# Health Effects of a Welfare Cut among Low-Income Retirees*

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**Abstract**

This paper investigates the causal health effects of a welfare benefit cut reform for low-income retirees in the Netherlands. The reform created a permanent negative income shock, determined by the number of adult co-residents. Using a difference-in-differences design and detailed administrative data, we analyze the impact of this reform on medication use for mental health problems, pain, and lifestyle-related diseases over a seven-year post-reform period. Our findings show that the welfare cut reduced total personal income by 13 percent. Over the longer term, the reform increased medication use for lifestyle-related diseases by 1.9 - 2.7 percentage points. However, we find no significant effects for pain or mental health-related medication use. These results highlight the long-term health implications of income reductions among low-income elderly populations.

*JEL-codes:* H55, H75, I38, I12, I14

*Keywords:* Welfare cut, health, low-income retirees, difference-in-difference

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# 1 Introduction

Developed countries face persistent health disparities between low- and high-income individuals (e.g. Chetty et al., 2016; Marmot, 2015; WHO, 2019). A key driver of these disparities is the divergence in the development of chronic conditions, particularly lifestyle-related diseases. Recent research indicates that approximately 60% of the disparity in health outcomes can be attributed to the faster progression of chronic diseases among low-income individuals (Danesh et al., 2024). Understanding the determinants of this divergence is essential for designing more effective policies to address health inequalities.[1]

An ongoing policy debate concerns the role of income interventions for low-income elderly individuals. Evidence from studies on the health impact of cash transfers and (positive) shocks in pension benefit levels largely show positive effects (e.g. Malavasi and Ye, 2024; Miglino et al., 2023; Pak, 2021; Salm, 2011). However, as most of these studies have focused on mortality rates and self-reported (mental) health, there remains limited understanding of how and to what extent income policies shape the development and progression of chronic diseases among low-income elderly populations.

In this paper, we examine the short- and long-term effects of a welfare benefit cut reform on mental health problems, pain, and lifestyle-related diseases among low-income retirees. This reform of the Dutch AIO benefit scheme, which provides financial support to retirees with incomplete state pensions and insufficient additional income, generated a persistent negative shock in AIO benefits. Specifically, the reform introduced a "cost-sharing" policy, where benefit levels were reduced based on the number of adult co-residents in the household. The primary group affected by the reform consisted of low-income elderly individuals, predominantly with a migration background and limited labor market history. The reform was announced in December 2014 and implemented in July 2015, providing an opportunity to measure outcomes up to seven years after its implementation. This setup enables

[1] In addition, Lifestyle-related diseases are the leading cause of death worldwide, and healthcare utilization for mental health problems has risen sharply. Together, these factors place a substantial economic burden on health systems.

us to capture both the immediate and longer-term effects of the policy change.

From a theoretical perspective, we expect a permanent negative effect of the welfare cut on income. As a direct mechanical effect, the reform reduces both the likelihood of receiving benefits and the total amount disbursed. Although the reform might incentivize increased employment (in addition to receiving pension benefits), this effect will be small as the target population consists of elderly people with weak labor market positions. Overall, the direct income effect is expected to outweigh the behavioral response by large, leading to a permanent decline in income.

Regarding health outcomes, we predict that the welfare cut will worsen the prevalence of certain chronic conditions through two mechanisms. In the short term, the welfare cut is likely to increase financial stress, potentially leading to a rise in mental health problems (psychological disorders, such as depression and anxiety) and pain-related conditions (see e.g. Haushofer and Fehr, 2014; Ridley et al., 2020). Over the longer term, the welfare cut is expected to further strain monthly budgets available for maintaining a healthy lifestyle and exacerbating chronic financial stress. Consequently, individuals may adopt more affordable but less healthy behaviors, such as poorer dietary choices and reduced physical activity. These combined effects—unhealthy lifestyle behaviors and chronic financial stress—may contribute to the onset and exacerbation of lifestyle-related health conditions, including diabetes, hypertension, and high cholesterol.

We analyze detailed individual-level administrative data on the welfare reform, along with monthly data on benefit receipt, benefit payments, employment, and earnings. Additionally, we measure total personal income at the yearly level. These income-related measures are used to gain insight into the mechanical and behavioral income effects of the reform. Regarding the health outcomes, we collect quarterly data on medication use for psychological disorders (mental health problems), pain-related conditions, and several lifestyle-related diseases (hypertension, high cholesterol, and diabetes mellitus).

We estimate the causal effects of the welfare cut reform using a difference-in-differences design. As previously discussed, the reform introduced a permanent negative income shock for AIO benefit recipients with cost sharers (adult co-residents)

in their household, while those without cost sharers remained unaffected. The treatment group consists of benefit recipients who had cost sharers in their household at the pre-treatment month, while the control group includes benefit recipients without cost sharers. To account for potential anticipation effects, including changes in household composition, we define the announcement of the welfare reform in December 2014 as the start of the treatment period and the time leading up to its implementation in July 2015 as the anticipation period. We estimate both pooled and dynamic models, capturing treatment effects over a seven-year period following the start of the treatment. To support the parallel trends assumption, we demonstrate clear parallel trends in the four years preceding the announcement of the welfare reform.

Our study provides three key findings. First, the welfare cut results in a significant and long-lasting negative income shock. The reform decreased benefit receipt with 28.6 percentage points (34.0 percent) and the benefit payments with 139 Euros (47.4 percent) over a seven-year post-reform period. The negative effect on benefit payments is only limitedly compensated by increased employment (0.3 percentage points) and earnings (6.15 Euros). As a consequence, the welfare cut reduced the annual total personal income with 1,551 Euros (13 percent) on average for a period of (at least) seven years. Second, we do not find significant treatment effects on medication use for pain and mental health problems, neither in the short nor in the longer run. The pooled estimates for these outcomes are close-to-zero and precisely estimated. Third, we find a significant increase in medication use for lifestyle-related conditions in the longer term, but not in the short run. Specifically, we find an increase in medication use for high cholesterol of 2.7 percentage points (6.2%) and 1.9 percentage points (3.5%) for hypertension for the period 19-28 quarters (4.5 - 7 years) after the start of the treatment. The positive treatment effect on diabetes mellitus was less robust.

Our findings contribute to the growing body of literature examining the health effects of income policies among the elderly poor in high-income countries (e.g. Malavasi and Ye, 2024; Miglino et al., 2023; Pak, 2021; Salm, 2011).[2] While these

[2]Relatedly, there is a growing literature that focuses on the elderly poor in low- and middle-

studies have shown that positive income shocks and cash transfers can reduce mortality rates, our study provides additional insight into a potential underlying mechanism. Specifically, our findings suggest that a permanent income shock significantly impacts the prevalence of lifestyle-related diseases, such as hypertension and high cholesterol, over time. This offers a plausible explanation for the divergence in mortality rates observed in previous studies.

Additionally, our study makes a methodological contribution by leveraging high-quality administrative data on medication use to measure health effects. As highlighted in the literature review by Brydon et al. (2024), examining health outcomes through healthcare utilization remains an important gap in the literature on the relationship between income and health. Using medication use data offers several key advantages: it covers the entire population, ensures high reliability compared to survey-based data, provides granular information across a wide range of health outcomes, and allows for frequent measurement over time. These attributes enable the dynamic estimation of both short- and long-term effects (as in Chetty et al., 2016; Danesh et al., 2024), offering a more comprehensive understanding of the temporal impacts of income shocks on health

This paper is structured as follows. Section 2 provides an overview of the Dutch pension system for retirees and details the welfare cut reform. Section 3 outlines the data and presents descriptive statistics. Section 4 explains the difference-in-differences methodology. Section 5 reports the findings on income- and health-related outcomes. Section 6 discusses explanations for the main findings. Section 7 concludes.

