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Regeneration of deprived neighbourhoods and indicators of functioning in older adults: a quasi-experimental evaluation of the Dutch District Approach

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Authors' contributions

EJT, ER, MH and MA conceptualized the study. EJT and AR prepared the data. AR obtained the data on programme intensity. EJT performed the statistical analyses, interpreted the data, and drafted the manuscript. All authors revised intermediate manuscript versions critically for important intellectual content. All authors have read and approved the final version of the manuscript.

Conflict of interest statement

The authors declare that they have no competing interests.

Abstract

This study examines the impact of the Dutch District Approach, a major urban regeneration programme that was started in 2008 in the Netherlands, on social, physical and mental functioning of older adults. Data from 1092 participants (58-93 years at baseline) across two waves (2005/06 and 2011/12) of the Longitudinal Aging Study Amsterdam were linked to detailed data on exposure to the programme. Using a difference-in-difference approach, we assessed differences from pre-intervention to the intervention period between the target and control districts in loneliness, social engagement, social isolation, physical activity, and anxiety and depressive symptoms. Regardless of programme intensity, the results indicate that the Dutch District Approach did not benefit or harm these aspects of functioning in older adults.

Key words: Mental functioning, Physical activity, Social engagement, Social isolation, Urban regeneration programme

Introduction

Living in deprived areas, characterized by poor economic, physical and social conditions, has been linked to poor mental and physical health and social engagement (Diez Roux and Mair, 2010; Hand and Howrey, 2019). Urban regeneration programmes are increasingly common as a means of simultaneously addressing spatially concentrated problems related to the personal circumstances of residents in deprived areas as well as problems that derive from the place itself, such as the local physical and social environment (Anderson and Musterd, 2005; Droomers et al., 2016; Lupton, 2003). As urban regeneration programmes target the social determinants of health at both the individual- and area-level, they may contribute to health improvements of residents and reduce geographical health inequalities (Egan et al., 2013; Ruijsbroek et al., 2017; Whitehead, 2007). The evaluation of the health impact of urban regeneration programmes can therefore provide information about the usefulness of area-level policies as a strategy to tackle poor health and health inequalities (Ruijsbroek et al., 2017).

The Dutch District Approach is an urban regeneration programme that was implemented by the Dutch government in 2008 with the aim to improve the living conditions of the 40 most deprived districts (hereafter called target districts) in 18 cities of the Netherlands within ten years (Ministry of Housing, Spatial Planning and the Environment, 2007). Each target district implemented a set of interventions tailored to suit specific local needs. Interventions were focused on five policy areas and aimed at improving employment and income, educational level, housing conditions and physical neighbourhood environment, safety, and social cohesion (Droomers et al., 2014). Examples of interventions include the organization of local economic activities, programmes to prevent school dropout, renovation of the housing stock, creation of green space and facilities for sport and recreation, programmes to reduce neighbourhood nuisance, and activities to increase social cohesion, social neighbourhood networks, social support, and social capital in the target district (Droomers et al., 2014; Ruijsbroek et al., 2017). The mix, content and intensity of interventions differed by target district (Droomers et al., 2014). Although the Dutch District Approach was intended to last 10 years, the national funding stopped in 2012 as a result of changes in political priorities (The House of Representatives, 2011). Yet, it has been suggested that the Dutch District Approach addressed the neighbourhood environment to such an extent that future health impacts of this area-based intervention could be expected (Droomers et al., 2014).

Previous evaluation studies on the health impact of the Dutch District Approach have focused on the general adult population and have revealed contradictory findings. Using repeated cross-sectional data, some studies reported more favourable trends in some health

indicators (e.g., self-reported general health, mental health and physical activity) in target districts than in control districts after 3.5 years of follow-up (Droomers et al., 2016; Jongeneel-Grimen et al., 2016; Kramer et al., 2014). By contrast, other studies found no evidence for a positive health impact of the urban regeneration programme (Ruijsbroek et al., 2017; Stronks et al., 2014). A 6.5 year follow-up evaluation by Ruijsbroek et al. (2017) found no evidence of longer-term impacts on self-reported general health, mental health and related lifestyle behaviours, including physical activity, overweight, obesity and smoking at the area-level. The study by Ruijsbroek et al. (2017) further showed that the health impact of the Dutch District Approach did not differ by the intensity of the urban regeneration programme.

