Multidisciplinary care by general practitioners in the Netherlands: the effect of a payment reform on regional healthcare expenditures

Master Thesis

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ABSTRACT

In 2015, the way Dutch general practitioners were reimbursed changed. A restructured and expanded payment model should stimulate multidisciplinary care and allow for effective substitution. This study aimed to evaluate the impact of the reform of the GP payment model in 2015 on regional healthcare costs. We used Vektis health insurance claims data (2011-2018) to compare the treatment regions for which we observed an uptake in multidisciplinary GP care costs against the control regions that did not have the desired response. In line with the aims of the new payment model, substitution effects were expected for GP care costs and medical specialist care costs. The expected effects were examined with difference-in-differences regression models with fixed effects. For GP care costs, no parallel trends could be assumed. For medical specialist care costs, the parallel trends assumption was met, and baseline group differences and time trend effects were observed. There was no clear difference in the change in costs post-reform across the treatment and control group. When repeating the analysis for the subgroup over the age of 50 a substitution effect was observed in 2018 (b = –38.07, t(-2.04), p = 0.042). These results implicate that it might take some time before the expected savings are realized.

Keywords: primary care; general practitioners; multidisciplinary care; bundled payment; substitution; payment reform; difference-in-differences

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1 INTRODUCTION

The Netherlands is amongst the European countries with the highest per capita health expenditure (Kroneman et al., 2016; OECD, 2017). While the 2009 global financial crisis primed a reduction of health expenditure as a proportion of GDP in several European countries, in the Netherlands health expenditure has continuously risen since 2000 (Kroneman et al., 2016). As health expenditure has become an increasingly large portion of total public spending, the pressure toward cost containment has increased. Despite previous cost control efforts, the expenditure growth rate threatens the accessibility and affordability of healthcare in the future. The ultimate concern remains about the financial sustainability of the Dutch healthcare system and there is still substantial room to improve efficiency (OECD, 2017).

Primary care has been the focus of Dutch healthcare policy development because of its potential to contain costs through effective care substitution (OECD, 2017; Wiegers et al., 2011). Primary care includes community-level care performed by general practitioners (GPs), physiotherapists, obstetricians, dieticians, nurses, home care providers, primary psychologists, and social workers. Good quality primary care includes prevention activities, health promotion and education, and integrated care with a central role of the patient in its environment (Wiegers et al., 2011). A robust primary healthcare system is associated with lower healthcare costs and better population health outcomes (Bodenheimer and Fernandez, 2005; van Weel and Kidd, 2011). Healthcare costs are higher in areas with high ratios of medical specialists versus primary care professionals, which illustrates that secondary specialist care is a large driver of healthcare spending (Bodenheimer and Fernandez, 2005). Primary care physicians are able to take over some of the services that are performed by secondary providers (Van Dijk et al., 2013). Healthcare provided by primary care physicians can be of similar quality while being less costly than specialist care. Consequently, substituting some specialist care with primary care can increase efficiency (Bodenheimer and Fernandez, 2005).

Present-day healthcare challenges require strong and appropriately organized primary care systems to allow for effective substitution of care. The Dutch primary care system has been burdened with an increasing and changing care demand due to growing numbers of chronically ill patients and frail elderly (Flinterman et al., 2018). These challenges threaten not only the financial sustainability of the system but also feed into the fragmentation of care in approaching these multimorbid patients. Fragmented delivery of care is characterized by a lack of communication and coordination among healthcare providers, which threatens the safety and quality of care (Morgan et al., 2020). While the Dutch primary care system is strong, these challenges call for a more advanced organization of integrated care, especially when aiming for a shift of care from the secondary to the primary level (OECD, 2017). In response, primary care professionals have increasingly started working in more multidisciplinary care structures (Kroneman et al., 2016). Multidisciplinary care includes the provision of integrated treatment involving various care professionals from multiple disciplines that provide the variety of care elements required in cohesive cooperation with each other and the patient.

In 2013 the Dutch Minister of Health agreed with stakeholders on approaches to strengthen primary care by stimulating more multidisciplinary care initiatives (Zorgakkoord, 2013). In the Netherlands, primary care is characterized by the central role of GPs, both in the coordination of multidisciplinary care and in making referrals to specialist care (Zorgverzekeringswet, 2005; Kroneman et al., 2016). The 2013 agreement led to the introduction of a new GP payment model that expands the reimbursement possibilities of multidisciplinary care activities and specifically rewards care substitution efforts, as of 2015 (NZa, 2014). The stimulation of multidisciplinary care should allow for effective diffusion of the substituted care and the explicit financial incentive for substitution efforts should further strengthen the ‘gatekeeper’ role of the GP.

It is relevant for Dutch policy development to evaluate whether the payment reform has had the desired effects. Therefore, this study evaluated the impact of the new payment model on regional healthcare costs. While multiple studies have investigated the effects of bundled payment for specific diseases, the generalized effect of the 2015 payment reform, in terms of health expenditure and substitution effects, remains unknown. This paper aims to contribute to the existing literature on the healthcare expenditure effects of payment reforms and financial incentives.

We observed rising trends in multidisciplinary care, GP care, and secondary specialist care over the years 2015-2018. Models did not identify the expected substitution effects caused by the payment reform in 2015. Sensitivity analyses showed different results for older populations, perhaps due to a larger substitution potential. In the older populations we observed a lagged effect (2018: b = –38.07, t(-2.04), p = 0.042), reflecting a substitution from secondary care to multidisciplinary care.

This paper is further organized as follows: in *chapter 2* we explain the reformed GP payment model, which feeds into our research objective and hypotheses development in *chapter 3*. *Chapter 4* provides the theoretical framework with an overview of the relevant background literature. *Chapter 5* describes the data source and empirical methods used. Results are reported in *chapter 6* and further discussed and concluded in the final *chapter 7*.

2 REFORMING THE GP PAYMENT MODEL

This chapter provides the necessary background on the GP payment model before and after 2015. The new GP payment model is explained in more detail, and the desired effects are conceptualized. Furthermore, we explain the role of the GP in multidisciplinary care in the Netherlands.

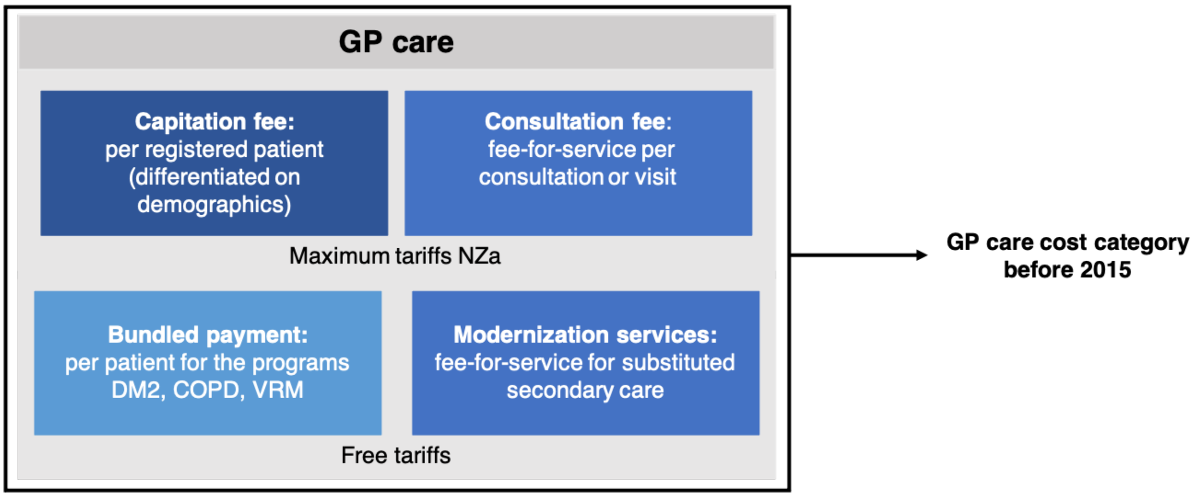
2.1 Paying the GP before 2015

GP care is covered by the mandatory basic health insurance under the Health Insurance Act (Kroneman et al. 2016; Zorgverzekeringswet, 2005). Under this act, GPs negotiate with insurance companies on tariffs for reimbursement. This tariff negotiation is partly regulated by the Dutch Healthcare Authority (NZa). As part of the Dutch Health Insurance Act, healthcare insurance companies are required to annually report the healthcare costs that were declared by the providers and insured. With mandatory insurance, almost all Dutch citizens have basic healthcare insurance (OECD, 2017). Vektis is the national health insurance database with national coverage of the health care costs claimed under the basic health insurance in the Netherlands (de Boo, 2011).

Before 2015, GP care costs were declared under the GP care cost category (see *figure 1*), which included the following routes of reimbursement (Van Dijk, 2009; NZa, 2014).

- **Capitation fees**: payment per registered patient. The NZa regulated maximum tariffs and the tariffs were differentiated on the basis of demographic characteristics.
- **Consultation fees**: payment per service, consult or visit. The NZa regulated maximum tariffs.
- **Modernization services:** payment per service for substituted secondary care. Tariffs were left free for negotiation.
- **Bundled payment for specific multidisciplinary care programs**: since 2010 a bundled payment was introduced for multidisciplinary care programs for type 2 diabetes, COPD, and vascular risk management. Tariffs were left free for negotiation.

Figure 1: a visual representation of the GP payment model before 2015



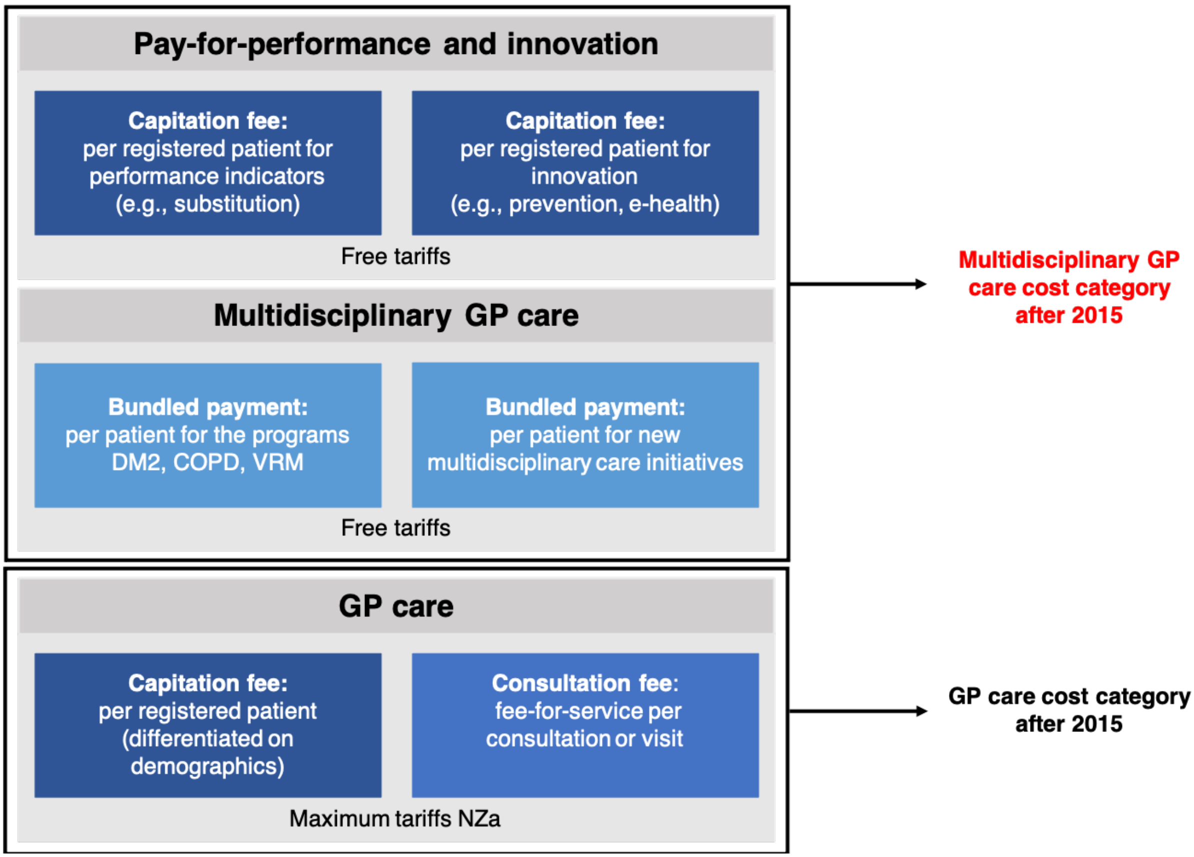
Source: NZa (2014), visualized by the author. Note: for simplification only the modules of interest are pictured. GP: general practitioner, DM2: type 2 diabetes, COPD: chronic obstructive pulmonary disease, VRM: vascular risk management, NZa: The Dutch Healthcare Authority.

