ food consumed per week. The official recommendations also concern water and alcohol consumption and physical activity, which are not quantifiable in the current data set. Each dietary recommendation is quantified so that a household receives a score between 0 and 1 according to how well it performs regarding each specific guideline. A 1 implies that the recommendation is met in a given month. Scores are calculated as follows:

\[
\text{Score}_{ij,t} = \frac{(s_{ij,t} - s_{ij,0})}{(s_{ij,\text{recommend}} - s_{ij,0})}
\]

Where \( s_{ij,t} \) is the share or amount of the given food or nutrient \( j \) at the time \( t \) for household \( i \), \( s_{ij,\text{recommend}} \) is the recommended consumption and \( s_{ij,0} \) is the consumption level that yields a score of zero. Defining the consumption level for \( s_{ij,0} \) is based on the 99th percentile of the consumption for foods and nutrients with adverse health effects observed in the data. Furthermore, the recommendations concerning

| Food or nutrient category | Official recommendation |
|--------------------------|-------------------------|
| Fruit and vegetables     | Min. 600 g per day, hereof at least 300 g vegetables |
| Fish                     | Min. 350 g per week     |
| Fiber                    | Min 25–35 g dietary fiber per day |
| Meat from beef, veal, lamb or pork | Max 500 g per week |
| Saturated fats           | Max. 25–40 pct. of the daily calorie intake |
| Added sugar              | Max. 10 pct. of the daily calorie intake |
| Salt                     | Max 5-6 g daily         |

Table 1 Operationalization of the official 2013 Danish dietary guidelines into the Healthy Eating Index (HEI).

Source: The Danish Veterinary and Food Administration: www.almenkost.dk, accessed November 2020.

We chose this approach since it is not possible to have a consumption of, e.g. 100% added sugar or 100% saturated fat in the diet.
quantities were recalculated to fit the individual household, i.e., the guidelines for fruit and vegetables for a two adult household equals 1200 g per day, whereas it will be 600 g a day for a single adult household. The recommendations are also adjusted to the age and gender recommended energy intake, so that a child that only has a recommended energy intake of 5MJ per day is only required to consume half of the recommend intake of, e.g., fruit and vegetables. The linearity of the health effect of increasing or decreasing the consumption of a specific food or nutrient is indirectly assumed in the index, which may be a weakness. In reality, the marginal value of the dietary quality of a piece of fruit may be greater if the initial consumption is zero compared to an initial consumption of three pieces. The individual scores are weighted together using an Euclidean distance measure, the square root of the summed squared scores for each of the 8 dietary guidelines, yielding an HEI value for each household $i$ at month $t$.

$$HEI_{it} = \sqrt{\sum_{j=1}^{8} (score_{ij})^2}$$

The HEI has a minimum value of 0 and a maximum value of 2.83. The aggregation is without weights, meaning that all dietary guidelines are considered to be equally important. This may introduce error, but we apply this neutral approach, since a potentially relevant weighting of the eight food and nutrient categories is beyond the scope of this analysis. This implies that the index is a simple average measure of adherence to the dietary guidelines. The weight neutral aggregation is similar to methods applied in other indices (see e.g. Gil et al. 2015).
4. Empirical model and method

In this section, we elaborate on the empirical approach used to identify the effects of retirement on food purchases under the assumption of being able to control for relevant covariates which influence the decision to retire and food purchases. First, we address the identification and our baseline model. Next, we discuss specification tests in the form of varying the independent variables included in the model, as well as the regression method including a discussion of the similarities between the results obtained from controlling for covariates and using IV on a subset of the sample. Finally, we discuss the robustness checks conducted to check the sensitivity of our results with respect to data selection and cleaning.

4.1. Main specification

Several issues need to be addressed to estimate the effects of retirement on dietary quality and behavior when observational rather than experimental data are used. A simple ordinary least square regression is likely to yield biased estimates as unobserved household effects may be correlated with both consumption and retirement decisions. We, therefore, use a fixed effects model (FE) to control for this unobserved heterogeneity:

\[ y_{it} = \beta_0 + \delta_i t + \delta_t t^2 + \sum_{k=1}^{11} \delta_k s_{ik} + \rho_1 OLM_{it} + \gamma_1 OLM Ret_{it} + \gamma_2 work Ret_{it} + \beta X_{it} + \alpha_i + u_{it} \]  

(1)