None of the studies above specifically focused on older adults, a population that might be particularly affected by urban regeneration programmes. It has been suggested that older adults are more dependent upon their immediate local environment and are more concerned about neighbourhood conditions than their younger counterparts due to their limited mobility, higher physical and/or social vulnerability (Aneshensel et al., 2016). The impact of urban regeneration programmes on older adults, however, is difficult to predict. On the one hand, programmes such as the Dutch District Approach, entail various interventions that may reduce loneliness, social isolation and anxiety and depressive symptoms, while increasing levels of social engagement and physical activity among older adults in the most deprived neighbourhoods (World Health Organization, 2007). For instance, increases in green spaces for recreation might offer a space for older adults to meet, resulting in improved physical activity and mental health, and reduced social isolation (Barnett et al., 2017; Barnett et al., 2018). On the other hand, urban regeneration programmes often target improvements that more directly benefit younger adults, and do not specifically focus on improving the social and physical environment of older adults. In addition, they may also result in unexpected changes that disrupt the environment older adults recognize and habituated too, potentially leading to negative consequences such as reduced social engagement or increased social isolation. To our knowledge, no study has examined the effects of the Dutch District Approach on indicators of functioning among older adults specifically.

The aim of this study was to evaluate the Dutch District Approach's impact on loneliness, social engagement, social isolation, physical activity and anxiety and depressive symptoms among older adults, using a quasi-experimental design and data from an ongoing large-scale longitudinal cohort study on aging in the Netherlands. Firstly, we use a difference-in-difference approach to compare changes in outcome measures between the pre-intervention

and intervention period in the target and control districts. Secondly, we assess whether the impact of the urban regeneration differs by the intensity of the urban regeneration programme.

Material and Methods

Study design and sample

Data from the Longitudinal Aging Study Amsterdam (LASA) were used in this study. The Longitudinal Aging Study Amsterdam is an ongoing, prospective cohort study in the Netherlands on the determinants, trajectories and consequences of physical, cognitive, emotional and social functioning in older adults (Hoogendijk et al., 2016; Huisman et al., 2011). Sampling, response and procedures are described in detail elsewhere (Huisman et al., 2011). In short, a random sample of older men and women (55-85 years), stratified by age and gender, was drawn from the population registries of eleven municipalities in three culturally distinct regions in the Netherlands. The baseline data collection was conducted in 1992/93 and the baseline sample included 3107 respondents. Since then, follow-up measurements have been conducted approximately every three years. Additional respondents (n=1002) were recruited from the same sampling frame in 2002/03.

For this study, data from waves 2005/06 and 2011/12 were used, as these corresponded to the period just before and after the onset of the intervention. The sample in 2005/06 included 2165 respondents, and 643 of which were lost to follow-up by 2011/2012 ($n_{deceased}$=449, $n_{refusal}$=129, $n_{ineligible}$=57, $n_{not\_contacted}$=8) (Hoogendijk et al., 2020). The reasons for attrition between these two waves did not significantly differ between target (deceased: 69.1%, refusal: 20.5%, ineligible: 9.2%, not contacted: 1.2%) and control districts (deceased: 72.5%, refusal: 17.5%, ineligible: 7.5%, not contacted: 2.5%) (p-value of Pearson Chi-square test=0.84). The percentage of deceased respondents that died during the pre-intervention and intervention period did not significantly differ between target (pre-intervention: 41.4%, intervention: 58.6%) and control districts (pre-intervention: 35.6%, intervention: 64.4%) (p-value of Pearson Chi-square test=0.53). Respondents with no data on their residential address during the study period (n=3) were excluded from the analyses. Furthermore, individuals who migrated to dissimilar district types (i.e., participants from target districts moving to control districts and participants from control districts moving to target districts) during the pre-intervention period (n=4) and intervention period (n=12) were excluded from the analyses to prevent attributing programme effects to the inward or outward migration of (un)healthier residents. In addition, respondents with missing data on at least one outcome measure (n=409) and on at least one covariate (n=2) were excluded from the analyses. The final analytical sample consisted of 1092 individuals with

full data at both waves. All participants completed an informed consent and the study was approved by the Ethical Review Board of the VU University medical center.