# 2 Institutional context

## 2.1 Pension benefits for low-income retirees

The Dutch AIO benefit scheme, formally known as the Supplementary Income Provision for the Elderly, aims to provide income support to retirees with an incomplete

income countries such as Barham and Rowberry (2013); Bernal et al. (2024); Cheng et al. (2018); Cooper et al. (2020); Jensen and Richter (2004); Miglino et al. (2023).

state pension (AOW) and insufficient additional income or assets, ensuring their total income reaches the social minimum.[3] A full state pension is granted to individuals who have resided in the Netherlands for the 50 years prior to their date of retirement, with each missing year reducing the AOW pension amount by 2%. Consequently, incomplete state pensions are most prevalent among individuals with a migration background.

The Social Insurance Bank (SVB) executes the AIO benefit scheme. Its tasks include informing potentially eligible individuals, processing applications, and disbursing monthly benefits. The SVB notifies eligible individuals if their AOW pension falls below the AIO eligibility threshold. Applications for the scheme can be submitted up to two months prior to reaching the retirement age.

Individuals are eligible for the AIO benefit if they have reached the state pension age (set at 65 years and 2 months in 2014), reside in the Netherlands (with a maximum of 13 weeks abroad annually), and have income and assets below the AIO thresholds. In 2014, the income threshold excluded 25% of labor income up to €194, while the asset limit was set at €5,850 for singles and €11,700 for couples or single parents with children under 18. In practice, as the state pension level exceeds the AIO benefit level, only individuals with no state pension or a partial state pension may qualify. The AIO benefit level depends on household type (single or cohabiting) and the level of income from the state pension, additional pension schemes, or other sources. As of November 2014, the maximum AIO benefit level was €1044 for singles and €1437 for cohabits.

## 2.2 The welfare cut reform

The welfare cut reform was officially introduced in 2015 and generated a permanent decrease in benefit levels based on the number of adult co-residents. The reform was referred to as the introduction of the cost sharing standard. The reform was implemented to account for assumed economies of scale within households due to adult co-residents, as well as to reduce government spending and prevent the accumulation

[3]The AIO scheme is part of the Participation Act, which also includes welfare benefits for individuals below the retirement age.

of benefits within a single household.

Before the introduction of the cost-sharing standard, the benefit level for AIO recipients was independent of the number of adult co-residents. Under the new cost-sharing standard, the maximum benefit level decreases with each adult co-resident over the age of 21, regardless of their income or their contribution to the living costs of the household. Certain groups, such as students and non-relatives residing commercially, were excluded from being considered cost sharers. The maximum applicable benefit level is calculated as:

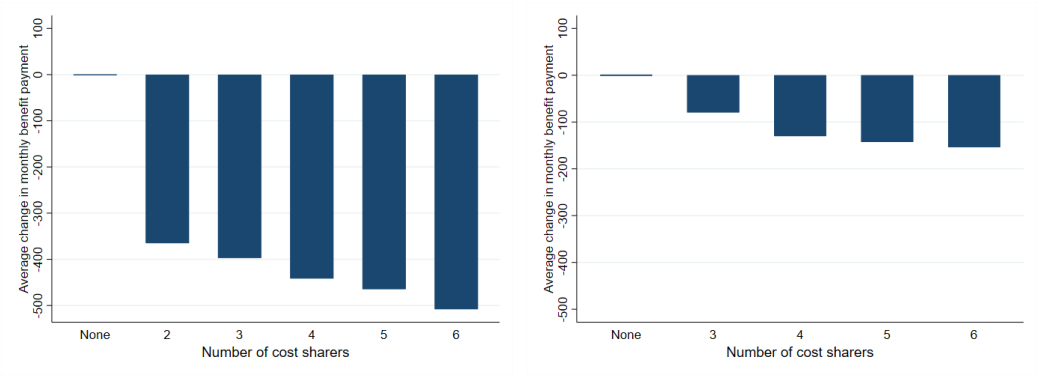
$$\frac{(40\% + A \times 30\%)}{A} \times B \tag{1}$$

where $A$ represents the number of adult co-residents in the household (including the AIO recipient(s)) and $B$ is the base amount (maximum benefit level for cohabits). As a consequence, AIO recipients with more co-residents face larger reductions in their AIO benefit.

This is also reflected in Figure 1, which shows the change in AIO benefit payments between June and July 2015 for both single and cohabiting AIO recipients depending on the number of adult co-residents (cost sharers). While AIO recipients without cost sharers did not face a change in their benefit payments, the payments for recipients with one additional co-residents sharply dropped with 365 Euros for singles and 74 Euros (per person) for cohabiting recipients. A larger number of cost sharers further decreases the benefit payments.

The cost-sharing standard was first announced by the SVB in December 2014, with the adjusted benefit levels communicated in June 2015. The reduced benefit payments began in July 2015. To account for potential anticipation effects, we treat the announcement of the reform in December 2014 as the start of the treatment period and the time between December 2014 and July 2015 as the anticipation period.

**Figure 1:** Change in benefit amount versus number of cost sharers




**(a)** Singles **(b)** Cohabits

*Note:* The figures show the average change in the amount of AIO benefit received between June and July 2025 for AIO-recipients versus the number of cost sharers (including AIO recipients themselves) in their household. Panel (a) reflects changes for single AIO recipients and Panel (b) for cohabiting AIO-recipients. AIO recipients in June 2015 who lost their benefit in July 2015 are excluded. The calculations are executed by the authors using individual-level welfare data from Statistics Netherlands. Total N singles = 24,855; total N cohabits = 16,612.

# 3 Data

## 3.1 Data sources and sample selection

We use individual-level administrative data from Statistics Netherlands. Specifically, we utilize monthly data from the benefit registry, which provide comprehensive information on the type, level, and amount of AIO benefits. To enrich our analysis, we integrate data from additional sources, including social security records (employment and earnings), the municipal population register (sociodemographics), and the National Health Care Institute (dispensed medicines). By combining these sources, we construct a detailed longitudinal dataset spanning January 2011 to December 2021.

Our sample consists of all individuals receiving an AIO benefit at November 30, 2014. We excluded recipients belonging to an institutional household, as the cost sharing standard was not applicable to them. Furthermore, we excluded a small number of recipients with a non-standard or unknown household type.[4] Our final sample consists of 46,467 individuals of which 6,690 have cost sharers in their

[4]Non-standard households refer to private households where the AIO-recipient shares the household with non-partners, non-parents, or non-resident children (e.g., siblings sharing a home).

household (treatment group) and 39,777 (control group) not.

## 3.2 Data description and sample characteristics

We analyze the impact of the welfare cut on income- and health-related outcomes using a range of constructed variables. For income-related outcomes, we construct variables related to AIO benefit, labor income, and total income. Specifically, we create a binary variable indicating AIO benefit receipt and a continuous variable capturing the AIO benefit amount (including zeros). To examine whether the welfare cut has been offset by increased labor market participation, we introduce a binary variable indicating employment status, where a value of one denotes positive wage earnings and zero indicates no earnings. Additionally, we construct a continuous variable for labor market earnings, including individuals with zero earnings. Total personal annual income is measured as a continuous variable, encompassing income from pensions, social benefits, and earnings. All continuous income variables are adjusted for inflation to ensure comparability over time.

For health outcomes, we construct binary variables for three categories of chronic conditions: (1) psychological disorders (mental health problems), (2) pain and inflammatory conditions (abbreviated as pain), and (3) three lifestyle-related diseases—hypertension, high cholesterol, and diabetes mellitus.[5] To link the medication data to these chronic conditions, we use the ATC-3 medication classification framework from Huber et al. (2013), with adaptations to the Dutch context from Yildiz et al. (2020).[6] A detailed mapping of ATC-3 codes to these chronic conditions is provided in Table A.1 in Appendix A.

Our medication data come from pharmacy dispensation records, excluding items supplied directly by hospitals or nursing homes, which represent only a small proportion of medications. The dataset includes only dispensed medications, meaning no-shows are excluded. Additionally, rare medications that contribute less than

[5]Type 2 diabetes is classified as a lifestyle-related condition, while Type 1 diabetes is not. Since our data do not distinguish between these types, we report their combined prevalence. Given that Type 1 diabetes accounts for only 9.2% of all diabetes cases in the Netherlands (Vanhommerig and Knottnerus, 2024), this combined measure is a reasonable proxy.