Where \( y_{it} \) denotes the outcome measures of dietary quality and food consumption behavior (HEI, energy consumption in MJ per std. person per month, total food expenditure in DKK per std. person per month, and efficiency, i.e., DKK paid per kJ purchased). \( t \) is a monthly time trend, while \( s_{ik} \) are month dummies accounting for seasonal variation in food consumption. \( \alpha_i \) is household fixed effects while \( u_{it} \) is the idiosyncratic error term. \( OLM_{it} \) is a dummy, which takes the value of 1 when the individual who is mainly responsible for shopping is outside the labor market, and 0 otherwise. \( OLM Ret_{it} \) is a dummy, which takes the value of 1 when the individual who is mainly responsible for shopping has retired while not on the labor market, and 0 otherwise. \( work Ret_{it} \) is a dummy, which takes the value of 1 when the individual who is mainly responsible for shopping has retired from employment, and 0 otherwise. \( X_{it} \) contains a range of independent variables, which are discussed below.

For the HEI, we also estimate:

\[ y_{it} = \beta_0 + \delta_i t + \delta_t t^2 + \sum_{k=1}^{11} \delta_k s_{ik} + \rho_1 OLM_{it} + \gamma_1 OLM Ret_{it} + \gamma_2 OLM Ret_{it} \cdot t_i + \gamma_3 work Ret_{it} + \gamma_4 work Ret_{it} \cdot t_i + \beta X_{it} + \alpha_i + u_{it} \]  

(2)

Where \( t_i \) is the level of the healthiness of the diet before retirement calculated as the average HEI in the period before retirement. We conduct one base estimation and additional estimations where we add these interactions to check for any habitual behavior or heterogeneity in response across the distribution of dietary quality. This is only estimated for the model with HEI as the dependent variable.

To obtain an unbiased estimate for the effect of retirement on dietary healthiness and food consumption behavior, we need to assume that we have controlled for all relevant factors affecting the retirement decision and the dependent variables simultaneously. In the fixed effects model, we control for all unobserved time constant factors such as general state of health, which might affect both the decision to retire and food consumption. However, time-varying factors such as sudden changes in health status and income shocks may also affect both consumption and the retirement decision leading to reverse causality. For example, a sudden deterioration in health may result in an individual deciding to retire earlier (Gupta and Larsen, 2010), and it may also influence food consumption patterns. Likewise, a positive shock to income or wealth such as an inheritance or reaching the end of mortgage repayments may affect the decision to retire (Brown et al., 2010) and lead to changed consumption patterns. The potential endogeneity arising from such events has been addressed in earlier papers by using the age eligible for retirement as an instrument (e.g. Allais et al., 2020; Hinnosaar 2018) or a Regression Discontinuity Design (Eibich, 2015). We take a slightly different approach to the instrumental (IV) method as we can add proxies for both health and wealth shocks. The current monthly number of health-contact days acts as a proxy of health status to account for the immediate effect of health on diets. We also include the number of health-contact days in the past 6 months prior to the current month to account for the long-term effects of health shocks on both dietary quality and retirement.

The previous literature has discussed wealth shocks as an unobserved reason for retirement (Allais et al., 2020; Stephens Jr and Toohey, 2018; Hinnosaar, 2018). We do not have direct access to wealth shock variables, but we do have wealth related income as part of a total income variable. Therefore, by including this income variable, we control for large income shocks from wealth that could cause the individual to retire and potentially also influence consumption behavior. Due to the structure of the retirement system in Denmark, which means that retirement is a long term planning decision, we assume that retirement decisions are more likely to be influenced by health than by sudden changes in income or wealth. However, we include income as a control in the estimations. The inclusion of income in the estimations implies that our main results has to be interpreted as the effect of increased time and other aspects of retirement on behavior not related to potential income declines due to retirement. We test the validity of our approach by adding estimations using an IV approach and compare this with the results estimated from the main specification. We discuss the approach briefly in the section on specification below and in more detail in appendix C and present the results in appendix D. The results from the specification test without income discussed in Section 4.2, and the IV approach will contain the effects from both the potential income decline as well as the effect of increased time and other aspects of retirement. Approximately one third of the households consist of singles, whereas the remainder are two-adult households. Whether the individual who is mainly responsible for shopping has a partner and whether this partner is retired may have an influence on the effect of retirement on dietary quality and behavior. Therefore, we estimate the models separately for couple and single households. In the estimations using couple households, we include variables describing the OLM status of the spouse as well as dummies for retirement from either work or OLM for the spouse. However, we do not interact pre-retirement level of healthiness of diets (HEI) with the labor-market status of the spouse since preliminary estimations showed that the main shopper has the largest effect on household food purchase behavior. Another argument for this decision is that in most cases the variables for the labor market status of the spouse are insignificant. As we consider a reasonable long time-period, unspecified trends in dietary preferences, e.g., new diets such as the New Nordic Diet or changed official dietary guidelines may affect general consumption patterns. Therefore, we include older working households as controls in the regression (single households in the estimations for singles and couple households in the estimations for couples). We test the robustness of the results to the exclusion of the control group. See Section 4.3 for a discussion of the robustness tests. We control for the age of the individual who is mainly responsible for shopping using a quadratic specifications as age is important in terms of the level of physical activity and appetite regulation and, thereby, calorific requirement.