<u>Dependent variables</u>

Loneliness

Loneliness was measured using the De Jong Gierveld Loneliness Scale (De Jong Gierveld and Van Tilburg, 1999). This 11-item scale ranges from 0 to 11, with higher scores indicating higher levels of loneliness.

Social engagement

Social engagement was measured by asking participants about their social participation activities (Hoogendijk et al., 2016; Huisman et al., 2011). As social engagement measure, one dichotomized variable (0=no, 1=yes) was created to indicate membership of a group, club and/or organization.

Social isolation

Social isolation was defined based on whether participants indicated that they had no daily contact with anyone from their personal social network (0=no, 1=yes) (Timmermans et al., 2019). Participants who lived together with a partner or someone else were not considered as socially isolated.

Physical activity

Physical activity was measured using the LASA Physical Activity Questionnaire (LAPAQ) (Stel et al., 2004). The LAPAQ covers frequency and duration of various activities during the previous two weeks. Activities included walking outside, cycling, gardening, light and heavy household work and a maximum of two sports. In order to calculate average daily physical activity in minutes, the frequency and duration of walking, cycling, gardening and sport activities were multiplied and divided by 14 days, and subsequently summed. The intervention activities of the Dutch District Approach particularly focus on increasing outdoor physical activities (e.g., walking, cycling and gardening) and sport activities, and not on increasing indoor home activities (Droomers et al., 2014). Therefore, light and heavy household work were not included in the physical activity measure.

Anxiety symptoms

Anxiety symptoms were examined by the Hospital Anxiety and Depression Scale – Anxiety scale (HADS-A) (Zigmond and Snaith, 1983). The HADS-A is a questionnaire comprising seven four-point Likert scaled items. The scale ranges from 0 to 21, with higher scores representing more anxiety symptoms.

Depressive symptoms

Depressive symptoms were measured using the Center for Epidemiologic Studies Depression Scale (CES-D) (Radlof, 1977). The CES-D is a 20-item self-report scale ranging from 0 to 60, with higher scores representing more depressive symptoms.

Independent variable

Exposure to the Dutch District Approach

In the Netherlands, districts (average area size: 13.9 km^2) are geographically delineated administrative areas within municipalities and include, on average, approximately 2860 households (Statistics Netherlands, 2013). The districts where participants were living were categorized into two different categories. The districts in which the Dutch District Approach was implemented were considered as target districts. In this study, all target districts (n=5) were located in the municipality of Amsterdam at each wave. The districts that were unaffected by the Dutch District Approach were considered as control districts. In 2005/06 and 2011/12, participants lived in 107 and 122 control districts that were located in 55 and 66 municipalities across the Netherlands, respectively.

Effect modifier

Intensity of the urban regeneration programme

The assessment of the intensity of the urban regeneration programme in each target district has been previously described in detail elsewhere (Droomers et al., 2014; Jongeneel-Grimen et al., 2016). In short, an inventory of types of interventions within the five policy areas was made for each target district in the Netherlands. The inventory resulted in 17 different types of interventions across the target districts. Based on the number of residents reached or magnitude of environmental change achieved, the intensity of each type of intervention was classified as 'less intensive' (score=0), 'moderately intensive' (score=1) or 'more intensive' (score=2). For four target districts, no detailed information on intervention activities was available. For the other 36 target districts, an intensity sum score (range: 0-24) was calculated that was based on the intensity scores of the 12 intervention activities that were related to the policy areas housing conditions and physical neighbourhood environment, safety, and social cohesion. Of the policy areas within the Dutch District Approach, these are also the most relevant policy areas for older adults. The mean intensity sum score across the target districts was 12. Based on this intensity sum score, the intensity of the Dutch District Approach in each target district was categorized (0=less intensive (intensity sum score≤11), 1=more intensive (intensity sum score≥12)). The more intensive programmes employed activities within a larger number of types of interventions and incorporated measures that covered the different policy areas (Droomers et al., 2014; Jongeneel-Grimen et al., 2016; Ruijsbroek et al., 2017). Of the five target districts in the this study, two districts implemented a less intensive programme and three districts implemented a more intensive regeneration programme.