[6]We made a minor modification by combining pain and inflammatory conditions into a single category, based on the advice of a Dutch pharmacist.

1% of total dispensed items are not represented. With precise dates of medication provision available, we selected a quarterly level of analysis. This frequency aligns with typical prescription durations of up to three months and provides a more accurate reflection of the prevalence of underlying chronic conditions than monthly measurements.

We constructed a treatment group variable that takes the value of one for individuals with cost sharers in their household as of November 2014, and zero for individuals without cost sharers. Notably, the benefit registry began registering the number of cost sharers from July 2015 (the month of implementation of the reform). To address this issue, we developed a binary proxy variable for cost sharers based on monthly household information, including members' age and student status.

Figure B.1 in Appendix B illustrates that the trends for the proxy cost sharers variable closely mirror those of the administrative cost sharers variable. Furthermore, we calculated an overlap in values for both variables of 97.3 percent for the period between July 2015 and December 2021. Additionally, we calculated a 97.3 percent overlap between the two variables for the period from July 2015 to December 2021. Based on this high level of concordance, we conclude that the constructed cost sharing variable serves as a reliable proxy for the administrative measure.

Our administrative dataset faces attrition due to not being registered in the Personal Records Database (BRP). Figure B.2 in Appendix B shows the trends of the share of treatment and control group individuals that were not registered in the BRP. In the pre-treatment period, attrition is small and can be explained by individuals having not yet migrated to the Netherlands. In the seven years after the start of the treatment, attrition raises to 26.8 percent for both treatment and control group. This can be explained mainly by increasing rates of individuals passing away over time and additionally by individuals moving abroad. We note that our data did not allow to distinguish between these reasons. Importantly, the figure shows nearly identical attrition patterns between both groups, both before and after the start of the treatment.

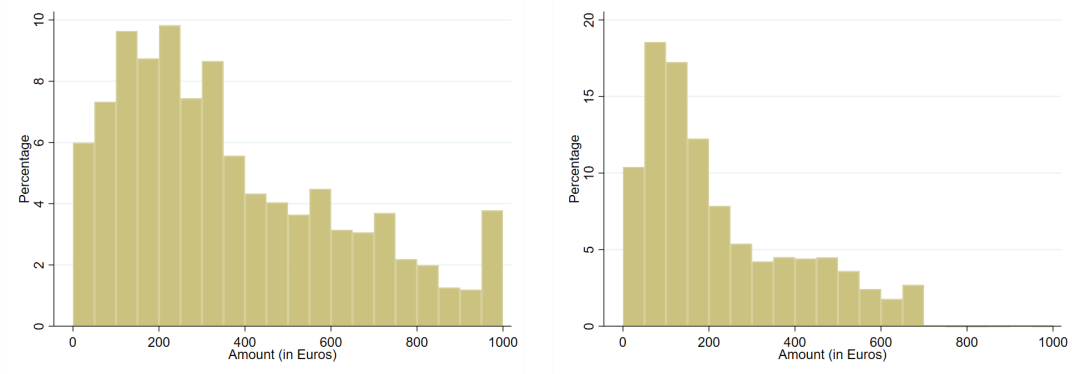
To account for attrition, our main analyses include all individuals until the period they were no longer observed. To ensure that attrition does not bias our results,

we conduct robustness checks using a balanced panel of individuals observed for the full 11-year period (see Section 5.3).

Table 1 presents descriptive statistics for the full sample, treatment group, and control group for the month prior to the announcement of the reform (November 2014). Below, we highlight the key characteristics of the full sample. Approximately 60 percent of the sample is female. The average age is 73.6 years, with 64 percent falling between the ages of 65 and 75. Around 92 percent of the sample has a migration background. This figure is high, because the majority of people with a Dutch background receive the full state pension. About 60 percent of our sample receives an AIO benefit for singles and the remaining part for cohabits.

Figure 2 illustrates the distribution of AIO benefit payments in November 2014 for both singles (Panel (a)) and cohabiting individuals (Panel (b)). The distribution is right-skewed, with peaks around 200 Euros for singles and around 150 Euros for cohabitants. The majority of recipients receive AIO benefits between 0 and 300 Euros. These distributions clearly demonstrate the supplemental nature of the AIO benefit.

**Figure 2:** Distribution in AIO benefit payments




**(a)** Singles **(b)** Cohabits

*Note:* The figures show the destribution in the AIO benefit payments at the month before the announcement of the welfare cut (November 2014). A small number of individuals with occassionaly higher payments were excluded. Total N singles = 27,716; total N cohabits = 18,622.

**Table 1:** Descriptive statistics

| | Full sample | Treated | Not treated |
|---|---|---|---|
| Female | 0.595 | 0.617 | 0.591 |
| Age (in years) | 73.551 | 73.74 | 73.52 |
| 65-69 years | 0.337 | 0.328 | 0.339 |
| 70-74 years | 0.303 | 0.306 | 0.302 |
| 75-79 years | 0.209 | 0.207 | 0.210 |
| 80-84 years | 0.101 | 0.102 | 0.101 |
| 85 years and older | 0.049 | 0.057 | 0.048 |
| | | | |
| No migration background | 0.078 | 0.023 | 0.088 |
| Migration background | 0.922 | 0.977 | 0.912 |
| Western | 0.157 | 0.116 | 0.165 |
| Surinam | 0.173 | 0.131 | 0.181 |
| Morocco | 0.160 | 0.233 | 0.148 |
| Turkey | 0.129 | 0.166 | 0.123 |
| Dutch Antilles / Aruba | 0.042 | 0.037 | 0.042 |
| Other non-Western | 0.258 | 0.290 | 0.253 |
| Unknown | 0.002 | 0.003 | 0.002 |
| | | | |
| Benefit type: Single | 0.598 | 0.579 | 0.601 |
| Benefit type: Cohabit | 0.402 | 0.421 | 0.399 |
| | | | |
| Number of individuals | 46,467 | 6,690 | 39,777 |

*Note:* Descriptive statistics of AIO benefit recipients at the month before treatment (November 2014).

# 4 Empirical strategy

## 4.1 The difference-in-difference model: specification

We implement a difference-in-differences estimator to investigate the effects of the welfare benefit cut. Specifically, we compare the change in outcomes for the treated group (AIO-recipients *with* cost sharers in their household) pre- and post-benefit cut, to the change in outcomes for the control group (AIO-recipients *without* cost sharers in their household) over the same period. The control group, not being directly affected by the reform that reduced welfare benefits for recipients with cost sharers, serves as a counterfactual for what might have happened with the treated group in the absence of the welfare benefit cut.

The relationship between (health) outcomes and the welfare benefit cut is cap-

tured by the following equation:

$$Y_{it} = Treat_i + Treat_i \times Post_{it} + \gamma_t + Age_{it} + \varepsilon_{it} \tag{2}$$

where $Y_{it}$ measures the outcome for individual $i$ at time $t$. We note that $t$ is determined in months for AIO benefit and labor market outcomes, in quarters for health outcomes, and in years for total personal income (see also Section 3.2).

$Treat_i$ is a dummy variable indicating whether individual $i$ is part of the treatment group, defined as individuals receiving AIO-benefits and having cost sharers in their household in November 2014 (the pre-announcement month).[7] $Post_{it}$ is a dummy variable that takes the value of one after the announcement of the welfare reform. In our graphical results, we also examine potential anticipation effects during the intermediary period between the reform announcement (December 2014) and its implementation (July 2015).

We interact the treatment and the post-reform variables to examine whether outcomes vary by the presence of cost sharers and timing of the reform (before and after the reform). Thus, the variable of interest is $Treat_i \times Post_{it}$, which takes the value of one for individuals in the treatment group after the reform. This variable captures the difference-in-differences in the outcome variables for individuals in the treatment and the control group after and before the reform.

Time period fixed effects are denoted by $\gamma_t$. We also include age fixed effects, $Age_{it}$, to control for differences in health that are strongly correlated with age. This is relevant as our sample consists of older (retired) welfare recipients.