Policymakers identified room for improving efficiency in this reimbursement scheme. Even though the modernization payments reimbursed services that were substituted from the secondary care level, a substitution effect was hardly noticeable (Van Dijk et al., 2009; EIB, 2012).

2.2 The new GP payment model as of 2015

Dutch health policymakers set out to stimulate more multidisciplinary GP care and explicitly reward substitution efforts by reimbursing the GP accordingly (NZa, 2014). Therefore, as of January 1, 2015, the original GP payment scheme, as earlier described in *section 2.1*, was restructured, and expanded. A schematic visualization of the 2015 payment structure is shown in *figure 2* (BR/CU-7105, 2015). When we compare *figure 1* and *2* we see that before 2015 there was one cost category under which GP costs were declared, and since 2015 there are two cost categories.

Figure 2: a visual representation of the GP payment model implemented in 2015



Source: NZa (2014), modified by the author. Note: for simplification only the modules of interest are pictured. GP: general practitioner, DM2: type 2 diabetes, COPD: chronic obstructive pulmonary disease, VRM: vascular risk management, NZa: The Dutch Healthcare Authority.

After 2015 (see *figure 2*) some of the original GP care is still reimbursed through a combination of capitation fees and fee-for-service payment. These costs are declared under the traditional GP care cost category. We observe a new additional cost category for GP reimbursement, the multidisciplinary GP care cost category. Within this cost category we recognize the pre-existing bundled payment schemes for type 2 diabetes, COPD, and vascular risk management. However, the bundled payment options have been expanded to allow for new multidisciplinary care initiatives and to cover the overhead costs of the coordination of multidisciplinary care (BR/CU-7105, 2015). The payment for specific modernization services for substituted secondary care has disappeared. Alternatively, we observe new pay-for-performance options to explicitly reward care innovation and substitution efforts. Specifically, the pay-for-performance can address substitution efforts such as adequate gatekeeping and rational medicine prescription. Innovative programs of interest can include (but are not limited to) prevention, self-management and e-health initiatives.

In summary, as of 2015, the bundled payment of existing multidisciplinary care programs, the bundled payment for new multidisciplinary care initiatives, and the new pay-for-performance are declared under the new multidisciplinary GP care cost category.

2.3 The role of the GP in multidisciplinary care

In the Netherlands, the GP plays a vital role in facilitating multidisciplinary care programs and integrating corresponding care elements (Grol et al., 2018). By law multidisciplinary care always includes GP care (Schut and Varkenvisser, 2017). GPs have formed care groups that bear the clinical and financial responsibility for the patients that are assigned. Health insurers negotiate with care groups on a single prospective bundled payment per patient for a range of multidisciplinary care activities within a fixed period (Schut and Varkenvisser, 2017). For the patients no additional costs are involved since the bundle of care is covered by insurance. Multidisciplinary care is provided by the care groups and their subcontracted providers. For the latter, care groups negotiate with other providers on their share of the single bundled payment. As a result, GPs have both a provider role and a commissioning role.

3 RESEARCH OBJECTIVE AND HYPOTHESES DEVELOPMENT

This research aimed to evaluate the impact of the new GP payment model, introduced in 2015, on regional healthcare expenditures. It addressed the following specific research questions:

- *To what extent did the new GP payment model stimulate multidisciplinary GP care uptake in the Netherlands?*
- *What is the substitution effect of more multidisciplinary GP care on regional healthcare expenditures in the Netherlands?*

For the development of our hypotheses, we utilized the advisory report of the Dutch Healthcare Authority that outlines the payment model reform and the cost shifts that can be expected (NZa, 2014).

Due to an expansion of the multidisciplinary care possibilities in 2015, we will likely observe an uptake in initiatives from 2015 onwards, reflected in an increase in annual costs declared in multidisciplinary GP care cost category. As explained in *chapter 2*, the multidisciplinary GP care cost category also includes the bundled payments for pre-existing multidisciplinary disease programs. Consequently, these costs will show up immediately in 2015. An increase over the years after 2015 will reflect an actual uptake in multidisciplinary GP care.

H1: *The multidisciplinary GP care costs will increase over time from 2015 onwards.*

The NZa (2014) describes that the expansion of multidisciplinary GP care can allow for easier diffusion of substituted care. This is in line with previously discussed literature on effective substitution of care by a strongly organized primary care system. Moreover, the reformed payment model allows for explicit rewards for substitution efforts. Therefore, it is in line with expectation that the costs declared under the multidisciplinary GP care cost category will grow relative to other cost categories due to substitution. Specifically, GP care services can be integrated in multidisciplinary GP care initiatives. Consequently, we expected that for the regions with an uptake in multidisciplinary GP care, the corresponding costs grew relative to the costs declared under the GP care cost category.

H2: *The trend in multidisciplinary GP care costs is inversely related to the trend in GP care costs.*

As previously discussed, a robust primary care system has the potential to substitute some secondary specialist care. Additionally, the new cost category includes explicit rewards for substitution efforts. Accordingly, we expected that for the regions with an uptake in multidisciplinary GP care, the corresponding costs grew relative to the costs declared under the medical specialist care cost category.

H3: *The trend in multidisciplinary GP care costs is inversely related to the trend in medical specialist care costs.*

4 THEORETICAL FRAMEWORK

This chapter covers the existing literature that is relevant to our research. The effect of bundled payments on the organization of multidisciplinary care is further explored, and the research on bundled payment in relation to healthcare expenditure discussed.

4.1 Bundled payment schemes for multidisciplinary care organization

Since 2010, the Netherlands has implemented bundled payment schemes for multidisciplinary primary care programs for several chronic conditions (type 2 diabetes, COPD, vascular risk management) (Bakker et al., 2011; Tsiachristas et al., 2011). The aim was to improve the coordination of care around the patient and decrease healthcare expenditures through improved quality and efficiency of the primary care provided. In general, national evaluations elucidated slightly positive results with regards to care organization and quality of care. As a result of bundled payments, care groups have organized themselves in a network with almost nation-wide coverage (EIB, 2012; Struijs et al., 2012). These networks were mainly realized for the treatment of diabetes, but still existed to a lesser extent for COPD and vascular risk management. In 2012, only 8% of the healthcare expenditure on diabetes could be linked to the bundled payment of multidisciplinary care (EIB, 2012). So, there was no massive uptake of multidisciplinary care yet.

The care groups themselves reported improved care coordination and integrated collaboration due to their ability to coordinate the care process (Bakker et al., 2011). According to care groups the bundled payment schemes increased efficiency and quality of care because the care groups consist of providers that utilize their clinical expertise in treatment decisions (Struijs, 2015). This resulted in less over- and underuse of services and better adherence to clinical protocols. Moreover, transparency of care seemed to increase with bundled payment schemes due to mandatory record-keeping for individual providers (Struijs and Baan, 2011; Struijs, 2015). Improved transparency also equipped care groups to improve performance benchmarks for providers. National evaluations also reported small positive effects on the quality of care (EIB, 2012). However, since there was no clear control group in these studies the possibility exists that these effects were a continuation of pre-existing trends.

With gaining experience in handling bundled payments, insurers increasingly supported the new systems (Struijs and Baan, 2011). However, from the insurer's perspective, the worry remained about the potential double funding of care and the complexity of defining the care bundles (Bakker et al. 2011). Additionally, insurers reported the risk of additional administrative costs of these new schemes and reduced competition among care groups. The subcontracted providers also worried about conflicting interests within the double role of the GPs as both providers and commissioners (Bakker et al., 2011; Struijs and Baan, 2011). The substantial market power of the care groups might lead to distorted relationships between subcontracted providers and care groups. However, national evaluations did not observe misuse of an imbalance in market power (EIB, 2012).

4.2 Healthcare expenditure effects

The research on the effect of the earlier bundled payment schemes for multidisciplinary care programs on healthcare expenditure is limited and conflicting. In the Netherlands, diabetes patients that were included in bundled payment schemes showed a decrease in the use of secondary specialist care (EIB, 2012). The COPD and cardiovascular risk programs did not show the same effects, probably due to the lower uptake of those multidisciplinary care initiatives. However, while there was some substitution of diabetes care in terms of utilization, the annual costs for diabetes patients that were included in bundled payment schemes were significantly higher than for diabetes patients that received care as usual (EIB, 2012, Struijs et al., 2012). The patients in multidisciplinary disease programs might have been referred to specialists at a later time, when they were in need of more expensive care (Struijs et al., 2012). Longer-term evaluations report that higher healthcare costs resulted from the bundled payment schemes themselves (Karimi et al., 2021). Difference-in-difference analyses revealed that as a result of the introduction of bundled payments, the healthcare expenditure per enrolled patient increased every year for all three disease programs, especially for multimorbid patients (Karima et al., 2021).

In some other countries we observe more expanded bundled payment programs, for which evaluations show positive results. In 2012, the United States set up a program to reimburse care groups for any multidisciplinary care their patient populations needed (Eijkenaar & Schut, 2015). Payment methods included a combination of bundled payment and pay-for-performance. The program led to substantial cost savings while the quality of care simultaneously increased. Bundled payment programs in Germany also showed positive effects (Busse & Stahl, 2014; Eijkenaar & Schut, 2015). In 2005 the integrated care project started in the German region Kinzigtal. The project included reimbursement through a similar combination of bundled payment and pay-for-performance for any multidisciplinary care the patient population in Kinzigtal needed. For all patients that were enrolled in the program, in comparison to a comparable control population, cost savings were realized while quality increased.

4.3 The need for expansion of the Dutch GP payment model

In the Netherlands, challenges remain in the uptake and organization of multidisciplinary care initiatives to facilitate care substitution. Interestingly, in the Netherlands, before 2015 there were only bundled payment options for three specific chronic conditions, while the programs in the United States and Germany, as described above, provided bundled payments for all multidisciplinary care the population required (Busse & Stahl, 2014; Eijkenaar & Schut, 2015). This called for improved payment models to further expand the desired organization of integrated patient-centered primary care in the Netherlands (Struijs, 2015). Multidisciplinary care is shaped by the policy context in which it is provided, and financial resources and reimbursement models influence the extent of multidisciplinary care (Leach et al., 2017). Therefore, to promote multidisciplinary care initiatives, appropriate payment structures for primary care were found to be essential.

The new GP payment model introduced in 2015, was a concrete step to encourage willing providers. The 2015 payment model addresses all those multidisciplinary organized primary care activities as outlined under the Health Insurance Act (NZa, 2014). The Health Insurance Act includes all medical care covered under statutory insurance and accounts for the largest part of the healthcare budget (Zorgwijzer, n.a.). Strengthening Dutch primary care through more multidisciplinary care initiatives with the aim of effective care substitution can therefore make a large impact on health spending.

5 DATA AND EMPIRICAL STRATEGY

5.1 Vektis data

We performed retrospective analyses using population healthcare cost data from Vektis (Vektis, 2021). Vektis collects this declaration data and claims that at least 98% of the realized costs were declared. We only had access to the open data source with claims data for the years 2011 to 2018 (Vektis, 2021). Vektis guarantees data integrity by aggregation of data. The data is collapsed across observations by categories of postal code. The data for which the first three postal code digits[1] are identical are

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[1] Dutch postal codes consist of four digits and two uppercase letters. A full postal code identifies eight addresses on average. The four-digit postal codes identify a cluster of addresses in the same city and region. The postcode3 regions contain the cluster of four-digit postal codes for which the first three postal code digits are identical.

combined in one category (postcode3). We observe 799 different postcode3 regions in our dataset. The data has a panel design as it contains cost measurements for all postcode areas for all eight years (2011-2018). For each postcode3 region, 24 different cost categories are distinguished. The cost data in these categories are broken apart into two gender categories (male/female) and 90 year-based age categories (age categories 0-90+). Practically, each row in our dataset contained the year specific costs declared per cost category for the subpopulation within the same gender and age category, living in the same postcode3 region.