Covariates

Analyses were adjusted for age in years, gender (0=women, 1=men), partner status, educational level, employment status, mobility disability and population density.

Marital status was categorized into *partner status* (0=no partner (i.e., single or never been married, divorced or widowed), 1=partner (i.e., married or cohabitating, registered partnership or living apart)).

Educational level was dummy-coded (0=no, 1=yes) into: low (reference category; elementary education not completed, elementary education, or lower vocational education), intermediate (general intermediate education, intermediate vocational education, or secondary education), and high (higher vocational education, college education, or university education).

Employment status was assessed by asking participants whether they had a paid job at present (0=no, 1=yes).

Mobility disability was assessed as the self-reported degree of difficulty or need of help with walking five minutes outdoors without resting. Mobility disability was considered as present (0=no, 1=yes) when participants indicated that they could not do this activity at all or without help (Lan et al., 2003).

Population density was measured as the number of residents per square kilometer in neighbourhoods, which are administrative sub-areas within districts (average area size: 3.1 km^2 and average number of households: 630) (Statistics Netherlands, 2016; Timmermans et al., 2018).

Statistical analyses

Characteristics of the study sample were presented using descriptive statistics. Means and standard deviations (SDs) were presented for normally distributed continuous variables. Frequencies and proportions were presented for dichotomous or categorical variables. Pre-intervention differences in characteristics between target and control groups were statistically tested using Independent Samples T Tests and Pearson Chi-square Tests.

A difference-in-difference approach was applied to examine the impact of exposure to the Dutch District Approach on various indicators of functioning. We assessed differences in the outcome measures from the pre-intervention and intervention period between the target and control districts. This difference-in-difference approach was implemented in linear regression models (for continuous variables) and linear probability models (for dichotomous variables) which controlled for relevant covariates, including age, gender, partner status, educational level, employment status, mobility disability and population density. In these models, outcomes were estimated as a function of a period indicator (intervention period compared to its reference pre-intervention period), treatment indicator (target districts compared to its reference control districts), and the interaction between the period and treatment indicator, which corresponds to the difference-in-difference estimate of interest.

To examine whether the effect of the Dutch District Approach on the outcome measures differed by the intensity of the urban regeneration programme, the analyses were stratified by the intensity variable.

All analyses were repeated in three sensitivity analyses. In the first sensitivity analysis, only participants living in the municipality of Amsterdam were included. In the second sensitivity analysis, only data from participants in target districts and the 25% most deprived

control districts (based on the socioeconomic status score from The Netherlands Institute for Social Research (Knol, 2012)) were included. In the third sensitivity analysis, a broad definition of target districts was used to increase the number of participants in the target districts. This definition was based on actual target districts and districts within five kilometers of those districts. Most (older) adults want to actively travel (i.e., by foot or bicycle) this distance for activities, such as grocery shopping (KiM Netherlands Institute for Transport Policy Analysis, 2016; Prins et al., 2014). Individuals living near target districts may therefore also be affected by the programme. A key assumption of our approach is that trends in target and control districts would have been parallel in the absence of intervention. A common way to test this assumption is to examine trends in outcomes in the years prior to the programme. These analyses revealed that trends in indicators of functioning did not differ between target and control districts in the period 2001-2005, indicating a common trend in target and control districts.