## 4.2 Validity of the difference-in-difference model

This section outlines the rationale and supporting evidence for the DID assumptions. In the context of this study, the no anticipation assumption posits that individuals do not alter their behavior or outcomes in anticipation of the welfare reform. This ensures that pre-treatment trends are unaffected by knowledge of the impending policy change. As discussed in Section 2.2, this issue was addressed by defining the

[7]The status of having cost sharers in one's household may change over time; the implications of this are discussed in Section 6.

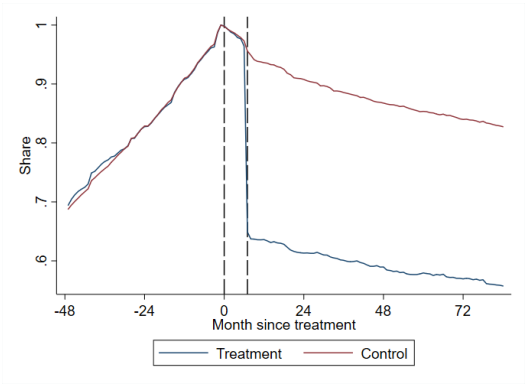
treatment period as beginning in the month the welfare cut was first announced (November 2014).

The identifying assumption in this analysis is the parallel trends assumption, which asserts that, in the absence of treatment, the outcomes of the treatment and control groups would follow the same trends over time. While this assumption cannot be directly tested, the presence of parallel trends in the pre-treatment period is commonly considered as supporting evidence. To visually assess these trends, Figure 3 and Figure 4 present the pre- and post-treatment trends for both groups. These figures demonstrate that all income- and health-related outcomes followed a similar trend over the four years prior to the start of the treatment (announcement of the welfare cut). Consistently, we find no significant DID effects for any outcomes across the pre-treatment periods (see Figure 5 and Figure 6). The only exception is a small, statistically significant DID effect on total personal income in year $t = -3$. However, this effect is minimal both in absolute terms (137 Euros) and relative terms (approximately 1 percent).

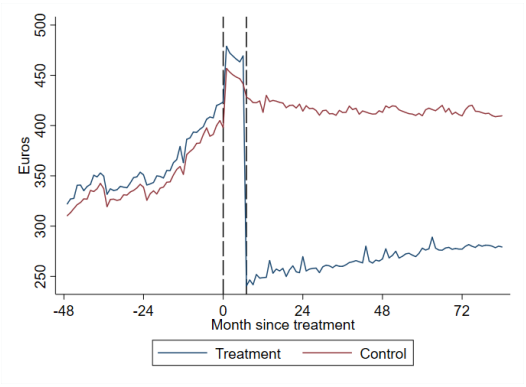
To formally test the parallel pre-treatment trend, we estimated difference-in-differences (DID) coefficients for each outcome and calculated the averages for two-year and four-year pre-treatment periods. Small and statistically insignificant effects are interpreted as evidence supporting the parallel trends assumption. The results of this test are presented in Table 2. Consistent with the findings in Figure 3 and Figure 4, we observe coefficients close to zero and statistically insignificant for all income- and health-related outcomes across both time periods.[8] To further emphasize the similarity in trends, the average coefficients for all health outcomes across both time periods ranged from -0.002 to 0.002, essentially zero. Taken together, these results strongly support the parallel trends assumption.

[8]The only exception is total personal income, for which we find a statistically significant effect. However, the magnitude of this effect (64 Euros annually) is small and close to zero in practical terms.

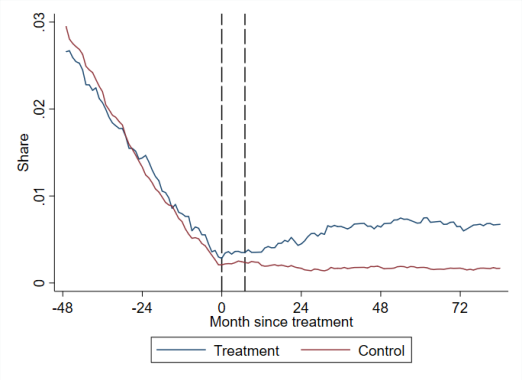
**Figure 3:** Trends for income-related variables



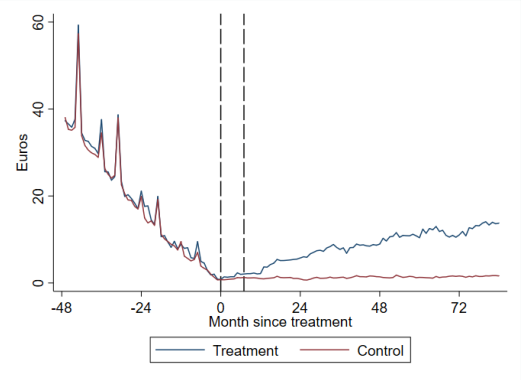

**(a)** Benefit receipt



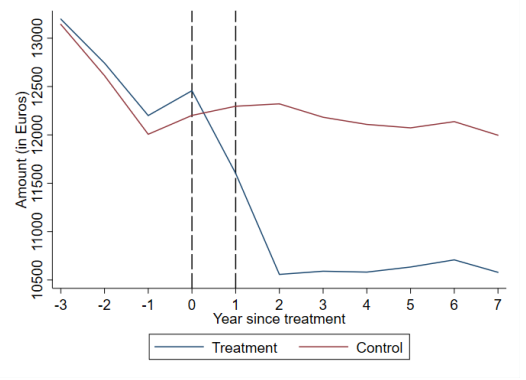

**(b)** Benefit amount (€)




**(c)** Employed



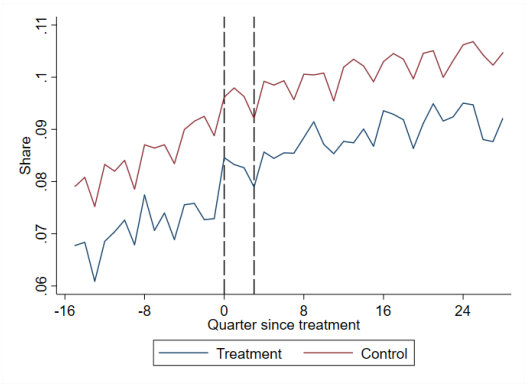

**(d)** Earnings (€)



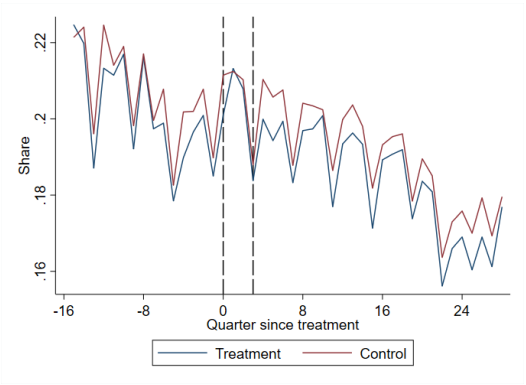

**(e)** Total personal income (€)

*Note:* Trends for outcome variables for treated versus control groups. $t = 0$ indicates the month of first announcement of the welfare cut. $t = 7$ is the month of the introduction of the welfare cut. Number of individuals = 46,467.