For privacy reasons Vektis combines all postcode3 regions that contained less than 10 individuals into one postcode3 region coded zero. We removed these postcodes from further analysis. 98.9% of the postcode3 regions are observed for all eight years. The missing postcode3 regions per year were as follows.

- 2011: 104, 300, 800, 970
- 2012: 300, 500, 800, 970
- 2013: 500, 650, 970
- 2014: 500, 970
- 2015: 460, 500, 970
- 2016: 100, 104, 250, 460, 500, 970
- 2017: 100, 250, 300, 460, 500, 650
- 2018: 100, 250, 300, 460, 500, 650

5.2 Study variables

The open source Vektis data provided us with the multidisciplinary GP care cost category for the years 2015-2018. This cost category contains the aggregated data for all declarations under the multidisciplinary GP care cost category as described in *section 2.2* (bundled payment of existing multidisciplinary care programs, the bundled payment for new multidisciplinary care initiatives, and the new payment for performance and innovation, see also *figure 2*).

Further variables of interest were the GP care cost category and the medical specialist care cost category, both of which exist for the years 2011-2018. For the years before 2015, the GP care cost category contains the aggregated data for all declarations as outlined in *figure 1* (capitation fees, consultation fees, bundled payment of existing multidisciplinary care programs, modernization services). For the years after 2015, the GP care cost category contains the aggregated data for all declarations as outlined in *figure 2* (capitation fees, consultation fees). The medical specialist care cost category includes the aggregated data for the declarations of secondary specialist care.

To ensure comparability of cost data across subpopulations, we calculated average per capita expenditures for each category of interest by weighting the data with the year specific subpopulation size (corrected for incomplete registration periods due to births, deaths and removals).

5.3 Difference-in-difference design

We performed regression models with a quasi-experimental difference-in-difference (DiD) design to analyze the impact of the payment reform in 2015. The variable uptake of multidisciplinary GP care across the different postcode3 regions created a natural experiment. This design allows for a more reliable estimation of the treatment effect compared to traditional regression analyses of retrospective data (Wing et al., 2018). The treatment effect can be econometrically estimated with regression analyses on the interaction between the post-treatment variable and the group membership. The DiD design suits our research as there is cost data available for the four years before (2011-2014) and the four years after the payment reform (2015-2018).

The estimations are considered robust if the parallel trends assumption is satisfied (Wing et al. 2018). The parallel trends assumption implies common trends in the outcome variable for the treatment and control group before the treatment took place. It assumes the counterfactual that without the treatment the trends would have remained similar over time. The parallel trends assumption was addressed by visual inspection and tested empirically.

The DiD design further assumes that the treatment is unrelated to the outcome at baseline. This assumption was inherently met in our data because the reformed payment model was implemented for the first time in 2015. Additionally, the natural experiment requires an independent treatment and control group. This assumption was not fully satisfied as the payment reform was not randomly assigned to a specific group of GPs in the Netherlands. Alternatively, we determined group membership based on the uptake in the amount of multidisciplinary GP care costs declared.

5.4 Group allocation

The treatment group was defined as the postcode3 regions with GPs that showed intensive uptake of multidisciplinary care after 2015. The control group was defined as the postcode3 regions with GPs that did not show an uptake of multidisciplinary care after 2015. To form the treatment and control group, we used the average per capita declared multidisciplinary GP care costs as a proxy for the volume of care that was provided in a postcode3 region.

As described in *chapter 2*, the bundled payments for pre-existing disease programs (COPD, diabetes, vascular risk management), that were previously declared under the GP care cost category, were declared under the multidisciplinary GP care cost category after 2015. Thus, the postcode3 regions with GPs that declared large amounts of bundled payment before 2015 could also present as the regions with high costs declared under the multidisciplinary GP care cost category after 2015. Therefore, to properly formulate our treatment group, we selected the postcode3 regions with increasing multidisciplinary GP care costs after 2015 as those postcode3 regions truly show an uptake in multidisciplinary care after the implementation of the new payment model. Accordingly, the treatment group was operationalized as the postcode3 regions for which the average per capita multidisciplinary GP care costs increased each year ($2016 > 2015$ & $2017 > 2016$ & $2018 > 2017$). The control group was operationalized as the postcode3 regions for which the multidisciplinary GP care costs were either lower or equal each year ($2016 \leq 2015$ & $2017 \leq 2016$ & $2018 \leq 2017$).

Postcode3 regions that did not exist for all years after 2015 could not be allocated to either the treatment or control group based on their multidisciplinary GP care costs. Consequently, we excluded the following eight postcode3 regions: 100, 104, 250, 300, 460, 500, 650, 970 (see also *section 5.1*).

5.5 Analyses

All statistical estimations were performed in Stata 16.1 (2019). Tables were created using asdoc, a Stata program written by Shah (2018). The sample characteristics, multidisciplinary GP care costs, and the group characteristics were described with descriptive statistics. Descriptive statistics of the multidisciplinary GP care costs informed the first research question and hypothesis on the expected uptake of multidisciplinary GP care over the years after 2015. DiD models informed the second research question and second and third hypotheses on substitution effects.

The DiD models were estimated with weighted OLS regressions. Because we modelled average costs declared per capita derived from subpopulations that varied in size, we weighted the regression models with weights n_{itag}, where n_{itag} is the subpopulation size in postcode3 region i, in year t, with inhabitants of age a, and gender g. The average costs declared per capita that are derived from large subpopulations are less sensitive to statistical error and thus provide more meaningful information. By weighting the regression models with the varying subpopulation sizes, we can weigh those observations with higher information value more heavily.

Our DiD models included postcode3 fixed effects to account for pre-treatment expenditure differences among postcode3 regions, year fixed effects to account for common time trends across both groups, age fixed effects to account for pre-treatment expenditure differences among age categories, and gender fixed effects to account for pre-treatment expenditure differences among gender categories. Subpopulations within the same postcode3 region will in partly be treated by the same GP. Therefore, we used clustered standard errors at postcode3 level to account for a correlation in declared costs for the subpopulations within the same postcode3 region. To empirically address the parallel trends assumption, we estimated the following two regression equations (which only differ in their dependent variable):

$$(\mathbf{1})\ GP\ Care\ Costs_{itag} = \beta_1 * D_{Treatment} + \beta_2 * D_{2011} + \beta_3 * D_{2012} + \beta_4 * D_{2013} + \beta_5 * D_{2015} + \beta_6 * D_{2016} + \beta_7 * D_{2017} + \beta_8 * D_{2018} + \beta_9 * D_{2011} * D_{Treatment} + \beta_{10} * D_{2012} * D_{Treatment} + \beta_{11} * D_{2013} * D_{Treatment} + \beta_{12} * D_{Gender} + \beta_{13} * \mathrm{Age} + \beta_{14} * \mathrm{Postcode3} + \varepsilon_{itag}$$

$$(\mathbf{2})\ Medical\ Specialist\ Care\ Costs_{itag} = \beta_1 * D_{Treatment} + \beta_2 * D_{2011} + \beta_3 * D_{2012} + \beta_4 * D_{2013} + \beta_5 * D_{2015} + \beta_6 * D_{2016} + \beta_7 * D_{2017} + \beta_8 * D_{2018} + \beta_9 * D_{2011} * D_{Treatment} + \beta_{10} * D_{2012} * D_{Treatment} + \beta_{11} * D_{2013} * D_{Treatment} + \beta_{12} * D_{Gender} + \beta_{13} * \mathrm{Age} + \beta_{14} * \mathrm{Postcode3} + \varepsilon_{itag}$$

The dependent variable is the average per capita healthcare costs declared under the cost category GP care in *equation 1* and medical specialist care in *equation 2*, for postcode3 region i, in year t, for age group a with gender g (with i: postcode3 100 … 999, t: year 2011 … 2018, a: age 0 … 90+, g: gender male or female). $D_{Treatment}$ is a dummy variable that is 1 if the postcode3 region belongs to the treatment group and 0 if the postcode3 region belongs to the control group. $D_{2011\text{-}2018}$ are year dummy variables that capture the year fixed effects. The year dummies were coded 1 for the corresponding year and 0 for any other years (e.g., 1 for 2011, 0 for 2012-2018). We used 2014 as our reference year, therefore its corresponding dummy variable was left out of the model. D_{Gender} is a gender dummy that captures the gender fixed effects. The categorical variable age captures the age fixed effects. The categorical variable postcode3 captures the postcode3 fixed effects. ε_{itas} is the error term clustered at postcode3 level. If the parallel trends assumption holds, there should be no interaction between group membership ($D_{Treatment}$) and the year specific trends before the treatment ($D_{2011\text{-}2013}$). Thus, we test H0: β_9, β_{10}, $\beta_{11}=0$. To satisfy the assumption β_9, β_{10}, β_{11} in *equations 1* and *2* should be insignificant.

After the robustness check of parallel trends, we estimated the DiD models. Firstly, we performed traditional DiD estimations with a binary treatment period (pre-reform and post-reform). We regressed the GP care costs and medical specialist care costs on the interaction between the post-treatment variable and the group membership, using the following two models (which again only differ in their dependent variable):

$$(\mathbf{3})\ GP\ Care\ Costs_{itag} = \beta_1 * D_{Intervention} + \beta_2 * D_{2011} + \beta_3 * D_{2012} + \beta_4 * D_{2013} + \beta_5 * D_{2015} + \beta_6 * D_{2016} + \beta_7 * D_{2017} + \beta_8 * D_{2018} + \beta_9 * D_{\text{Post}} * D_{Intervention} + \beta_{13} * D_{gender} + \beta_{14} * \text{agegroups} + \varepsilon_{itag}$$

$$(\mathbf{4})\ Medical\ Specialist\ Care\ Costs_{itag} = \beta_1 * D_{Intervention} + \beta_2 * D_{2011} + \beta_3 * D_{2012} + \beta_4 * D_{2013} + \beta_5 * D_{2015} + \beta_6 * D_{2016} + \beta_7 * D_{2017} + \beta_8 * D_{2018} + \beta_9 * D_{\text{Post}} * D_{Intervention} + \beta_{13} * D_{gender} + \beta_{14} * \text{agegroups} + \varepsilon_{itag}$$

In *equation 3* and *4*, we have the same variables as in *equation 1* and *2*. But, in *equation 3* and *4* we test the interaction between group membership ($D_{Treatment}$) and the post-treatment variable (D_{Post}). D_{Post} is a dummy variable that is coded 0 for the period 2011-2014 and 1 for the period 2015-2018. We test H0: $\beta_9=0$ in *equation 3* and *4*, indicating no treatment effect of multidisciplinary GP care uptake on the costs of GP care or medical specialist care declared over the period after 2015. In line with our hypotheses, we expected β_9 in *equations 3* and *4* to be negative, indicating a substitution effect.

Next, we performed DiD estimations with year dummies for each year after the treatment, according to the design of Diepstraten et al. (2020). It takes time for financial incentives to have an effect because they often require many organizational changes (Bonfrer et al., 2018). Therefore, we are also interested in the treatment effect per year. This design allowed us to address whether the treatment effect increased, decreased, or stayed constant over the years since the reform (Autor, 2003). The DiD was estimated with the following two regression equations (which again only differ in their dependent variable):

$$\mathbf{(5)}\ GP\ Care\ Costs_{itag} = \beta_1 * D_{Intervention} + \beta_2 * D_{2011} + \beta_3 * D_{2012} + \beta_4 * D_{2013} + \beta_5 * D_{2015} + \beta_6 * D_{2016} + \beta_7 * D_{2017} + \beta_8 * D_{2018} + \beta_9 * D_{2015} * D_{Intervention} + \beta_{10} * D_{2016} * D_{Intervention} + \beta_{11} * D_{2017} * D_{Intervention} + \beta_{12} * D_{2018} * D_{Intervention} + \beta_{13} * D_{gender} + \beta_{14} * \text{agegroups} + \varepsilon_{itag}$$

$$\mathbf{(6)}\ Medical\ Specialist\ Care\ Costs_{itag} = \beta_1 * D_{Intervention} + \beta_2 * D_{2011} + \beta_3 * D_{2012} + \beta_4 * D_{2013} + \beta_5 * D_{2015} + \beta_6 * D_{2016} + \beta_7 * D_{2017} + \beta_8 * D_{2018} + \beta_9 * D_{2015} * D_{Intervention} + \beta_{10} * D_{2016} * D_{Intervention} + \beta_{11} * D_{2017} * D_{Intervention} + \beta_{12} * D_{2018} * D_{Intervention} + \beta_{13} * D_{gender} + \beta_{14} * \text{agegroups} + \varepsilon_{itag}$$

In *equation 5* and *6*, variables represent the same as in *equation 1* and 2. However, in *equation 5* and *6* we test the interaction between group membership ($D_{Treatment}$) and the year specific trends after the reform ($D_{2015\text{-}2018}$). We test H0: β_9, β_{10}, β_{11}, $\beta_{12}=0$ in *equation 5* and *6*, indicating no treatment effect of multidisciplinary GP care uptake on the declared costs of GP care or medical specialist care. In line with our hypotheses, we expected β_9, β_{10}, β_{11}, and β_{12} in *equation 5* and *6* to be negative, indicating a substitution effect.