\[ y_{it} = \beta_0 + \delta_i t + \delta_t t^2 + \sum_{k=1}^{11} \delta_k s_{ik} + \rho_1 OLM_{it} + \gamma_1 OLM Ret_{it} + \gamma_2 OLM Ret_{it} \cdot t_i + \gamma_3 work Ret_{it} + \gamma_4 work Ret_{it} \cdot t_i + \beta X_{it} + \alpha_i + u_{it} \]
This is important since our control groups are slightly younger than the treatment groups.\textsuperscript{17} Standard errors are adjusted for clustering at the level of the households (Abadie et al., 2017).

### 4.2. Specification test

We conduct a range of specification tests on the main model. These include: (a) estimating the model without income and income squared, (b) estimating the model without age and age squared, (c) estimating the model without the three variables eating lunch at home or eating homemade lunchboxes, cooking dinner at home and the level of exercise of the individual who is mainly responsible for shopping includes biking to work, garden work and sports, etc. (annual measure). (4) Average weekly hours of exercise of the individual who is mainly responsible for shopping includes biking to work, garden work and sports, etc. (annual measure).

\textsuperscript{17} In the specification tests, we repeated the estimations without the age variable. This is discussed in Section 4.2.
months that had been adjusted for one or more missing weeks and re-estimated the model; (b) We removed all households that continued to work after retirement and re-estimated the model; (c) We deleted households that changed civil status during the observation period and re-estimated the model, and finally (d) We re-estimated the model without a control group. The results of these robustness tests are presented in appendix B.

5. Results

5.1. Descriptive statistics

Tables 2 and 3 presents descriptive statistics for the independent and dependent variables respectively split into single and couple households, control and treatment groups. Individuals from groups (1) and (7) are in the control group for the single regression. Individuals from group (4) and (10) are in the control group for the couple regression. Groups (2)-(3), (5)-(6), (8)-(9) and (11)-(12) show the statistics of the households that changed civil status during the observation period and re-estimated the model, and finally (d) We re-estimated the model without a control group. The results of these robustness tests are presented in appendix B.

5.2. Estimation results for single households

Table 4 shows the results of the estimations with single households. We find a significant increase in the HEI at retirement from work (panel 1) and a positive but insignificant increase when retiring from OLM. This result is stable across specification and robustness tests (Table A.1 and B.1 in appendix A and B). The only robustness test which shows a different result from the main specification is the one that deletes households where the main shopper still has some paid work. Deleting households with paid work increases the effect of retirement on HEI. This suggests that the result in the main specification is underestimated.

In panel 2, the retirement is interacted with pre-retirement level of HEI in a 25:50:25 split across the entire sample of retiring households.\(^19\) HEI represents the 25% of the households that had the least healthy diet before they retired (reference group), HEI3 the 25% of the households with the most healthy diets before retirement and HEI2 the remaining 50% in the middle. What is noticeable is that the positive effect of retirement on HEI decreases with pre-retirement HEI levels. For those who retire from employment, those with 25% poorest dietary health pre-retirement exhibit an increase of 0.078, the 50% in the middle exhibit an increase of (0.0784–0.0486) 0.030 and there is almost no change for the 25% healthiest, 0.006. For retirement from OLM, the 25% with the highest dietary quality pre-retirement even experience a decrease in dietary quality. While it is interesting that the dietary quality of the lowest percentile increases significantly, we note that the lack of an effect for higher percentiles may be due to mechanical reasons as the HEI has a fixed upper level. We find that eating lunch at home and a temporary OLM status increases the HEI.