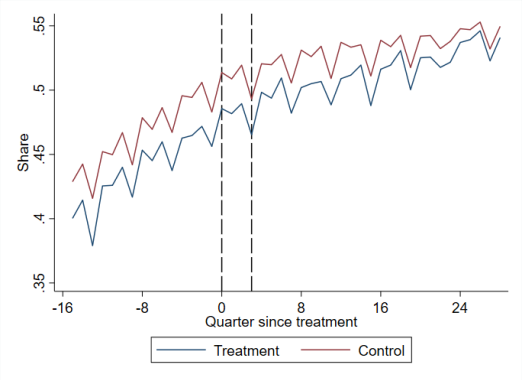
**Figure 4:** Trends for health variables



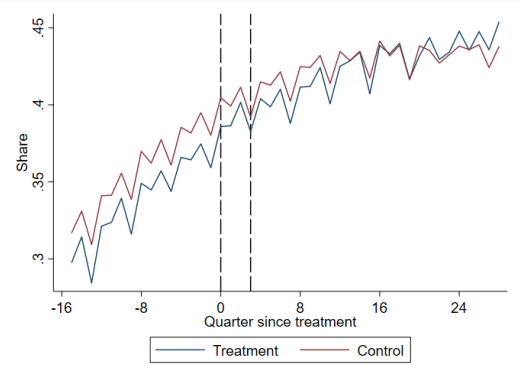

**(a)** Psychological disorders



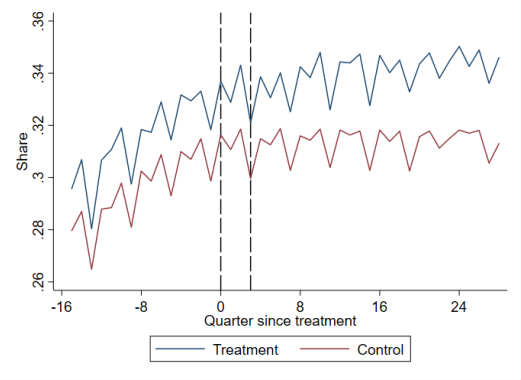

**(b)** Pain




**(c)** Hypertension




**(d)** High cholesterol




**(e)** Diabetes mellitus

*Note:* Trends for outcome variables for treated versus control groups. $t = 0$ indicates the quarter of first announcement of the welfare cut (Q4 2014). $t = 3$ is the quarter of the introduction of the welfare cut (Q3 2015). Number of individuals = 46,467.

**Table 2:** Test of parallel pre-treatment trends

| | Pre-trend 2 years | | | Pre-trend 4 years | | |
|---|---|---|---|---|---|---|
| | coef | se | p-value | coef | se | p-value |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: Income-related outcomes** | | | | | | |
| AIO benefit receipt | -0.001 | 0.002 | 0.423 | -0.001 | 0.002 | 0.713 |
| AIO benefit amount | -1.160 | 2.438 | 0.634 | -1.937 | 2.600 | 0.456 |
| Employed | 0.000 | 0.001 | 0.798 | -0.001 | 0.001 | 0.614 |
| Earnings | 0.658 | 1.296 | 0.612 | 1.086 | 1.968 | 0.581 |
| Total personal income (year)* | - | - | - | -64** | 26 | 0.013 |
| **Panel B: Health outcomes** | | | | | | |
| Psychological disorder | 0.001 | 0.002 | 0.558 | 0.002 | 0.002 | 0.301 |
| Pain | -0.001 | 0.004 | 0.834 | 0.000 | 0.004 | 0.925 |
| Hypertension | -0.002 | 0.003 | 0.644 | -0.002 | 0.004 | 0.688 |
| Cholesterol | 0.002 | 0.003 | 0.624 | 0.001 | 0.004 | 0.771 |
| Diabetes Mellitus | 0.000 | 0.003 | 0.929 | -0.001 | 0.003 | 0.843 |

*Note:* The table presents the coefficients, robust standard errors, and corresponding p-values of the pre-trend analysis for two-year (Columns (1)–(3)) and four-year (Columns (4)–(6)) periods. Each coefficient represents the average difference-in-difference estimate for the respective outcome (using Eq. (2)) for the corresponding pre-treatment period, obtained through Stata's lincom command. Panel A reports average monthly estimates, except for total personal income, which is presented on an annual basis and only for a three-year pre-treatment period. Panel B provides average quarterly estimates. Standard errors are robust and clustered at the household level. Number of individuals = 46,467; number of clusters = 39,711. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

# 5 Results

## 5.1 Effects on income-related outcomes

The welfare cut has a substantial and long-lasting negative impact on AIO benefit receipt and payments. Panels (a) and (b) of Figure 5 and Table 3 show the corresponding monthly and pooled difference-in-difference effects, respectively. At the time of implementation, AIO benefit receipt drops sharply by approximately 30 percentage points, accompanied by a reduction in monthly benefit payments of about 170 Euros. These immediate declines result from the introduction of the cost-sharing standard, which rendered a portion of AIO recipients ineligible for benefits. The negative effect on AIO benefit receipt remains substantial over time, with a reduction of 27.6 percentage points even seven years after the welfare cut was announced. The effect on monthly benefit payments slightly diminishes over time but still stands at 122 Euros seven years after the welfare reform. Over the full post-treatment period, the pooled treatment effects are a 28.6 percentage point reduction in benefit receipt (equivalent to a 34.0% decrease compared to the sample mean) and a 139 Euro reduction in monthly benefit payments (a 47.4% decrease) (see Column (6) of Table 3).

The negative shock in AIO benefits has been only marginally offset by higher earnings. As illustrated in Panels (c) and (d) of Figure 5 and Table 3, the welfare reform has positive effects on the probability of employment and earnings over the long term. For the full pos-treatment period, the welfare cut increases employment with 0.3 percentage points (about 150 percent) and earnings with 6.15 Euros (278 percent). The relative effects are large as only a very small proportion of our sample works besides receiving AIO benefits. As a consequence, the size of the positive treatment effect on earnings remains small in light of the reductions in AIO benefits.

Overall, the welfare cut reform resulted in a substantial and persistent negative income shock. Panel (e) of Figure 5 presents the yearly treatment effects on total personal income showing a substantial negative effect on income at the time of the welfare cut implementation (spread over two calendar years). The negative income effect was approximately 1,970 Euros in the year following implementation

**Table 3:** Pooled difference-in-difference effects of the welfare cut on income-related outcomes

| | Anticipation period | Post-treatment period | | | Anticipation & post-treatment period | Full post-treatment period |
|---|---|---|---|---|---|---|
| | Month 0-7 | Month 7-30 | Month 31-54 | Month 55-84 | Month 0-84 | Month 7-84 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: Benefit receipt** | | | | | | |
| Coefficient | -0.001 | -0.298*** | -0.284*** | -0.276*** | -0.259*** | -0.286*** |
| (s.e.) | (0.002) | (0.007) | (0.007) | (0.008) | (0.006) | (0.007) |
| Sample mean | 0.986 | 0.879 | 0.836 | 0.805 | 0.853 | 0.840 |
| **Panel B: Benefit payment** | | | | | | |
| Coefficient | 4.80* | -153.31*** | -137.04*** | -125.53*** | -124.93*** | -138.54*** |
| (s.e.) | (2.37) | (2.35) | (2.67) | (2.98) | (2.30) | (2.48) |
| Sample mean | 342.26 | 301.12 | 292.32 | 283.85 | 296.97 | 292.32 |
| **Panel C: Employed** | | | | | | |
| Coefficient | 0.000 | 0.001 | 0.004*** | 0.004*** | 0.003*** | 0.003*** |
| (s.e.) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Sample mean | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| **Panel D: Earnings** | | | | | | |
| Coefficient | -0.25 | 2.73* | 6.52*** | 9.17*** | 5.55*** | 6.15*** |
| (s.e.) | (1.33) | (1.63) | (2.11) | (2.69) | (1.87) | (1.97) |
| Sample mean | 1.01 | 1.59 | 2.32 | 2.71 | 2.10 | 2.21 |
| N observations | 1,430,508 | 2,154,146 | 2,069,467 | 2,176,547 | 4,502,474 | 4,181,364 |

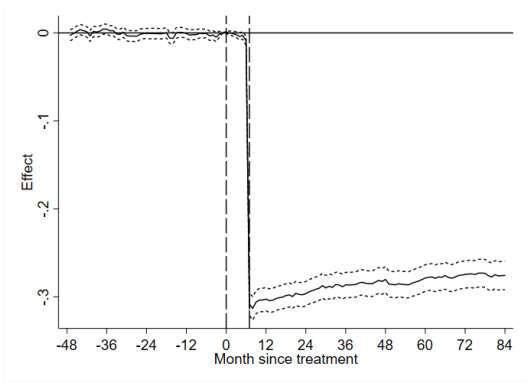
*Note:* The table shows pooled difference-in-difference (DID) treatment effects on income-related outcomes for the corresponding treatment period. The pooled DID estimates include months $t = -1$ to $t = -24$ as baseline and controls for age. Standard errors are robust and clustered at the household level. Number of individuals = 46,467; number of clusters = 39,711

and slightly decreased to 1,645 Euros by year seven. Table 4 shows the pooled treatment effects on annual personal income. Over the entire treatment period, the average annual income decrease was 1,551 Euros (including the first six months of 2015 with full AIO benefits), corresponding to an income reduction of about 13 percent.