In all analyses, a p-value below 0.05 was considered as statistically significant. All statistical analyses were performed in IBM SPSS Statistics (Version 20; IBM Corp, Armonk, New York, United States of America).

Results

Of all 1092 participants, 63 lived in target districts, while 1029 lived in control districts. Before the onset of the programme, participants in the target districts were similar to participants in the control districts in terms of age, gender, educational level, employment status and mobility disability, but they were less likely to have a partner. Target districts were characterized by a higher population density than control districts (Table 1).

Table 1

During the pre-intervention period as well as the intervention period, participants in the target districts had less favourable outcomes on each separate indicator of functioning than those in the control district (Figure 1 and Table 2). No statistical evidence was found that exposure to the Dutch District Approach significantly influenced loneliness, social engagement, social isolation, physical activity, and anxiety and depressive symptoms (Table 2).

Figure 1

Table 2

The results of the stratified analyses indicated that the changes in the various indicators of functioning were not consistently larger in target districts that implemented a more intensive urban regeneration programme (Table 3).

Table 3

The first sensitivity analysis included data from 63 and 149 participants in target and control districts in the municipality of Amsterdam, respectively. The findings indicate that the Dutch District Approach did not benefit or harm functioning of older adults in Amsterdam (Table 4). This was regardless of programme intensity (results not shown). The second sensitivity analysis included data from 63 and 208 participants in target and the 25% most deprived control districts, respectively. The findings of this sensitivity analysis were similar to those of the main analyses as well as the first sensitivity analysis (results not shown). The third sensitivity analysis included data from 205 and 887 participants in target (broad definition) and control districts,

respectively. The findings of this sensitivity analysis also revealed that the Dutch District Approach did not significantly affect functioning of older adults (results not shown).

Table 4

Discussion

This study examined the impact of the Dutch District Approach, a major urban regeneration programme, on loneliness, social engagement, social isolation, physical activity, and anxiety and depressive symptoms, among older adults in the Netherlands. The results showed no significant effects of the programme on social, physical and mental functioning in the four years after the start of the programme. The results further showed that the impact of the Dutch District Approach on the various indicators was not significantly larger in high-intensity target districts.

An important condition for a quasi-experimental design is that the composition of target and control groups remains stable over time (Craig et al., 2012). A limitation of existing quasi-experimental evaluations of the Dutch District Approach is the use of repeated cross-sectional data, which may have resulted in compositional changes over time in treatment and control groups (Droomers et al., 2016; Jongeneel-Grimen et al., 2016; Kramer et al., 2014; Ruijsbroek et al., 2017). An important strength of the current study is the use of longitudinal data from a large-scale nationally representative cohort study on ageing in the Netherlands. This enabled us to evaluate the Dutch District Approach using data on various indicators of functioning from the same participants before and after the implementation of the urban regeneration programme in 2008. In addition, this is the first study on the Dutch District Approach focusing on older adults.

Some limitations should however be acknowledged. Firstly, the proportion of our sample exposed to the Dutch District Approach was very small, potentially resulting in unprecise estimates. In addition, because of the small number of participants, we were not able to stratify the analyses for individual-level characteristics. Secondly, the target districts in this study were all located in the city of Amsterdam, whereas the Dutch District Approach was also implemented in 35 districts across 17 other cities in the Netherlands (Ministry of Housing, Spatial Planning and the Environment, 2007). Consequently, the generalizability of our findings to target districts in much smaller cities might particularly be limited. Thirdly, a potential concern is that control districts in our study may have been affected by interventions as well, through spillover effects or other local regeneration programmes that were not part of the Dutch District Approach. These interventions could have contributed to an underestimation of the impact of the Dutch District Approach. Nevertheless, investments in target districts have been shown to be larger and more comprehensive than the activities implemented concurrently in other (deprived) control districts (Permentier et al., 2013; Ruijsbroek et al., 2017). Therefore, it is unlikely that interventions that took place in control districts have affected our evaluation to such extent that we could not detect any existing effect of the Dutch District Approach. Finally,

a follow-up time of four years might have been too short to identify an effect (Ruijsbroek et al., 2017).