6 RESULTS

6.1 Descriptive statistics

Table 1 describes age and gender for the total insured population per year in the Netherlands. We see that the total insured population slowly but steadily increases (with approximately 0.4%) over the years. The average age slowly increases with the population, pointing towards an ageing population. Every year the total insured population consists of slightly more females than males.

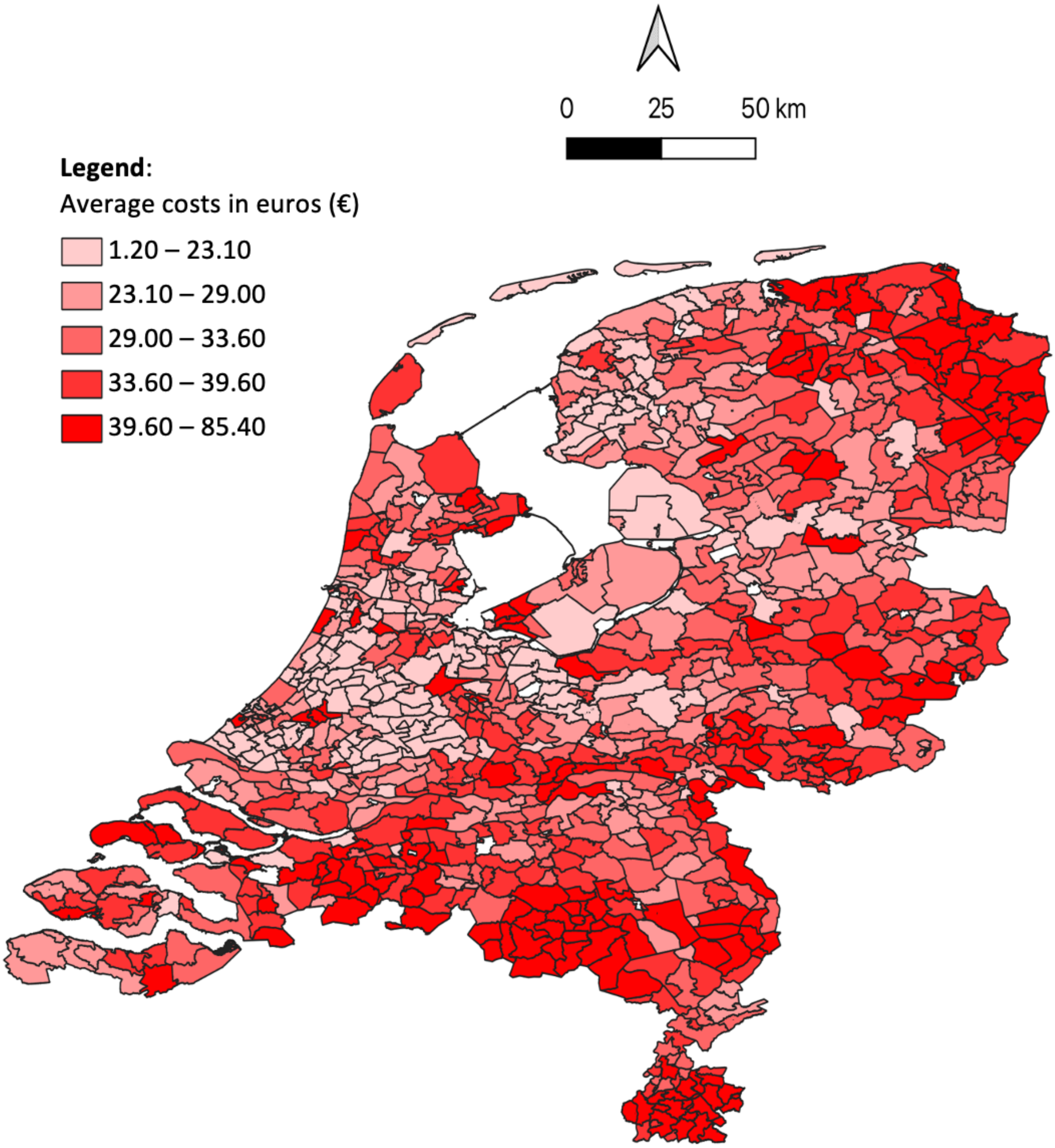
Table 1: Descriptive Statistics of the total insured population per year

Year	Insured population (N)	Age (mean ± SD)	Female (%)	Male (%)
2011	16417421.7	40.5 ± 22.9	50.7%	49.3%
2012	16481601.1	40.7 ± 23.0	50.6%	49.4%
2013	16525581.4	41.0 ± 23.0	50.6%	49.4%
2014	16573053.1	41.2 ± 23.1	50.6%	49.4%
2015	16643035.9	41.4 ± 23.1	50.6%	49.4%
2016	16741627.3	41.6 ± 23.2	50.6%	49.4%
2017	16811315.8	41.8 ± 23.3	50.6%	49.4%
2018	16925817.3	42.0 ± 23.3	50.5%	49.5%

N reflects the total insured population in our data. Age and gender data were available for the aggregated subpopulations and weighted by the subpopulation sizes n_{itag}.

In *figure 3* we see a geographical map of all the postcode3 regions in the Netherlands. *Figure 3* shows the regional variations in the average per capita multidisciplinary GP care costs declared over the total period observed after the reform (2015-2018). On average, more costs were declared in the eastern regions of the Netherlands and particularly postcode3 regions in the urban conglomeration 'Randstad' seem to declare little costs.

Figure 3: Average per capita multidisciplinary GP care costs declared per region over the period 2015-2018



Legend: costs in euros (€) per quantile of data.

In *table 2* we see the multidisciplinary GP care costs per capita summarized by year and gender. As shown in *table 2*, we observe an annual rise (approximately 0.1%) in the mean multidisciplinary GP care costs, over the years 2015 to 2018, which was expected. The data for these four years contains slightly more females than males and males incurred higher mean multidisciplinary care costs over the total period of 2015 till 2018.

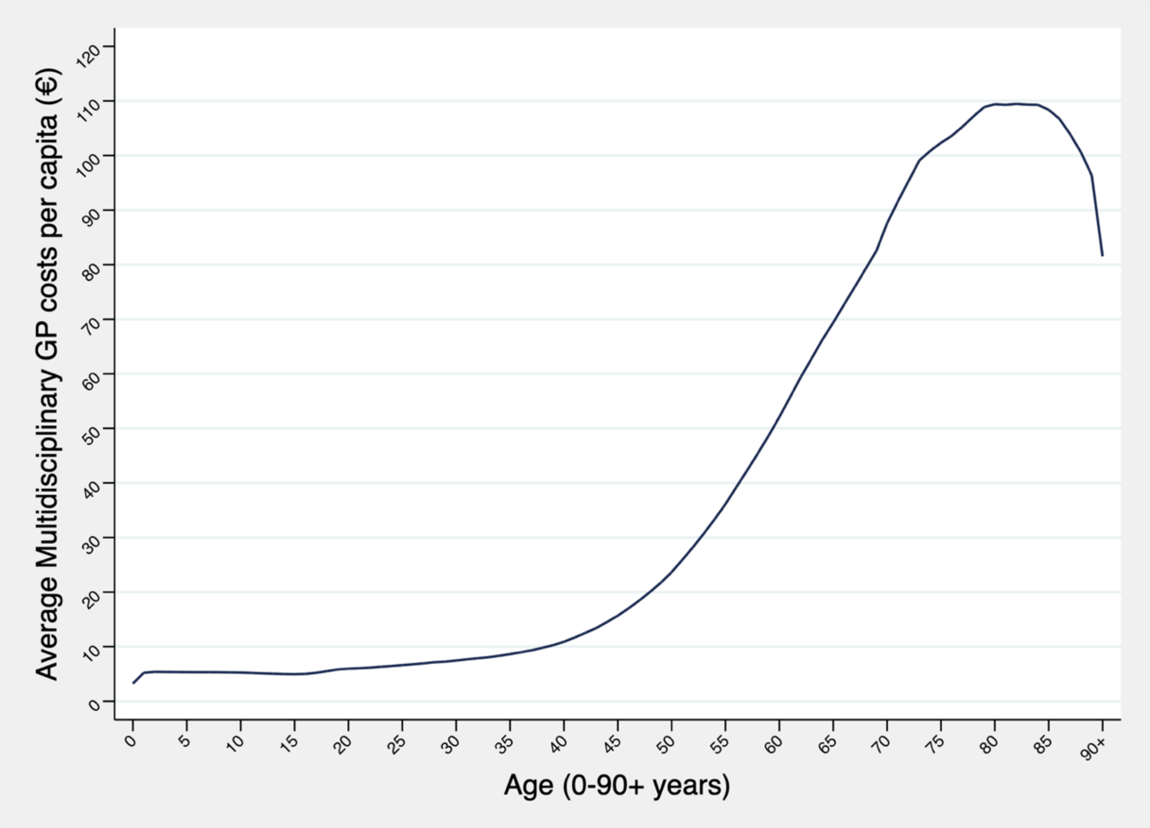
Table 2: Descriptive Statistics of Average Multidisciplinary GP care Costs per capita

	N	Mean	SD	Min	Max
Year					
2015-2018	546752	31.921	39.320	-0.567	1187.420
2015	136465	27.764	34.669	-0.075	449.925
2016	136638	31.362	38.822	0	628.322
2017	136733	33.561	41.533	0	589.416
2018	136916	34.932	41.427	-0.567	1187.420
Gender					
Female	274197	31.765	38.655	-0.567	739.893
Male	272555	32.080	39.989	-0.067	1187.420

Summary statistics are weighted by subpopulation size n_{itag}. N reflects the number of subpopulations that made up the summary statistics. Costs are in euros (€). Negative cost values can occur due to retrospective corrections in reimbursed costs (Vektis).