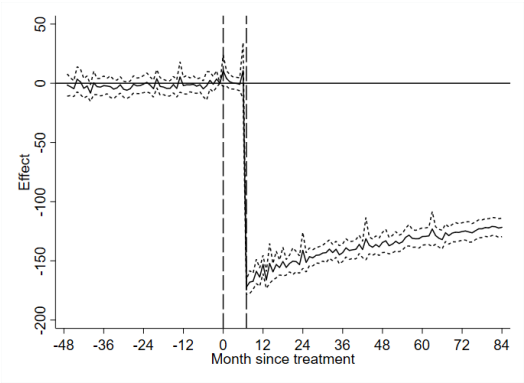
## 5.2 Effects on health outcomes

Figure 6 and Table 5 present the quarterly and pooled treatment effects on health outcomes. Panels (a) and (b) of Figure 6 show no significant treatment effects on medication use for psychological disorders and pain across any post-treatment quarter. Consistent with this finding, the pooled estimates for these outcomes are close to zero and precisely estimated, with standard errors ranging from 0.002 to

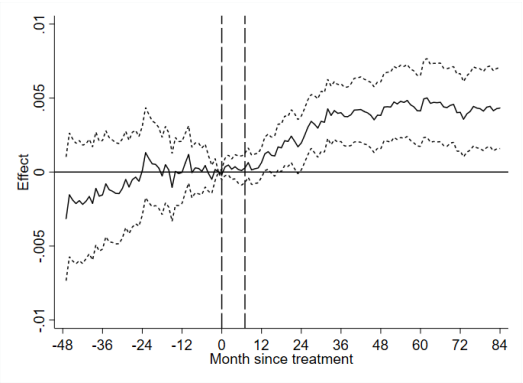
**Figure 5:** DID-effects of the welfare cut on income-related outcomes



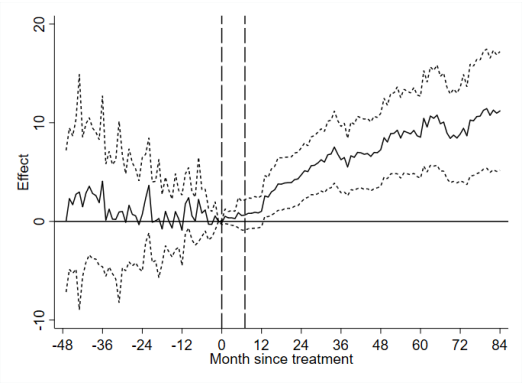

**(a)** Benefit receipt



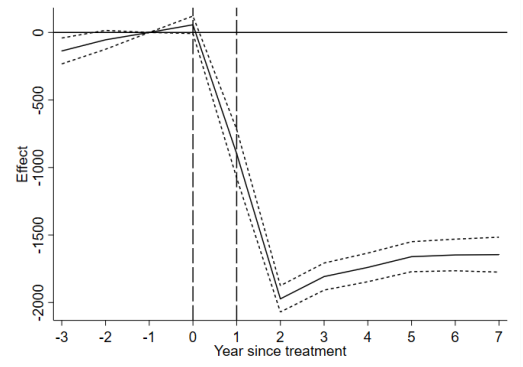

**(b)** Benefit amount (€)




**(c)** Employed




**(d)** Earnings (€)




**(e)** Total personal income (€)

*Note:* The figures show monthly difference-in-difference (DID) treatment effects with corresponding 95%-confidence intervals on income-related outcomes. For Panel (e), the figure shows yearly difference-in-difference treatment effects. The DID estimates use t=-1 as baseline and include controls for age. For each outcome variable, the treatment effects are estimated in a single model. The 95% confidence interval (dashed lines) are based on robust standard errors clustered at the household level. For Panels (a)–(d), $t = 0$ and $t = 7$ indicate the *month* of announcement and implementation of the welfare cut, respectively. For Panel (e), $t = 0$ and $t = 1$ indicate the *year* of announcement and implementation of the welfare cut, respectively. Number of individuals = 46,467; number of clusters = 39,711

**Table 4:** Pooled difference-in-difference effects of the welfare cut on total personal income

| | Year 0-2 | Year 3-5 | Year 6-7 | Year 0-7 | Year 1-7 |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| **Panel A: Total personal income** | | | | | |
| Coefficient | -851*** | -1,676*** | -1,583*** | -1,309*** | -1,551*** |
| (s.e.) | (48) | (53) | (62) | (46) | (50) |
| Dependent mean | 12,170 | 11,905 | 11,865 | 12,006 | 11,967 |
| N observations | 271,227 | 255,368 | 205,516 | 458,421 | 412,144 |

*Note:* The table shows pooled difference-in-difference (DID) treatment effects on total annual personal income for each corresponding treatment period. The pooled DID estimates include years $t = -1$ to $t = -3$ as baseline and controls for age. Standard errors are robust and clustered at the household level. Number of individuals = 46,467; number of clusters = 39,711

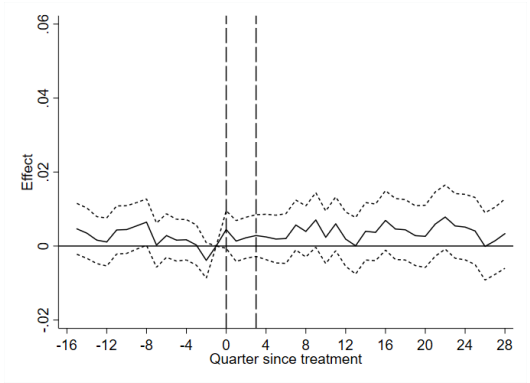
0.004 (Table 5).

In contrast, Panels (c)–(e) of Figure 6 show that the welfare benefit cut increases medication use for lifestyle-related diseases in the longer term. For high cholesterol, the increase becomes apparent during the anticipation period and progressively grows over time. For hypertension and diabetes mellitus, significant positive effects emerge in the later quarters of the post-treatment period. Specifically, the pooled estimates for quarters 19–28 (55–84 months) indicate increases of 1.9 percentage points (+3.5%) for hypertension, 2.7 percentage points (+6.2%) for high cholesterol, and 1.3 percentage points (+4.1%) for diabetes mellitus. Although the pooled treatment effects over the full post-treatment period are slightly smaller, they remain statistically significant at the 1-percent level.

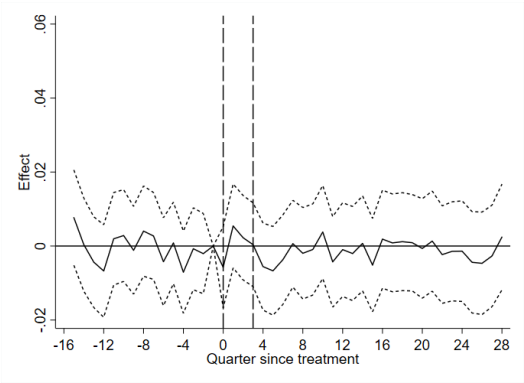
## 5.3 Robustness analyses

We perform several robustness analysis to check whether the treatment effects on health outcomes hold for alternative specification and sample choices. First, we estimate two-way fixed effects by adding individual fixed effects to Equation (2). Second, we estimate treatment effects for a balanced panel by including only individuals who where observed in the health data for the full 11-year time period (effectively by excluding individuals who were no longer registred in the Basic Per-

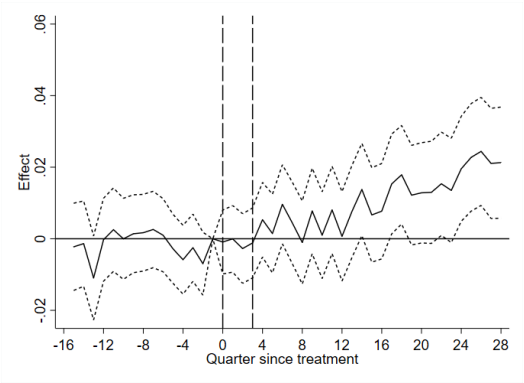
**Figure 6:** DID-effects of the welfare cut on health outcomes