In line with the results of previous evaluation studies that used repeated cross-sectional data from the adult population (Droomers et al., 2016; Jongeneel-Grimen et al., 2016; Kramer et al., 2014; Ruijsbroek et al., 2017; Stronks et al., 2014), our evaluation study using longitudinal data did not show a significant impact of the Dutch District Approach on various indicators of functioning among older adults. There might be several explanations for the lack of impact of the Dutch District Approach on the various indicators of functioning among older adults. Improving health and functioning was not one of the five main objectives defined at the start of the programme, and as such the programme may not have sufficiently focused on social determinants that are relevant to health. On the other hand, the Dutch District Approach targeted social determinants of health on the individual- as well as area-level, and as such it should have impacted some of the outcomes examined.

A possible reason for the lack of effects is that the duration of the Dutch District Approach was relatively short. Although the four-year programme was expected to have lasted sufficiently to induce noticeable impacts (Droomers et al., 2014), this was not confirmed by the null findings in our study. Evidence suggests that these types of interventions may need considerable time and funding to be effective in transforming the local area and impacting health (Batty et al., 2010). For instance, the findings of evaluation studies of the New Deal for Communities regeneration programme in the United Kingdom and the Moving to Opportunity for Fair Housing programme in the United States of America suggested time frames of at least five and ten years were needed to exert a noticeable impact on the local environment and health (Batty et al., 2010; Lawless and Pearson, 2012; Sanbonmatsu et al., 2012). It is uncertain, however, whether effects on older adults will emerge in the longer term, given the fact that no study has demonstrated significant changes in the short-run.

Another explanation is that the interventions across target districts might not have been intensive enough to induce noticeable effects. A study by Permentier et al. (2013) indicated that changes in liveability, social cohesion, safety, and social mobility in the target districts were generally similar to comparably deprived control districts. If there are no clear positive changes in the individual and environmental determinants of health and functioning, positive trends in health and functioning cannot be expected either. It has also been suggested that the ambitious goals of the Dutch District Approach might have led to inefficiencies (Permentier et al., 2013). For instance, the considerable amount of energy it took to choose local priorities within the larger programme and the fragmentation of activities due to the broadly defined goals could

have undermined the success of the programme (Permentier et al., 2013; Ruijsbroek et al., 2017).

Notably, results of this study indicate decline in several indicators of functioning in target as well as control districts (e.g., loneliness, social isolation and physical activity). These findings might be due to the ageing of the individuals. Additionally, with natural experiments, there is always the risk that other developments disrupt the intended effect of the intervention. In the case of the Dutch District Approach, the most disruptive factor seems to have been the economic crisis, which began at almost the same time as the activities implemented (Jongeneel-Grimen et al., 2016). The decline in several indicators of functioning might also reflect the impact of the economic crisis.

Although we did not find substantial effects of the Dutch District Approach on indicators of functioning among older adults at the area level, this does not mean that there were no benefits among some individuals. It might be that older adults who actually participated in programme activities benefit more than those who did not get involved (Kelahar et al., 2010; Lawless and Pearson, 2012). It has been suggested that the impact of the 17 types of intervention activities in the Dutch District Approach can be categorized into three levels: interventions impacting participants, environmental changes affecting users, and environmental changes affecting all residents (Droomers et al., 2014). The person-based intervention activities in the Dutch District Approach were, however, not specifically targeted to older adults, but were mainly focused on children and younger workers (Droomers et al., 2014). Furthermore, older adults who live in (relatively) unaffected parts of a target district and/or who make no use of the intervention activities might be unlikely to show changes in functioning. It is likely that urban regeneration programmes that were not targeted to older people resulted in limited benefits for the older population.