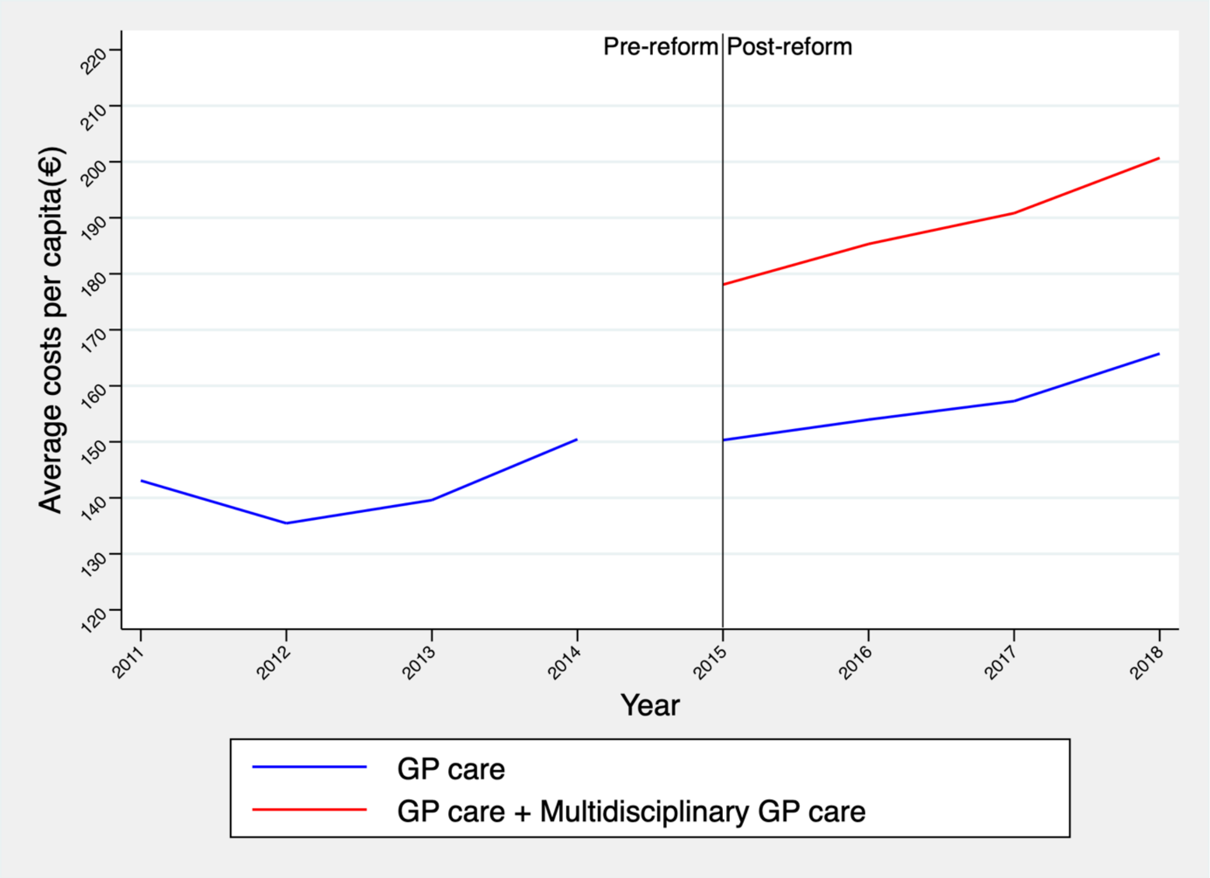
Figure 4 visualizes the average costs per capita declared under the multidisciplinary GP care cost category over the age groups (0-90+). We observe hardly any multidisciplinary GP care costs for subpopulations of age < 40 years. Over 40 we see a small rise in costs but especially over 50 we observe a substantial increase in costs per increase in age, until age 80. At age 85 we observe a steep decline in costs as subpopulations get older.

Figure 4: Average Costs per capita for Multidisciplinary GP care per age



In *figure 5* we observe the development of the GP care costs before and after the reform in 2015 and the combined costs for GP care and multidisciplinary GP care after 2015. As shown in *figure 5*, the GP care trend drops in 2015, which conceptualizes the shift in the bundled payments from the GP care cost category to the multidisciplinary GP care cost category. However, closely observing the development of the combined costs, we see that this graph slightly diverges from the GP care costs. This development conceptualizes the increase in multidisciplinary GP care costs each year, as also shown in *table 2*, regardless of the GP care costs.

Figure 5: Average Costs per capita for GP care and GP care plus Multidisciplinary GP care per year



6.2 Groups

The final groups consisted of 21 postcode3 regions with 29532 subpopulations (where a subpopulation is n_{itag}) in the control group and 380 postcode3 regions with 531516 subpopulations in the treatment group. As shown in *table 3* the age composition is quite similar across the treatment and control group with almost equal means and standard deviations from the means. The same holds roughly for gender across groups. While differences are small, we observe slightly more female subpopulations in both the control and treatment group. As previously shown in *table 1*, there are in general slightly more females in the total population. Thus, the control and treatment group seem to adequately represent the total population characteristics.

The multidisciplinary GP care costs declared by the treatment group are €11.63 higher than by the control group. We observe a much bigger range in costs for the treatment group with a much higher maximum than the control group. The higher maximum implies that the postcode3 regions that declared the highest amounts of average per capita multidisciplinary GP care costs were included in the treatment group.

We observe a €6.07 difference in mean GP care costs declared by the treatment group versus the control group. The difference in mean medical specialist care costs declared is much bigger with the treatment group observing €33.51 more costs. In general, the amount of average per capita costs declared under the medical specialist care cost category was much greater in comparison to the multidisciplinary GP care costs and GP care costs.

Table 3: Descriptive Statistics of Age, Gender and Average Costs per capita by Group

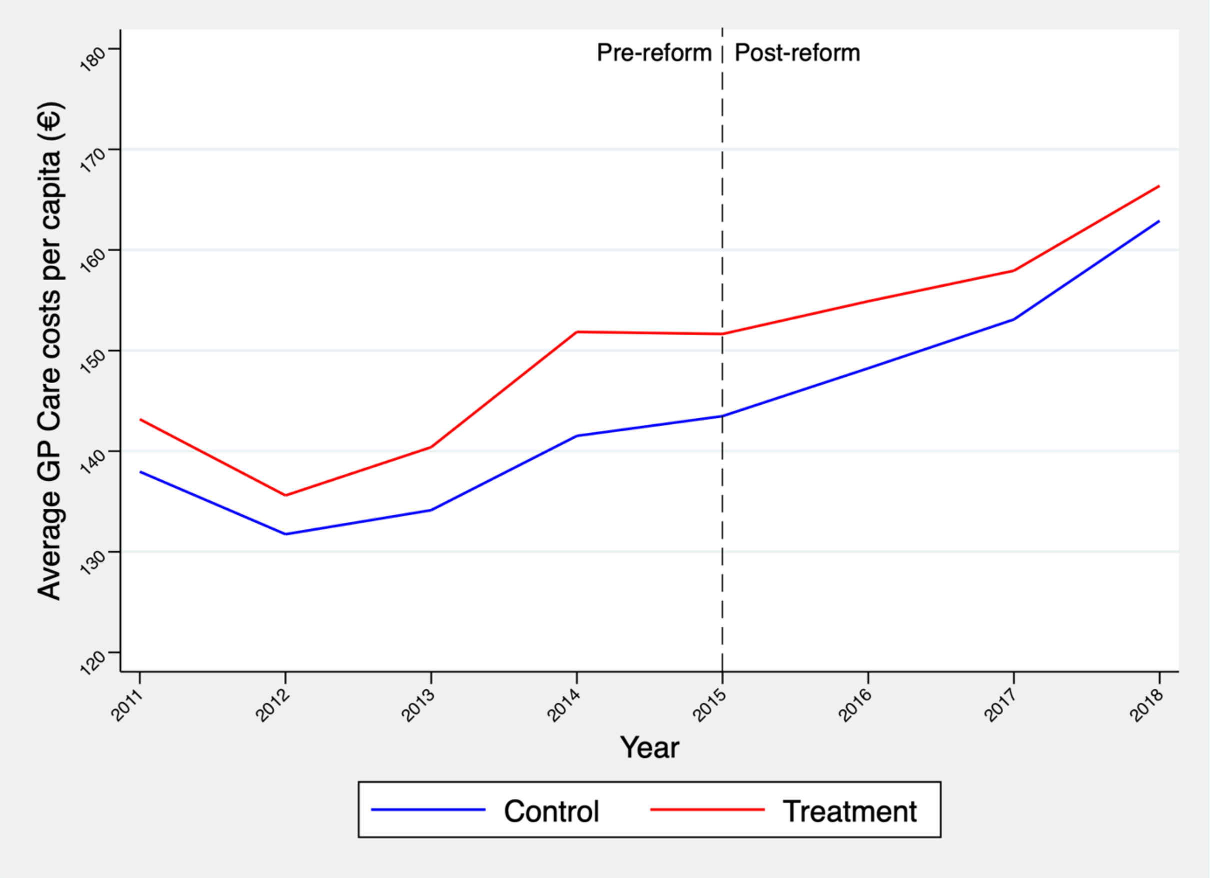
	N	Mean	SD	Min	Max
Multidisciplinary GP care costs					
Control	14786	19.49	34.02	0	330.97
Treatment	266235	31.12	37.54	-0.02	1187.42
Age					
Control	29532	41.24	23.28	0	90
Treatment	531516	41.02	22.98	0	90
Gender					
Female in Control	14774				
Male in Control	14758				
Female in Treatment	266830				
Male in Treatment	264686				
Medical specialist care costs					
Control	29532	1230.79	1085.19	0.98	41546.79
Treatment	531516	1264.30	1132.21	-631.16	1.08e+05
GP care costs					
Control	29532	144.23	46.46	68.09	931.35
Treatment	531516	150.32	52.90	33.86	1430.68

Summary statistics are weighted by subpopulation size n_{itag}. N reflects the number of subpopulations that made up the summary statistics. Costs are in euros (€). Negative cost values can occur due to retrospective corrections in reimbursed costs (Vektis).

6.3 Change in GP care costs

In *figure 6* we see the time trend of the average per capita GP care costs over the total period of 2011-2018 for both the control and treatment group separately. The plotted time trend is not controlled for age, gender and postcode3. We observe a small difference between the control and treatment group and a mostly rising trend in costs declared. While the costs declared by the control group keep rising from 2012 till 2018, the treatment group shows a slight drop between 2014 and 2015. This drop could hint an effect of the payment reform. Also, while both groups show rising trends after 2015, the treatment group seems to rise less steeply.

Figure 6: Time trend of Average GP Care costs per capita



In *table 4* we see the results from the parallel trend test described with *equation 1*. We observe no significant interactions between group membership and the years 2011 and 2013 (with 2014 as base year). However, there is a significant interaction between group membership and the year 2012. This implies that the expected mean difference in GP care costs in 2012 compared to 2014 was different between the two groups. Results of further DiD regression analyses for this outcome variable should therefore be interpreted with caution as we can't fully assume perfect parallel trends in GP care costs when the treatment would not have happened.

Table 4: Regression results of the parallel trend test for GP care costs

GP Care Costs	Coef.	St. Err.†	t-value	p-value	[95% Conf	Interval]	Sig
Group							
Treatment	-.081	.399	-0.20	.839	-.865	.703	
Year							
2011	-5.276	1.406	-3.75	0	-8.039	-2.513	***
2012	-11.983	.927	-12.92	0	-13.806	-10.16	***
2013	-10.1	.714	-14.14	0	-11.504	-8.695	***
2015	-.426	.194	-2.20	.029	-.807	-.045	**
2016	2.531	.275	9.20	0	1.99	3.071	***
2017	5.299	.305	17.35	0	4.699	5.9	***
2018	13.454	.411	32.70	0	12.645	14.263	***
Group * Year							
Treatment * 2011	-1.944	1.47	-1.32	.187	-4.835	.946	
Treatment * 2012	-3.229	.993	-3.25	.001	-5.181	-1.277	***
Treatment * 2013	-.689	.756	-0.91	.363	-2.175	.798	
Constant	171.272	1.21	141.53	0	168.893	173.651	***

Mean dependent var	165.348	SD dependent var	74.887
R-squared	0.872	Number of obs.	561048

*** p < .01, ** p < .05, * p < .1
†Standard errors adjusted for 401 clusters in postcode3.
Regressions are weighted by subpopulation size n_{itag}.
Postcode3, age and gender fixed effects applied but not shown.

In *table 5* we observe the results of *equation 3*. The variables in the model, as presented in *table 5,* explain a substantial proportion of the variance in GP care costs declared. We observe no clear difference in the mean GP care costs declared between the treatment and control group prior to the treatment. While the time trend previously shown in *figure 5* shows higher mean GP care costs declared for the treatment group, this difference seems to disappear when controlling for age, gender, and postcode3 fixed effects. So, the unadjusted difference in mean costs between the postcode3 regions with an uptake in multidisciplinary GP care and the regions that showed no uptake is largely explained by subpopulation characteristics. The year effects represent the expected mean difference in GP care costs declared per year compared to 2014 in the control group. We see a mostly rising trend since 2012, like the time trend visualized in *figure 6*. In 2015 the declared costs do not clearly differ from 2014. This indicates that regardless of any treatment effect, the GP care costs show a rising trend each year except in 2015. The binary DiD estimator is negative as was expected. However, since the corresponding t-value fails to reach significance and we failed to observe perfect pre-treatment parallel trends (see *table 4*) we cannot reliably conclude a substitution effect.