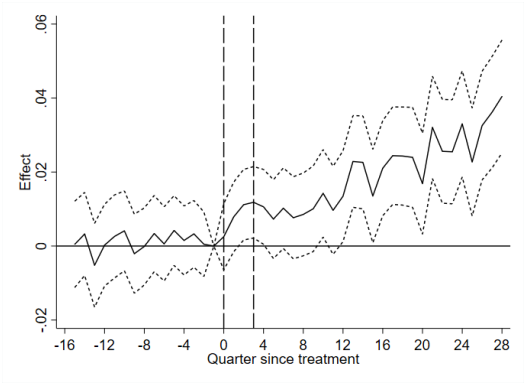

**(a)** Psychological disorders



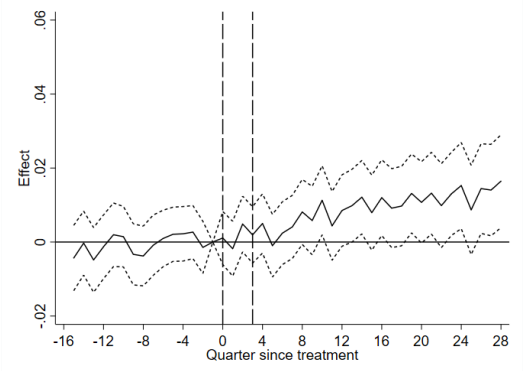

**(b)** Pain




**(c)** Hypertension




**(d)** High cholesterol




**(e)** Diabetes mellitus

*Note:* The figures show quarterly difference-in-difference (DID) treatment effects with corresponding 95%-confidence intervals on health outcomes. The DID estimates use quarter t=-1 as baseline and include controls for age. For each outcome variable, the treatment effects are estimated in a single model. The 95% confidence interval (dashed lines) are based on robust standard errors clustered at the household level. $t = 0$ and $t = 3$ indicate the *quarter* of announcement and implementation of the welfare cut, respectively. Number of individuals = 46,467; number of clusters = 39,711

sonal Registry). Third, We estimate treatment effects at the monthly level. While we consider measuring medication use at the quarterly level as most adequate for

**Table 5:** Pooled difference-in-difference effects of the welfare cut on health outcomes

| | Anticipation period | Post-treatment period | | | Anticipation & post-treatment period | Full post-treatment period |
|---|---|---|---|---|---|---|
| | Quarter 0-2 | Quarter 3-10 | Quarter 11-18 | Quarter 19-28 | Quarter 0-28 | Quarter 3-28 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: Psychological disorder** | | | | | | |
| Coefficient | 0.002 | 0.002 | 0.003 | 0.003 | 0.002 | 0.003 |
| (s.e.) | (0.002) | (0.002) | (0.003) | (0.003) | (0.002) | (0.003) |
| Sample mean | 0.095 | 0.097 | 0.100 | 0.102 | 0.099 | 0.099 |
| **Panel B: Pain** | | | | | | |
| Coefficient | 0.001 | -0.001 | 0.000 | 0.000 | 0.000 | -0.001 |
| (s.e.) | (0.003) | (0.003) | (0.004) | (0.004) | (0.003) | (0.003) |
| Sample mean | 0.211 | 0.200 | 0.193 | 0.176 | 0.192 | 0.189 |
| **Panel C: High cholesterol** | | | | | | |
| Coefficient | 0.006* | 0.008** | 0.017*** | 0.027*** | 0.016*** | 0.018*** |
| (s.e.) | (0.003) | (0.004) | (0.005) | (0.006) | (0.004) | (0.004) |
| Sample mean | 0.403 | 0.414 | 0.429 | 0.433 | 0.423 | 0.425 |
| **Panel D: Hypertension** | | | | | | |
| Coefficient | 0.000 | 0.005 | 0.011** | 0.019*** | 0.011** | 0.012*** |
| (s.e.) | (0.003) | (0.004) | (0.005) | (0.006) | (0.004) | (0.004) |
| Sample mean | 0.510 | 0.516 | 0.527 | 0.538 | 0.525 | 0.527 |
| **Panel E: Diabetes Mellitus** | | | | | | |
| Coefficient | 0.001 | 0.005 | 0.009** | 0.013*** | 0.008*** | 0.009*** |
| (s.e.) | (0.002) | (0.003) | (0.004) | (0.005) | (0.003) | (0.003) |
| Sample mean | 0.318 | 0.315 | 0.317 | 0.318 | 0.317 | 0.317 |
| N observations | 507,410 | 718,001 | 689,644 | 725,513 | 1,532,884 | 1,394,702 |

*Note:* The table shows pooled difference-in-difference (DID) treatment effects on health outcomes for the corresponding treatment period. The pooled DID estimates include quarters $t = -1$ to $t = -8$ as baseline and controls for age. Standard errors are robust and clustered at the household level. Number of individuals = 46,467; number of clusters = 39,711

the Dutch context (see Section 3.2), other studies have estimated treatment effects at the monthly level (Caliendo et al., 2023).

Overall, the results of the main models are robust to these alternative specifications. Panels (b), (c), and (d) show the results for these alternative specifications and samples for the longer term (month 55–84 or quarter 19–28). For psychological disorders and pain, the null-findings of the main model are robust to these alternative specifications. For cholesterol and hypertension, we also find significant treatment effects with similar effect sizes (in relative terms). The effects on diabetes mellitus are only robust for the monthly treatment effects, but not for adding individual fixed effects and the balanced panel.

# 6 Discussion

Our main findings are as follows: the welfare cut reform led to a substantial and persistent reduction in the personal income of AIO recipients. We observe close-to-zero and statistically insignificant treatment effects on medication use for psychological disorders and pain. In contrast, we find strong evidence of increased medication use for lifestyle-related diseases, particularly hypertension and high cholesterol. Below, we discuss potential explanations for these results. We note that our data do not permit final conclusions regarding these potential explanations.

The absence of significant effects of the welfare cut on medication use for psychological disorders may be explained by two factors. As discussed before, the presumed mechanism underlying the effect of a negative income shock on mental health medication use is increased financial stress. First, the welfare cut may not have substantially increased financial stress among the older AIO population, as older individuals are generally associated with lower levels of financial stress (De Bruijn and Antonides, 2020). However, we consider this unlikely, as increased (financial) stress is a typical and expected response to a significant income shock, particularly among low-income households (see Haushofer and Fehr (2014) for an overview). Moreover, the income shock in our context was both substantial and persistent.

Second, even if financial stress increased, it may not have translated into greater medication use for psychological disorders. A potential reason is that AIO recipients might have employed coping strategies, such as mental (or financial) support from their co-residents or co-resident children. The social support provided by co-resident cost sharers may have mitigated the need for mental health medication among AIO recipients in the treatment group. Additionally, underuse of medication for mental health issues within this population may have constrained the treatment effect.

Two mechanisms could explain the positive treatment effects on medication use for hypertension and high cholesterol. First, the persistent negative income shock may have increased chronic financial stress, potentially contributing to the onset or exacerbation of these lifestyle-related diseases. Second, the cut in AIO benefits could have constrained budgets for a healthy lifestyle, leading to poorer dietary choices and

decreased physical activity. Given the lack of significant treatment effects on mental health medication use, the second explanation may be more plausible. However, we note that with the current data, we are unable to provide definite conclusions.

We acknowledge that our estimates of outcomes may be somewhat conservative. The reason is that our DID design does not fully capture the eventual impact of the welfare benefit cut over time, as the magnitude of the negative shock to benefit payments diminishes in later periods. This reduction can be partially attributed to the natural dynamics of household composition, which affect the applicability of the cost-sharing standard across the treatment and control groups.