The number of health contact days has a positive correlation with the HEI, income increases the HEI but at a decreasing rate. The level of significance varies slightly for these variables across specifications and robustness tests, but the size of the coefficients is stable.\(^20\) Panel 3 and panel 4 shows the estimations with log expenditure and log energy as the dependent variables. The effect of retirement both from employment and from OLM on food expenditure is insignificant. The size and sign of the coefficients are remarkably similar across all specification and robustness tests (Table A.2 and B.2 in appendix A and B). Temporary OLM is likewise insignificant. Eating lunch at home has an expected positive and significant effect, while current number of health contact days has a negative effect, albeit marginally significant. In contrast, if we consider the effect of retirement from work on energy consumption, we find a positive and significant effect when retiring from employment, and an insignificant effect when retiring from OLM. Again, we find consistent results across specification and robustness analysis (Table A.3 and B.3 in appendix A and B). The most notable difference across the robustness checks is that when those working

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\(^18\) Households can, in principle, belong to more than one group: E.g. the same household can be observed as both single and couple and will, therefore, enter in the respective periods when the main shopping responsible is single/couple. The same may apply for non-retired households, which can be observed as both working and outside the labor market.

\(^19\) We also tried a 33:33:33 split, which resulted in the main conclusions being unchanged.

\(^20\) As we did not conduct the IV on the same specification of the model and exactly the same sample, we discuss the results of the IV estimation in appendix C where we also discuss our IV method in detail.
the fact that it is mainly those with the unhealthiest diets that exhibit significance in the effect on HEI of retirement may be explained by the amount of exercise seems to have a positive effect. The lack of home does not seem to affect the HEI in a positive direction whereas of diets. In contrast to the results for single households, eating lunch at home leads to an increase in energy while current health contact days have a negative effect. When we consider the results for energy purchased, we find a positive but not significant effect (However, the effect is marginally significant for some alternative specifications shown in Table A.3 and B.3 in appendix A and B). This may explain the lack of a significant effect when we consider retiring from OLM, i.e., it is not the act of retirement itself that increases the amount of energy purchased, but the fact that the individual is not working. Eating lunch at home leads to an increase in energy while current health contact days lead to a decrease. The combined effect of no significant change in monthly food expenditure at retirement and an increase in energy consumed at retirement implies an increase in efficiency at retirement. The effect of retirement on efficiency (panel 5). The exception to this is that retirement or temporary OLM for the spouse have no significant effect. The increase in energy purchased, a result that is stable across specification and robustness results (Tables A.6 and B.6 in appendix A and B). Temporary OLM for the individual who is mainly responsible for shopping leads to an increase in food expenditure of about 5% with medium pre-retirement level of HEI exhibit a small increase in HEI (0.043–0.0379) whereas those with the healthiest diets experience a decrease. These results are similar to those for singles. In panel 3, we present the results with log expenditure as the dependent variable. The retirement of the individual who is mainly responsible for shopping leads to an increase in food expenditure of about 5% while the retirement of the spouse has no significant effect on food expenditure. The effect of retirement from OLM is insignificant but marginally larger in magnitude compared to retirement from work. The conclusions are stable across specification and robustness tests (Table A.5 and B.5 in appendix A and B). Temporary OLM for the individual who is mainly responsible for shopping leads to a significant increase in food expenditure. Both eating lunch at home and cooking at home have a positive but largely insignificant effect while the amount of exercise is negatively correlated with food expenditure. Current health contact days have a negative effect. When we consider the results for energy purchase, we see that they, to a large extent, mirror the results for log food expenditure. When the individual who is mainly responsible for shopping leaves for temporary OLM or for retirement, we observe an increase in energy purchased, a result that is stable across specification and robustness results (Tables A.6 and B.6 in appendix A and B). The retirement or temporary OLM for the spouse have no significant effect. Eating lunch at home has a positive and significant effect, cooking at home has a positive and marginally significant effect while exercise, surprisingly, has a negative and significant effect. The joint increase in expenditure and energy purchased results in an insignificant effect of retirement on efficiency (panel 5). The exception to this is that households that eat lunch at home reduce the amount paid for their energy while those with a high level of exercise pay more. There is a negative but non-significant effect of retirement on efficiency in general. Retirement of the spouse from OLM has the largest effect of 3.7%, although this is only significant at the 10% level. Eating lunch at home is associated with greater efficiency while more exercise is associated with lower efficiency.