Table 5: Regression results of the DiD with a binary period for GP care costs

GP Care Costs	Coef.	St. Err.†	t-value	p-value	[95% Conf	Interval]	Sig
Group							
Treatment	-.65	.485	-1.34	.181	-1.604	.303	
Year							
2011	-7.096	.418	-16.98	0	-7.918	-6.274	***
2012	-15.007	.347	-43.19	0	-15.69	-14.323	***
2013	-10.745	.242	-44.38	0	-11.221	-10.269	***
2015	-.148	.897	-0.17	.869	-1.912	1.616	
2016	2.808	.914	3.07	.002	1.011	4.606	***
2017	5.577	.919	6.07	0	3.77	7.383	***
2018	13.732	.93	14.77	0	11.904	15.56	***
DiD							
Treatment * Post	-.297	.932	-0.32	.75	-2.129	1.536	
Constant	171.804	1.288	133.35	0	169.271	174.337	***
Mean dependent var		165.348	SD dependent var			74.887	
R-squared		0.872	Number of obs.			561048	

*** p < .01, ** p < .05, * p < .1
†Standard errors adjusted for 401 clusters in postcode3.
Regressions are weighted by subpopulation size n_{itag}.
Postcode3, age and gender fixed effects applied but not shown.

In *table 6* we observe the results of the annual treatment effects in *equation 5*. The variables in the model, as presented in *table 6,* explain a substantial proportion of the variance in GP care costs declared. Again, we observe no clear baseline difference in the mean GP care costs declared between the treatment and control group prior to the treatment. We see a mostly similar time trend as in *table 5*. However, in this model the costs declared in 2015 drop with an average per capita amount of €2.33 compared to 2014. After 2015 the costs keep rising which indicates that regardless of any treatment effect, the GP care costs show a rising trend each year. The DiD estimators show up positive at first and switch to negative coefficients in 2017. This trend might reflect that it takes some time before savings are realized. However, since the corresponding t-values fail to reach significance for the years 2015, 2016, and 2017, and we failed to observe perfect pre-treatment parallel trends (see *table 4*) we cannot reliably conclude a treatment effect. The DiD in 2018 could be a late adoption effect that indicates an inverse relationship between the uptake in multidisciplinary care and GP care, implying substitution. Still, referring back to the parallel trends dissatisfaction, we should be careful in interpreting these results.

Table 6: Regression results of the DiD with year dummies for GP care costs

GP Care Costs	Coef.	St. Err.†	t-value	p-value	[95% Conf	Interval]	Sig
Group							
Treatment	-.58	.486	-1.19	.234	-1.536	.376	
Year							
2011	-7.096	.418	-16.98	0	-7.918	-6.274	***
2012	-15.006	.347	-43.19	0	-15.69	-14.323	***
2013	-10.745	.242	-44.38	0	-11.221	-10.269	***
2015	-2.334	1.008	-2.32	.021	-4.315	-.354	**
2016	2.006	1.009	1.99	.047	.023	3.99	**
2017	6.425	1.061	6.05	0	4.339	8.511	***
2018	15.834	1.053	15.04	0	13.765	17.904	***
Group * Year							
Treatment * 2015	2.038	1.042	1.96	.051	-.01	4.087	*
Treatment * 2016	.56	1.039	0.54	.59	-1.482	2.602	
Treatment * 2017	-1.202	1.093	-1.10	.272	-3.35	.946	
Treatment * 2018	-2.542	1.114	-2.28	.023	-4.732	-.353	**
Constant	171.733	1.289	133.18	0	169.198	174.268	***
Mean dependent var		165.348	SD dependent var			74.887	
R-squared		0.872	Number of obs.			561048	

*** p < 01, ** p < 05, * p < 1

†Standard errors adjusted for 401 clusters in postcode3.

Regressions are weighted by subpopulation size n_{itag}.

Postcode3, age and gender fixed effects applied but not shown.

6.4 Change in medical specialist care costs

In *figure 7* we see the time trend of the average per capita medical specialist care costs over the total period of 2011-2018 for both the control and treatment group separately. The plotted time trend is not controlled for age, gender and postcode3. Both groups show quite similar trends over time. Between 2014 and 2015 both groups observe a substantial drop. While this is at time of reform, there is no clear visual difference in response between both groups.

Figure 7: Time trend of Average Medical Specialist Care costs per capita

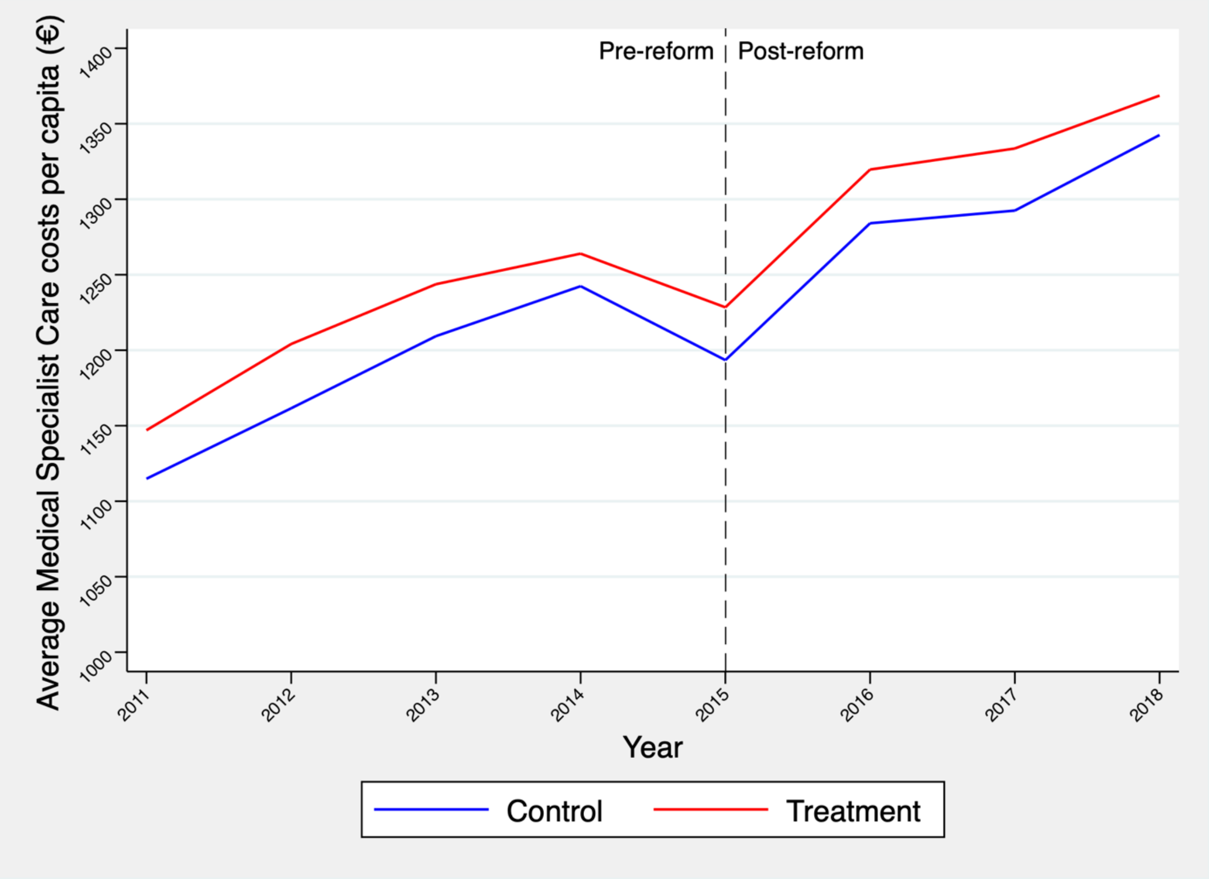


Table 7 shows the results of the empirical parallel trend test as described in *equation 2*. We see that all three interaction terms are insignificant. Therefore, we don't reject the parallel trends assumption.

Table 7: Regression results of the parallel trend test for medical specialist care costs

Medical Specialist Care Costs	Coef.	St. Err.†	t-value	p-value	[95% Conf	Interval]	Sig
Group							
Treatment	-16.946	4.056	-4.18	0	-24.919	-8.973	***
Year							
2011	-83.305	10.908	-7.64	0	-104.748	-61.861	***
2012	-46.075	11.782	-3.91	0	-69.237	-22.913	***
2013	-8.74	11.134	-0.78	.433	-30.628	13.149	
2015	-45.476	2.981	-15.26	0	-51.336	-39.617	***
2016	35.419	3.17	11.17	0	29.188	41.651	***
2017	39.127	3.295	11.87	0	32.649	45.605	***
2018	65.539	4.005	16.36	0	57.665	73.413	***
Group * Year							
Treatment * 2011	-5.153	12.046	-0.43	.669	-28.834	18.528	
Treatment * 2012	5.993	13.184	0.45	.65	-19.925	31.911	
Treatment * 2013	-.899	11.898	-0.08	.94	-24.29	22.491	

Constant	5884.221	52.573	111.93	0	5780.868	5987.575	***

Mean dependent var	1497.303	SD dependent var	1526.917
R-squared	0.726	Number of obs.	561048

*** p < .01, ** p < .05, * p < .1
†Standard errors adjusted for 401 clusters in postcode3.
Regressions are weighted by subpopulation size n_{itag}.
Postcode3, age and gender fixed effects applied but not shown.

Table 8 shows the results of the binary DiD analysis as described by *equation 4*. The model explains a substantial proportion of the variance in medical specialist costs declared. There was an observable difference between the treatment and control group before the reform. At baseline, the treatment group declared less costs than the control group. Considering the time trend in *figure 7,* controlling for population characteristic largely affects the baseline difference in costs. Higher medical specialist care costs in the treatment group can be explained by population characteristics. At constant population characteristics the treatment group actually declared less costs at baseline.

Table 8: Regression results of the DiD with a binary period for medical specialist care costs

Medical Specialist Care Costs	**Coef.**	**St. Err.†**	**t-value**	**p-value**	**[95% Conf**	**Interval]**	**Sig**
Group							
Treatment	-19.798	6.266	-3.16	.002	-32.117	-7.479	***
Year							
2011	-88.129	4.653	-18.94	0	-97.275	-78.982	***
2012	-40.463	5.486	-7.38	0	-51.248	-29.679	***
2013	-9.581	4.336	-2.21	.028	-18.106	-1.057	**
2015	-50.736	9.412	-5.39	0	-69.239	-32.233	***
2016	30.16	9.64	3.13	.002	11.208	49.112	***
2017	33.868	9.859	3.44	.001	14.486	53.25	***
2018	60.28	9.814	6.14	0	40.987	79.573	***
DiD							
Treatment * Post	5.618	9.912	0.57	.571	-13.869	25.104	
Constant	5886.897	53.108	110.85	0	5782.491	5991.303	***

Mean dependent var	1497.303	SD dependent var	1526.917
R-squared	0.726	Number of obs.	561048

*** p < .01, ** p < .05, * p < .1
†Standard errors adjusted for 401 clusters in postcode3.
Regressions are weighted by subpopulation size n_{itag}.
Postcode3, age and gender fixed effects applied but not shown.

The year effects indicate a rising trend in medical specialist care costs after 2015 regardless of any possible treatment effects. We observe a large drop in costs in 2015 for the control group. Considering the time trend in *figure 6*, the same drop in costs seems to be experienced by the treatment group in 2015. The binary DiD estimator informs us that the change in medical specialist care costs after the treatment does not significantly differ across groups. The decrease in costs declared in 2015, compared to 2014, can thus not be explained by the payment reform in 2015 and is likely caused by other year specific factors (see *chapter 7* for further discussion).

Table 9 shows the results of the DiD analysis as described by *equation 6*. The proportion of the variance explained, and the group and year effects are similar to those presented in *table 8*. We see no significant treatment effects over the years after the reform. The coefficients for the interactions with the year dummies show no particular pattern of increasing or decreasing effect. The coefficient for the DiD estimator in 2018 is negative, but the corresponding t-value fails to reach significance.