As shown in Figure B.2 in Appendix B, the proportion of AIO recipients with cost sharers in their household exhibits some convergence between the treatment and control groups over time, partly due to natural household dynamics. For instance, cost sharers may leave a household as children move out, while control group households may gain cost sharers when children turn 21 and are newly classified as such. Consequently, some treatment group AIO recipients eventually avoided the welfare cut, while some control group participants faced it, potentially leading to an underestimation of the longer-term income and health effects.

# 7 Conclusion

This study examines the short- and long-term health effects of a welfare cut reform for low-income retirees in the Netherlands. Using a difference-in-difference design and detailed medication provision data, we investigate the impact of this reform on medication use for mental health problems, pain, and several lifestyle-related conditions.

The welfare cut created a large and persistent shock in benefit payments, which was only limitedly compensated by increased earnings. Overall, the welfare cut decreases personal annual income with 13% for at least a seven-year period. Over time, the welfare cut led to increased medication use for hypertension and high cholesterol, indicating a negative impact on lifestyle-related health conditions. Additionally, we found no significant treatment effects on medication use for mental health problems

or pain. Importantly, our research design had sufficient power to rule out even small treatment effects in these domains.

Overall, our findings reinforce the evidence that lower income levels among low-income elderly individuals can have detrimental effects on health outcomes. Specifically, a substantial negative income shock contributes to the onset and exacerbation of lifestyle-related diseases, even among older populations. From a public policy perspective, this suggests that reductions in welfare benefits may lead to increased healthcare costs, offsetting potential fiscal savings. Policymakers should consider these adverse health effects when determining optimal benefit levels, particularly for vulnerable groups such as elderly people.

Moreover, our results demonstrate that income shocks in later life can exacerbate health inequalities. While prior research has highlighted the importance of early-life investments in reducing health disparities (Danesh et al., 2024), our findings suggest that targeted interventions to improve the income position of low-income elderly individuals can also be effective in mitigating health disparities. This underscores the need for policies that address health inequities across the entire life course, including among older low-income adults.

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# Online Appendix

Health Effects of a Welfare Cut among Low-income Retirees

# A Classification medication codes

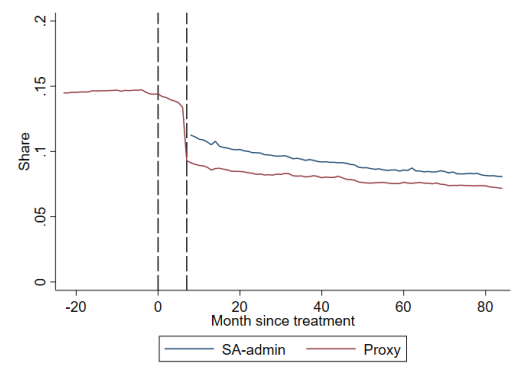
**Table A.1:** Classification of ATC3 medication codes to chronic conditions

| **Chronic condition** | **ATC3 Codes** |
|---|---|
| Psychological disorder | N05B, N05C, N06A |
| Pain & inflammatory conditions | N02A, H02A, M01A |
| High cholesterol | C10A, C10B |
| Hypertension | C03A, C07A, C07B, C08C, C08D, C09A, C09B |
| Diabetes mellitus | A10A, A10B |

*Note:* The table presents the ATC3 medication codes associated with each chronic condition. The classification is based on (Huber et al., 2013) and adapted to the Dutch context by (Yildiz et al., 2020). Medications that are rarely prescribed were not available in our dataset. For Psychological disorders: N06B; Pain & inflammatory conditions: N02B (not registered since 2019), H02B, M01C, and M02A; Hypertension: C02A, C02C, C02D, C02K, C07C, and C08G.

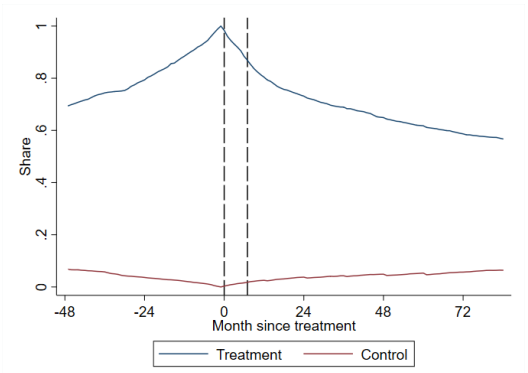
# B Additional descriptive statistics

**Figure B.1:** Share of AIO-recipients with cost sharers in their household

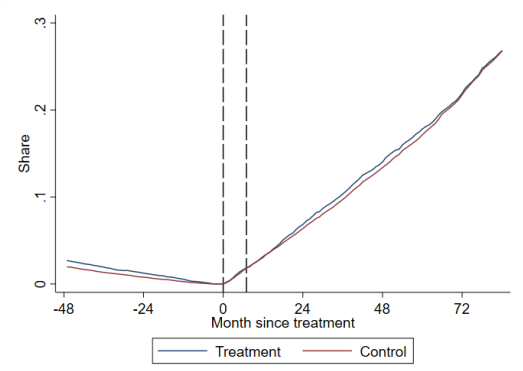



*Note:* Trend of share of AIO-recipients with cost sharers in their household over time. SA-admin refer to share with cost sharers based on administrative data; proxy to the calculated proxy used in this research. $t = 0$ indicates the month of first announcement of the welfare cut (month of treatment). $t = 7$ is the month of the introduction of the welfare cut. Number of individuals: ....

**Figure B.2:** Additional trend figures




**(a)** Trend: Has cost sharers in household




**(b)** Trend: Not registered in Personal Records Database (BRP)

*Note:* Trends for share with cost sharers in their household (Panel (a)) and not registered in the Personal Records Database (BRP) (Panel (b)). $t = 0$ indicates the month of first announcement of the welfare cut. $t = 7$ is the month of the introduction of the welfare cut. Number of individuals: ....

# C Robustness of the DID results

Pooled DID effects on health outcomes - quarter 19-28

| | Psychological disorders | Pain | Cholesterol | Hypertension | Diabetes Mellitus |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| **Panel A: Main model** | | | | | |
| Coefficient | 0.003 | 0.000 | 0.027*** | 0.019*** | 0.013*** |
| (se) | (0.003) | (0.004) | (0.006) | (0.006) | (0.005) |
| Sample mean | 0.102 | 0.176 | 0.433 | 0.538 | 0.318 |
| N observations | 725,513 | 725,513 | 725,513 | 725,513 | 725,513 |
| **Panel B: DID - with age and individual fixed effects** | | | | | |
| Coefficient | 0.001 | -0.004 | 0.023*** | 0.015*** | 0.003 |
| (se) | (0.003) | (0.004) | (0.005) | (0.006) | (0.004) |
| Sample mean | 0.102 | 0.176 | 0.433 | 0.538 | 0.318 |
| N observations | 725,513 | 725,513 | 725,513 | 725,513 | 725,513 |
| **Panel C: Balanced panel** | | | | | |
| Coefficient | 0.000 | -0.007 | 0.024*** | 0.016*** | 0.005 |
| (se) | (0.003) | (0.004) | (0.006) | (0.006) | (0.004) |
| Sample mean | 0.100 | 0.172 | 0.440 | 0.542 | 0.319 |
| N observations | 587,687 | 587,687 | 587,687 | 587,687 | 587,687 |
| **Panel D: Monthly effects** | | | | | |
| Coefficient | 0.001 | 0.000 | 0.014*** | 0.010** | 0.013*** |
| (se) | (0.003) | (0.003) | (0.005) | (0.005) | (0.004) |
| Sample mean | 0.071 | 0.093 | 0.262 | 0.332 | 0.208 |
| N observations | 2,176,547 | 2,176,547 | 2,176,547 | 2,176,547 | 2,176,547 |

*Note:* The table presents the results of various sensitivity checks for the pooled DID estimates for quarter 19-28 (months 55–84) after treatment. Panel A shows the main model with age fixed effects. Panel B includes DID estimates with both age and individual fixed effects. Panel C presents DID estimates with age fixed effects for a balanced panel of individuals observed over the full 11-year period. Panel D reports monthly DID estimates with age fixed effects. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$