6. Discussion and policy implications

In this paper, we revisit the retirement consumption puzzle by exploring whether retirement leads to a decrease in food expenditure.
As we control for income in some of the estimations, the results from these estimations address if the increased time available, at the point of retirement, can explain the decline in food expenditure. However, as we also estimate models without the income variables and models using an IV approach for comparison, these will directly test for the retirement (food) consumption puzzle.

We also explore whether retirement leads to a healthier diet and higher efficiency of food purchases. Our focus is on the phenomenon in a welfare state context and on heterogeneity. Furthermore, the strength of the current paper is that we have detailed data on the exact date of retirement and background characteristics. Additionally, we explore the heterogeneity in the effect of retirement on food consumption and purchase behavior since we are able to distinguish between retirement from employment and from a position outside the labor market. We start by summarizing and discussing our main results focusing first on the effect on healthiness of diets and secondly on food expenditure, energy consumed and the efficiency of food purchases. We also compare our results with those from the literature. We discuss the limitations of the current study and finally conclude and reflect on the policy implications of our findings.

6.1. Summary and discussion of main results

We find that the effect of retirement on the healthiness of diets is greater for single households compared to couples regardless of whether they retire from OLM or employment. This indicates that the presence of a spouse may influence the adoption to retirement since more people in the household are involved in the dietary decisions. The difference between singles’ and couples’ responses to retirement has also been found by Lundberg et al. (2003). However, we note that the retirement of the spouse does not significantly influence the healthiness of the diet and it thus seems that it is the retirement of the main shopper that has the greatest influence on household behavior. It should be noted that in the majority of the households, the main shopper is a female. In this age group, it is common that females are responsible for cooking, even in cases where the male spouse is retired. This may explain why we find that the retirement of the spouse has an insignificant effect.

We also find slightly greater effects of retirement on the healthiness of diets for those retiring from work than from outside the labor market. This is not surprising since retiring from employment is associated with a more drastic change in lifestyle, e.g., more time available for home production including shopping for food items and cooking at home (Atalay et al., 2020) than retiring from a position outside the labor market. We observe that fewer main shoppers retire from OLM compared to employment, which may explain the lack of significance of the results. We find that retirement leads to a healthier diet, especially for those that have the least healthy diets in the period before retirement. The lack of improvement for those with the 25% healthiest diet could be explained by an upper limit for the possible improvements in dietary healthiness when measured with the HEI, so there will be less room for improvement. The fact that unemployment of the main shopper leads to a healthier diet supports the hypothesis that extra time available for cooking and home-production lead to healthier diets. While HEI increases upon retirement, the magnitude is small. The change in HEI ranges from 0.0098–0.024 on a scale from 0 to 2.83.

The finding of increasing dietary quality at the point of retirement is in line with the results of Hinnooar (2018), who finds an increase in fruit and vegetable consumption in the US, but our finding is not in line with the studies that find that retirement has a negative effect using Chinese and cross-country data (Chen et al., 2017; Cellidomi et al., 2020). There may be several explanations for the difference in findings: First, dietary quality is measured differently across studies, either as intake of fruit and vegetables or as indices based on official dietary guidelines. For example, the index used by Chen et al. (2017) includes guidelines. For example, the index used by Chen et al. (2017) includes guidelines.
in the index used in this paper. Another reason for the difference in findings may be due to the institutional setting of retirement across countries, which we discuss below. In sum, our results suggest that the retirement transition overall is associated with minor but positive changes in dietary quality.

We find that food expenditure in single households is not affected by retirement while there is an increase when the main shopper retires for multiple adult households regardless of the path into retirement. We do not have a validated explanation for this difference, but a speculative explanation could be that both before and after retirement, average equalized disposable income is larger for couples than it is for singles, which may imply that there is more money available for food consumption. These results are consistent across specification and robustness tests and are also found in the estimations using instruments. We find an increase in the amount of energy consumed when retiring from work for both singles and couples, and also when retiring from a position outside the labor market for couples. The results from models estimated using more adults households are more complex to interpret since they also reflect interactions between household members. When we combine the results for food expenditure and energy purchased in the estimations considering efficiency, we find that singles pay 4% less per kJ post retirement, as do single individuals outside the labor market. We do not find the same for couples. A better economic situation does not appear to be the explanation since all results are robust regardless of whether income is included in the estimations.