Table 9: Regression results of the DiD with year dummies for medical specialist care costs

Medical Specialist Care Costs	**Coef.**	**St. Err.†**	**t-value**	**p-value**	**[95% Conf**	**Interval]**	**Sig**
Group							
Treatment	-19.645	6.322	-3.11	.002	-32.074	-7.216	***
Year							
2011	-88.129	4.653	-18.94	0	-97.275	-78.982	***
2012	-40.463	5.486	-7.38	0	-51.248	-29.679	***
2013	-9.581	4.336	-2.21	.028	-18.106	-1.057	**
2015	-51.6	7.433	-6.94	0	-66.213	-36.987	***
2016	29.607	11.952	2.48	.014	6.111	53.103	**
2017	26.796	12.314	2.18	.03	2.588	51.004	**
2018	68.703	12.358	5.56	0	44.408	92.997	***
Group * Year							
Treatment * 2015	6.541	7.951	0.82	.411	-9.091	22.172	
Treatment * 2016	6.208	12.434	0.50	.618	-18.235	30.652	
Treatment * 2017	13.172	12.622	1.04	.297	-11.642	37.986	
Treatment * 2018	-3.38	13.004	-0.26	.795	-28.944	22.185	
Constant	5886.745	53.119	110.82	0	5782.318	5991.173	***
Mean dependent var		1497.303	SD dependent var			1526.917	
R-squared		0.726	Number of obs.			561048	

*** $p < .01$, ** $p < .05$, * $p < .1$

†Standard errors adjusted for 401 clusters in postcode3.

Regressions are weighted by subpopulation size n_{itag}.

Postcode3, age and gender fixed effects applied but not shown.

6.5 Post hoc sensitivity analyses

We realize the models reported above might be sensitive to the group allocation methods. Therefore, as a sensitivity analysis we assessed whether the results were very different when observing only a subgroup of postcode3 regions. *Figure 2* shows that subpopulations of age < 50, on average, declared almost no multidisciplinary GP care costs. We therefore rearranged the groups by allocating the subpopulations that had an age ≥ 50 to a treatment and control group (by using the same method as described in *section 5.4*). Excluding the younger subpopulations from our sample might decrease statistical noise and refine the treatment and control group.

The results are presented in *tables 10-13* and the parallel trend tests are reported in *appendix A.* The new groups consisted of 29 postcode3 regions with 18589 subpopulations (where a subpopulation is n_{itag}) in the control group and 294 postcode3 regions with 181602 subpopulations in the treatment group. Age distributions were similar across groups and like the original grouping, there were slightly more females in the treatment group (data not shown). The parallel trends assumption was satisfied for the medical specialist care trends but not for the GP care trends.

As shown in *table 10,* the regression results of the same model that is presented in *table 5* are quite different when analyzing only the older subgroup (age ≥ 50). The model explains a substantial proportion of the variance in GP care costs declared. There is a significant baseline difference, with substantially less costs declared by the treatment group compared to control regions. We observe a relatively similar time trend, although there is no clear difference in the GP care costs that the control regions declared in 2016 and 2017 compared to declarations in 2014. The binary DiD estimator shows up positive and reaches significance for this subgroup. This was not in line with expectation and might point to a growth in GP care costs due to the payment reform in 2015. However, as the parallel trends assumption could not be satisfied (see *appendix A*) we cannot reliably conclude a treatment effect.

Table 11 shows similar results for the group and year effects when regressing the GP care costs on the interactions between group membership and year dummies. The DiD estimators also show up positive here and reach significance at the level 0.05 for all years except 2018. However, as we observe no parallel trends (see *appendix A)* we cannot reliably conclude any treatment effects.

Table 10: Regression results of the DiD with a binary period for GP care costs for age 50+

GP Care Costs	Coef.	St. Err.†	t-value	p-value	[95% Conf	Interval]	Sig
Group							
Treatment	-29.058	.916	-31.72	0	-30.86	-27.256	***
Year							
2011	-7.333	.605	-12.12	0	-8.523	-6.142	***
2012	-16.591	.549	-30.22	0	-17.671	-15.511	***
2013	-11.425	.351	-32.52	0	-12.116	-10.734	***
2015	-5.677	1.607	-3.53	0	-8.84	-2.515	***
2016	-2.048	1.66	-1.23	.218	-5.314	1.218	
2017	1.965	1.656	1.19	.236	-1.292	5.222	
2018	9.98	1.679	5.94	0	6.677	13.284	***
Group * Post							
DiD	4.679	1.691	2.77	.006	1.352	8.007	***
Constant	166.472	1.089	152.86	0	164.329	168.614	***
Mean dependent var		211.702	SD dependent var			89.168	
R-squared		0.861	Number of obs.			200191	

*** p < .01, ** p < .05, * p < .1
†Standard errors adjusted for 323 clusters in postcode3.
Regressions are weighted by subpopulation size n_{itag}.
Postcode3, age and gender fixed effects applied but not shown.

Table 11: Regression results of the DiD with year dummies for GP care costs for age 50+

GP Care Costs	Coef.	St. Err.†	t-value	p-value	[95% Conf	Interval]	Sig
Group							
Treatment	-29.064	.915	-31.76	0	-30.864	-27.264	***
Year							
2011	-7.333	.605	-12.12	0	-8.523	-6.142	***
2012	-16.591	.549	-30.22	0	-17.671	-15.511	***
2013	-11.425	.351	-32.52	0	-12.116	-10.734	***
2015	-7.184	1.422	-5.05	0	-9.982	-4.386	***
2016	-2.234	1.767	-1.26	.207	-5.71	1.242	
2017	2.643	1.734	1.52	.128	-.767	6.054	
2018	10.926	1.939	5.64	0	7.112	14.74	***
Group * Year							
Treatment * 2015	6.373	1.475	4.32	0	3.471	9.275	***
Treatment * 2016	4.888	1.825	2.68	.008	1.297	8.479	***
Treatment * 2017	3.917	1.799	2.18	.03	.377	7.457	**
Treatment * 2018	3.617	2.014	1.80	.074	-.346	7.58	*
Constant	166.478	1.088	152.98	0	164.337	168.619	***
Mean dependent var		211.702	SD dependent var			89.168	
R-squared		0.861	Number of obs.			200191	

*** p < .01, ** p < .05, * p < .1
†Standard errors adjusted for 323 clusters in postcode3.
Regressions are weighted by subpopulation size n_{itag}.
Postcode3, age and gender fixed effects applied but not shown.

The subgroup regression results for the medical specialist care costs (*table 12* and *13*) also show a much larger baseline difference between the treatment and control group than the results for the original groups with all ages. The proportion of variance explained by the model is smaller compared to previous results. Time trends are relatively similar in pattern, with the substantial drop in costs in 2015. The parallel trends assumption was not rejected by empirical tests (see *appendix* A). As shown in *table 12* the binary DiD shows up negative, as expected, but the corresponding t-value fails to reach significance in the model. The interactions with the year dummies all show up negative as well and the effect sizes increase over the years after 2015, which is in line with expectation. However, only the DiD estimator for 2018 reaches significance at the 0.05 level. This estimation could indicate that it takes several years before substantial savings are realized. The results suggest an inverse relationship between the uptake in multidisciplinary care and medical specialist care, implying substitution.

Table 12: Regression results of the DiD with a binary period for medical specialist care costs for age 50+

Medical Specialist Care Costs	Coef.	St. Err.†	t-value	p-value	[95% Conf	Interval]	Sig
Group							
Treatment	-137.178	7.909	-17.34	0	-152.739	-121.617	***
Year							
2011	-134.75	9.924	-13.58	0	-154.273	-115.227	***
2012	-82.731	11.585	-7.14	0	-105.523	-59.939	***
2013	-6.914	9.56	-0.72	.47	-25.722	11.894	
2015	-62.968	13.375	-4.71	0	-89.281	-36.654	***
2016	77.068	13.468	5.72	0	50.572	103.564	***
2017	74.916	13.934	5.38	0	47.504	102.328	***
2018	115.234	13.983	8.24	0	87.724	142.744	***
Group * Year							
DiD	-18.44	14.433	-1.28	.202	-46.834	9.955	
Constant	941.099	13.591	69.24	0	914.36	967.837	***

Mean dependent var	2456.150	SD dependent var	1427.416
R-squared	0.580	Number of obs.	200191

*** p < .01, ** p < .05, * p < .1

†Standard errors adjusted for 323 clusters in postcode3.

Regressions are weighted by subpopulation size n_{itag}.

Postcode3, age and gender fixed effects applied but not shown.

Table 13: Regression results of the DiD with year dummies for medical specialist care costs for age 50+

Medical Specialist Care Costs	Coef.	St. Err.†	t-value	p-value	[95% Conf	Interval]	Sig
Group							
Treatment	-137.262	7.906	-17.36	0	-152.816	-121.709	***
Year							
2011	-134.75	9.924	-13.58	0	-154.273	-115.227	***
2012	-82.731	11.585	-7.14	0	-105.523	-59.939	***
2013	-6.914	9.56	-0.72	.47	-25.722	11.894	
2015	-76.028	14.858	-5.12	0	-105.259	-46.797	***
2016	69.633	14.294	4.87	0	41.512	97.753	***
2017	77.102	15.609	4.94	0	46.393	107.811	***
2018	132.703	17.189	7.72	0	98.887	166.519	***
Group * Year							
Treatment * 2015	-3.76	16.775	-0.22	.823	-36.762	29.243	
Treatment * 2016	-10.082	15.905	-0.63	.527	-41.374	21.209	
Treatment * 2017	-20.896	16.872	-1.24	.216	-54.088	12.297	
Treatment * 2018	-38.074	18.634	-2.04	.042	-74.734	-1.414	**
Constant	941.184	13.588	69.27	0	914.451	967.917	***

Mean dependent var	2456.150	SD dependent var	1427.416
R-squared	0.580	Number of obs.	200191

*** p < .01, ** p < .05, * p < .1
†Standard errors adjusted for 323 clusters in postcode3
Regressions are weighted by subpopulation size n_{itag}.
Postcode3, age and gender fixed effects applied but not shown.

7 DISCUSSION AND CONCLUSION

This study aimed to evaluate the impact of the reform of the GP payment model in 2015 on regional healthcare costs. The treatment regions for which we observed an uptake in multidisciplinary GP care costs were compared against the control regions that did not have the desired response.

Time trends were observed for both outcomes. The costs declared in both categories increased over time for almost all years after the payment reform, regardless of any treatment. This observation is in line with changes in demographics. As populations age and experience more chronic conditions, healthcare costs in the GP care and medical specialist care categories simultaneously rise over time (Flinterman et al., 2018). The drop in medical specialist care costs in 2015, was experienced by both the treatment and control group. The change in costs could only be explained by time specific effects in 2015. Specifically, in 2015 some medical specialist care elements were no longer declared under the Health Insurance Act (NZa, 2013). As Vektis only includes claims data from care provided under the Health Insurance Act, this shift in declarations explains the drop in the average per capita medical specialist costs for both the treatment and control group in 2015.

With no parallel trends in GP care costs, we were unable to make causal inferences as any observed change in costs might also have occurred in the counterfactual situation without the treatment. The significant interaction effect in 2012 could also be an anticipation effect. Indeed, there was public attention for and political discourse about the payment reform before the implementation in 2015 (NZa, 2012). However, if there were any leading effects, we would expect a significant interaction in 2013 as well, as the payment reform was officially announced in 2013. This was not observed in our results, so it is more likely that there were no parallel trends in pre-treatment GP care costs for the treatment and control regions.

For medical specialist care costs, parallel trends were observed, but still none of the expected substitution effects were identified. These results imply that the new payment model did not have clear substitution effects. When looking back at *chapter 2*, it is apparent that the payment reform in 2015 is more of a restructuring and expansion of the model than a big shock. Our results suggest that this particular payment reform might not have been impactful enough to encourage providers to substitute care. Considering the cost saving successes in the United States and Germany, perhaps a better approach would be to further let go of the condition-focused bundled payments (Busse & Stahl, 2014; Eijkenaar & Schut, 2015). Indeed, this is in line with the long-term future perspective on the Dutch GP payment model, so perhaps future reforms will bring more success (NZa, 2014). Research on bundled payment structures highlights the importance of incentives for substitution over both the primary and secondary levels of care provision (Eijkenaar & Schut, 2015). If healthcare policy wants to stimulate substitution of secondary care to primary care, it would be beneficial to address the production incentives in secondary specialist care as well (Bakker et al., 2012; Struijs et al., 2012).

The results did show some substitution of medical specialist care to multidisciplinary care for older patients. These effects were not earlier observed in the main regression results. A potential explanation for this difference in results could be that for the older subgroup, which declared high amounts of costs in all categories, the substitution potential was greater. With a higher need of care and higher claims in the outcome costs before the reform, there is a larger portion of care than can potentially be substituted (Van Dijk et al., 2013). Specifically, a lagged substitution effect was observed in 2018. Also, while not statistically significant, the savings seemed to increase over the years up to 2018. These results might indicate late adopters, substituting some medical specialist care with multidisciplinary care. While assumptions were not fully met, the main regression results for GP care costs also showed a lagging substitution effect in 2018. Perhaps four years is not long enough to clearly observe the effect of the financial incentives in the new GP payment model. Realistically, new multidisciplinary care initiatives are not properly organized overnight. As previously touched upon in *chapter 4*, the extent of multidisciplinary care is very much shaped by the contextual factors (Leach et al., 2017). Besides proper reimbursement, other social barriers were identified. GPs might need more time to properly organize multidisciplinary care as such that it can allow effective substitution of care.