Increased efficiency of food purchase behavior may reflect the fact that the retired individual has more time to shop for bargains or has shifted from expensive to cheaper brands or from upper end convenience stores to discount stores, implying that this need not be translated into a decrease in food quality. This is supported by the fact that we find an increase in the healthiness of diets and is in line with the findings in the literature that home production increases at the time of retirement (Atalay et al., 2020), i.e., more time is spent on shopping and cooking. A more detailed analysis of the changes in product and store choice at the point of retirement would be an interesting route for further research.

Overall, we find no evidence of a retirement (food) consumption puzzle as we find either unchanged or even increasing food expenditure upon retirement. As mentioned earlier, when we include income as a proxy for wealth shocks in the model we address if the increased time available, at the point of retirement, affects food expenditure. However, as the income variables are jointly insignificant in the model estimating the effect of retirement on food expenditure and we find comparable results in models without the income variables and models using an IV approach for comparison, we are rather confident in our results.

Several studies have found that food expenditures decrease upon retirement (Aguiar and Hurst, 2005; Aguila et al., 2011; José Luengo-Prado and Sevilla, 2013), although most studies that split expenditure into food at home and eating out find a smaller decrease or even no effect on food at home (Chen et al., 2017; José Luengo-Prado and Sevilla, 2015; Miniaci et al., 2010). In the present study, we only consider food consumed at home, but we use proxies for the amount of food consumed at work and outside the home, which controls for potential substitution from outside to inside the home food consumption. Another study from France that also uses Home Scan data finds that food at home expenditure and the quantity of food bought drop by 26–29 percent upon retirement (Allais et al., 2020). However, the authors note that their estimates are larger than other countries, which may be because French households spend more money on food than households in other countries. The magnitude of our results are far smaller as the largest increase in expenditure is between 5%–6%. (Chen et al., 2017) find no effect on food at home expenditure and energy intake in China. A plausible explanation for not finding support for the retirement (food) consumption puzzle in our results may be that income replacement rates are high in Denmark compared to other countries with extra payment in terms of support for rent and medical expenses for low income households (OECD, 2019). For example, Chen et al. report an income decline of 52% whereas we observe a decline in disposable income of between 8 to 21 % upon retirement.

6.2. Limitations

Our study is not without its limitations. A major limitation of this study is that we use Home Scan data as reporting is voluntary. Retirement may mean that consumers report more frequently as they have more time available than before retirement. Since we adjust for missing weeks, we adjust when households were missing more weeks before retirement, and hence we limited the potential effect of increased reporting. This correction is not adequate if the households are equally good at sending in weekly reports before and after retirement but report a larger share of purchased items after retirement. However, our results are robust to the deletion of households where we adjust for missing weeks. Another caveat is that we do not have perfect controls for the number of meals eaten at home to control for substitution from food eaten outside the home to home consumption upon retirement since our proxies are measured on an annual basis. When we add the controls, they have the expected signs and are significant in many cases. Hence, we expect them to capture the most important variation. Adding these controls implies that we can minimize the degree to which our results are driven by substitution from outside to inside the home consumption. We expect our results to be valid in terms of examining the consumption puzzle for food at home expenditure, but they should be used with caution when interpreting how total food expenditure changes upon retirement. Second, we use public pension transfers to define retirement, which has the benefits of being based on high-quality data and being closely related to retirement behavior and withdrawing from the labor market. However, it has the disadvantage that individuals can still have some labor market attachments while receiving transfers. Individuals who receive pension transfers and work may be doing so to smooth consumption over time, which may explain why we find no negative effect of retirement on expenditure. We consider this to be of minor importance since there is a limit on the income that can be earned while receiving pension payments, and we demonstrate that removing households in which the main shopper still works after retirement has a negligible influence on our results. Our identification strategy lies in the selection of observables and the fact that we have no unobserved time-variant factors that influence the retirement decision or food purchase behavior. Previous literature has pointed to health and wealth as potentially important unobserved time-varying factors. We add controls to proxy for health status and wealth income to account for this. As a robustness check, we instrument retirement by the ages eligible for pension transfers. The IV model using eligibility for early voluntary retirement and eligibility for old age retirement was weakly identified. Therefore, we split the sample and only rely on eligibility for old age retirement as an instrument. Comparing these results with FE results of the effect of old age retirement exhibited small differences between FE and FE-IV. We, therefore, assume that bias issues in the FE results are of minor concern. Finally, our data describe household dietary behavior, not how the individuals within the household behave. The results for singles can be interpreted directly as a change in individual behavior related to retirement while the results we find for couple households are more blurred as they reflect the behavior of the retired individual in relation to another individual who may or may not be retired. Further analysis of the complexity around the change in dietary behavior upon retirement for households with more adults would be an interesting route for future research.

6.3. Conclusion and policy implications

In the current research, we do not find any evidence to support a retirement (food) consumption puzzle as we find no decline in food expenditure upon retirement and find unchanged or an increase in the amount of energy consumed. We find smaller changes in adaption to retirement when retirement is from OLM in single households. The results we find for couple households are more blurred as they reflect a larger share of purchased items after retirement. However, our results are robust to the deletion of households where we adjust for missing weeks. Another caveat is that we do not have perfect controls for the number of meals eaten at home to control for substitution from food eaten outside the home to home consumption upon retirement since our proxies are measured on an annual basis. When we add the controls, they have the expected signs and are significant in many cases. Hence, we expect them to capture the most important variation. Adding these controls implies that we can minimize the degree to which our results are driven by substitution from outside to inside the home consumption. We expect our results to be valid in terms of examining the consumption puzzle for food at home expenditure, but they should be used with caution when interpreting how total food expenditure changes upon retirement. Second, we use public pension transfers to define retirement, which has the benefits of being based on high-quality data and being closely related to retirement behavior and withdrawing from the labor market. However, it has the disadvantage that individuals can still have some labor market attachments while receiving transfers. Individuals who receive pension transfers and work may be doing so to smooth consumption over time, which may explain why we find no negative effect of retirement on expenditure. We consider this to be of minor importance since there is a limit on the income that can be earned while receiving pension payments, and we demonstrate that removing households in which the main shopper still works after retirement has a negligible influence on our results. Our identification strategy lies in the selection of observables and the fact that we have no unobserved time-variant factors that influence the retirement decision or food purchase behavior. Previous literature has pointed to health and wealth as potentially important unobserved time-varying factors. We add controls to proxy for health status and wealth income to account for this. As a robustness check, we instrument retirement by the ages eligible for pension transfers. The IV model using eligibility for early voluntary retirement and eligibility for old age retirement was weakly identified. Therefore, we split the sample and only rely on eligibility for old age retirement as an instrument. Comparing these results with FE results of the effect of old age retirement exhibited small differences between FE and FE-IV. We, therefore, assume that bias issues in the FE results are of minor concern. Finally, our data describe household dietary behavior, not how the individuals within the household behave. The results for singles can be interpreted directly as a change in individual behavior related to retirement while the results we find for couple households are more blurred as they reflect the behavior of the retired individual in relation to another individual who may or may not be retired. Further analysis of the complexity around the change in dietary behavior upon retirement for households with more adults would be an interesting route for future research.
However, despite the fact that no decline in the healthiness of diets is observed to any degree upon retirement, regardless of whether this is from a position at or outside the labor market, it is still important to focus on the dietary health of the elderly. The average HEI value among the households in the sample is quite a long way below the maximum value, which leaves considerable room for improvement. We find that those retiring from employment exhibit an increase in the healthiness of diets; hence, the political focus should be on the older population in general, not strictly focused on the retired. We find that older individuals outside the labor market have more health contact days and lower income before and after retirement. Despite that, we also find an increase in the healthiness of diets upon retirement for this group, they have a lower healthiness of diets both before and after retirement compared to other groups. Therefore, the focus of dietary policy should be on this group. Another policy relevant finding from the current research is the lack of economic importance in food purchase behavior. This implies that policymakers in Denmark do not need to implement economic support to subsidize healthier eating at the time of retirement, but they should focus more on older individuals outside the labor market both before and after retirement. Compensating the lower-income households by higher income-replacement rates than high-income households could be implemented in other countries to mitigate the reductions in food expenditure and potential decreases in dietary quality.

CRediT authorship contribution statement

Sinne Smed: Data curation, Formal analysis, Drafting, Writing and editing of the paper. Helene Normann Rønnov: Data curation, Formal analysis, Drafting, Writing and editing of the paper. Inge Tetens: Funding acquisition, Drafting, Writing and editing of the paper.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.foodpol.2022.102330.

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