Our study design showed strength in the fact that we observed multiple serial time points before and after the treatment. Therefore, the data was very well suited for a difference-in-difference design and allowed empirical testing of the parallel trends assumption. Furthermore, because we observed cost categories on the regional level, this analysis provided a higher level of information than frequently observed macro cost analysis on national levels. The study design also experienced some limitations. Firstly, as the new payment model was implemented for all Dutch GPs, there were no truly unexposed postcode3 regions. Alternatively, groups were based on which regions had the desired response or not. Whether the desired response was of sufficient magnitude to elicit an effect on other care categories is questionable. Secondly, the multidisciplinary GP care cost category that we used as a proxy for multidisciplinary care uptake, is partly disturbed by the payment for performance and innovation elements. However, recent analysis with country level data observed an increase in both multidisciplinary care and payment for performance and innovation costs separately (ZiN, 2021). Thus, an increase in claims under the multidisciplinary GP care cost category likely reflects an increase in both multidisciplinary care and payment for performance and innovation. Besides, large payment for performance costs partly correspond to more substitution (NZa, 2014), so, when in reality a substitution effect was there, with regards to medical specialist care a substitution effect could have been observed regardless.

Future research could improve the information value by using more detailed claims data to solely analyze the effect of an uptake in multidisciplinary care initiatives. Moreover, as our results imply possible lagging effects, future analysis might examine substitution effects longer after the payment reform. Besides further examining possible substitution effects, future research could focus on quality of care. Literature implies that multidisciplinary care leads to higher quality of care (EIB, 2012; Eijkenaar & Schut, 2015), and our results did show that regional multidisciplinary GP care rose over the years. So, it could give valuable insights to observe whether more multidisciplinary GP care led to improved quality of care and improved population health indicators.

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9 APPENDIX A: SENSITIVITY ANALYSIS – PARALLEL TREND TEST

Figure 8: Time trend of Average GP Care costs per capita for age 50+

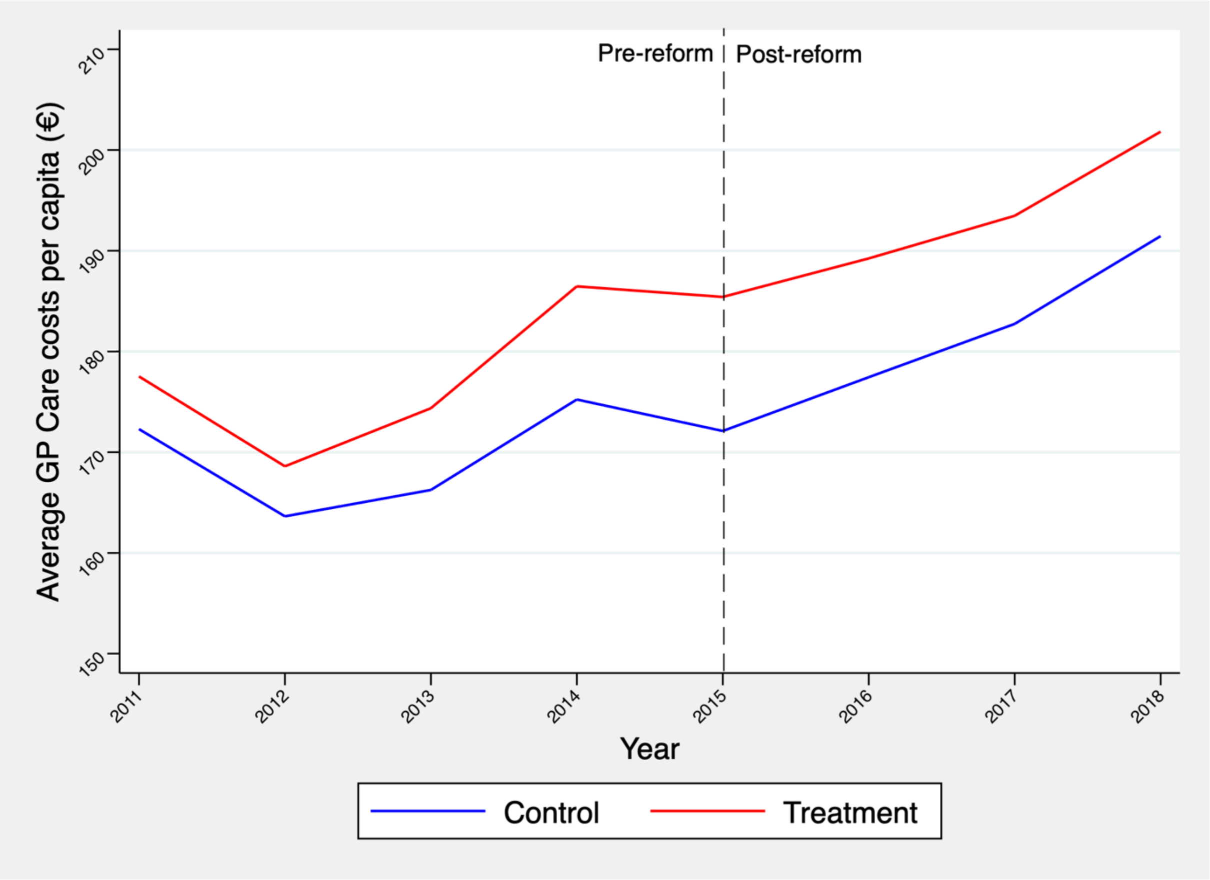

Table 14: Regression results of the parallel trend test for GP care costs for age 50+

GP Care Costs	Coef.	St. Err.†	t-value	p-value	[95% Conf	Interval]	Sig
Group							
Treatment	-24.459	.581	-42.13	0	-25.601	-23.317	***
Year							
2011	-1.028	1.667	-0.62	.538	-4.306	2.251	
2012	-10.168	1.496	-6.80	0	-13.111	-7.226	***
2013	-8.038	1.635	-4.92	0	-11.255	-4.821	***
2015	-1.514	.311	-4.87	0	-2.126	-.902	***
2016	2.115	.431	4.90	0	1.267	2.964	***
2017	6.128	.463	13.23	0	5.217	7.04	***
2018	14.143	.554	25.53	0	13.053	15.233	***
Group * Year							
Treatment * 2011	-7.087	1.808	-3.92	0	-10.645	-3.529	***
Treatment * 2012	-7.218	1.64	-4.40	0	-10.445	-3.991	***
Treatment * 2013	-3.807	1.779	-2.14	.033	-7.306	-.307	**

Constant	162.377	.764	212.40	0	160.873	163.881	***

Mean dependent var	211.702	SD dependent var	89.168
R-squared	0.861	Number of obs.	200191

*** p < .01, ** p < .05, * p < .1
†Standard errors adjusted for 323 clusters in postcode3.
Regressions are weighted by subpopulation size nitag.
Postcode3, age and gender fixed effects applied but not shown.

Figure 9: Time trend of Average Medical Specialist Care costs per capita for age 50+

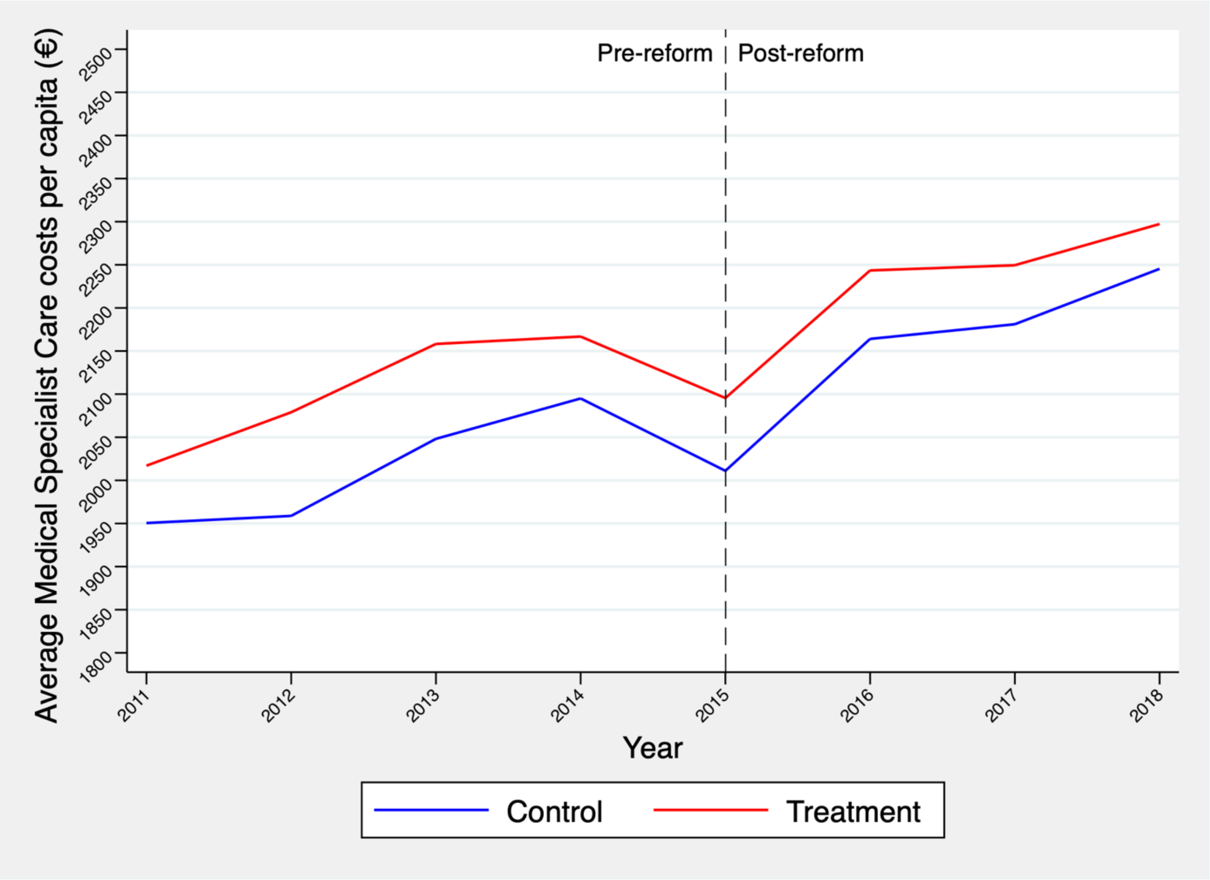

Table 15: Regression results of the parallel trend test for medical specialist care costs for age 50+

Medical Specialist Care Costs	Coef.	St. Err.†	t-value	p-value	[95% Conf	Interval]	Sig
Group							
Treatment	-155.392	6.565	-23.67	0	-168.307	-142.477	***
Year							
2011	-125.973	16.616	-7.58	0	-158.663	-93.283	***
2012	-122.564	24.461	-5.01	0	-170.687	-74.441	***
2013	-39.768	18.358	-2.17	.031	-75.885	-3.65	**
2015	-79.373	6.371	-12.46	0	-91.907	-66.839	***
2016	60.662	6.464	9.38	0	47.945	73.38	***
2017	58.511	6.981	8.38	0	44.777	72.244	***
2018	98.829	7.715	12.81	0	83.649	114.008	***

Group * Year							
Treatment * 2011	-9.869	19.118	-0.52	.606	-47.482	27.743	
Treatment * 2012	44.771	26.54	1.69	.093	-7.443	96.984	*
Treatment * 2013	36.926	19.956	1.85	.065	-2.334	76.186	*
Constant	957.296	12.002	79.76	0	933.684	980.908	***

Mean dependent var	2456.150	SD dependent var	1427.416
R-squared	0.580	Number of obs.	200191

*** p < .01, ** p < .05, * p < .1

†Standard errors adjusted for 323 clusters in postcode3.

Regressions are weighted by subpopulation size nitag.

Postcode3, age and gender fixed effects applied but not shown.