To obtain more insight into the impact of the Dutch District Approach on indicators of functioning among older adults, future studies could examine the impact of different activities, using longitudinal data from a larger number of participants per district and over a longer follow-up time. This will provide insights into the impact of the specific content of the interventions on indicators of functioning, and provide the opportunity to assess the impact in subgroups of older adults. Furthermore, future evaluation studies should not only focus on target districts in the municipality of Amsterdam, but should focus on all target districts across the Netherlands. Additionally, future research could take into account whether individuals were actually targeted and reached by the programme and were participating in intervention activities.

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Highlights

- We assessed the impact of the Dutch District Approach on older adults' functioning.

- The focus on older adults and the use of longitudinal data are novel in this field.

- This urban regeneration programme did not benefit or harm aspects of functioning.

- The impact of the Dutch District Approach did not differ by programme intensity.

Table 1: Characteristics of the study sample.

Characteristics	Target districts		Control districts		Pre-intervention differences between target districts and control districts
	Pre-intervention (2005/06)	Intervention (2011/12)	Pre-intervention (2005/06)	Intervention (2011/12)	p-value
Numbers (n)					
Individuals in total	63	63	1029	1029	-
Individuals in low-intensity target districts	9	10	-	-	-
Individuals in high-intensity target districts	54	53	-	-	-
Age (Mean ± SD)	69.1 ± 8.4	75.1 ± 8.4	68.2 ± 7.4	74.3 ± 7.4	0.40
Gender (%)					0.50
Men	41.3	41.3	45.7	45.7	
Women	58.7	58.7	54.3	54.3	
Partner status (%)					0.01
No partner	44.4	47.6	28.4	32.3	
Partner	55.6	52.4	71.6	67.7	
Educational level (%)					0.40
Low	47.6	47.6	43.9	43.9	
Intermediate	38.1	38.1	34.6	34.6	
High	14.3	14.3	21.5	21.5	
Employment status (%)					0.72
No paid job at present	76.2	92.1	78.1	87.9	
Paid job at present	23.8	7.9	21.9	12.1	
Mobility disability (%)					0.27
No	85.7	77.8	90.1	83.0	
Yes	14.3	22.2	9.9	17.0	
Population density (Mean ± SD)	5706.3 ± 3150.5	5487.7 ± 2901.6	2598.5 ± 3138.5	2640.3 ± 3167.0	<0.001

Table 2: Comparisons of indicators of functioning among older adults between pre-intervention and intervention period in target and control districts.

Indicators of functioning	Target districts			Control districts			Difference in Difference (Confidence interval) [b]	p-value
	Pre-intervention (2005/06)	Intervention (2011/12)	Intervention versus pre-intervention period [a]	Pre-intervention (2005/06)	Intervention (2011/12)	Intervention versus pre-intervention period [a]		
Loneliness (Mean ± SD)	2.4 ± 2.6	2.9 ± 3.1	0.5	1.7 ± 2.3	1.9 ± 2.4	0.2	0.5 (-0.3-1.3)	0.24
Social engagement (%, yes)	68.3	73.0	4.7	83.8	82.2	-1.6	6.0 (-7.5-19.6)	0.38
Social isolation (%, yes)	20.6	28.6	8.0	11.1	16.0	4.9	2.9 (-7.5-13.3)	0.58
Physical activity (Mean ± SD)	54.8 ± 45.1	50.1 ± 48.8	-4.7	71.3 ± 90.9	64.1 ± 74.6	-7.2	3.5 (-25.0-32.0)	0.81
Anxiety symptoms (Mean ± SD)	3.4 ± 3.1	3.0 ± 3.1	-0.4	2.9 ± 3.0	2.9 ± 3.0	0.0	-0.5 (-1.5-0.6)	0.38
Depressive symptoms (Mean ± SD)	9.2 ± 8.5	8.4 ± 7.3	-0.8	7.3 ± 6.8	7.9 ± 6.9	0.6	-1.4 (-3.7-0.8)	0.21

[a] The pre-intervention period is the reference category.

[b] Adjusted for age, gender, partner status, educational level, employment status, mobility disability and population density.

Table 3: Comparisons of indicators of functioning among older adults between pre-intervention and intervention period in high-intensity target districts, low-intensity targets and control districts.

Indicators of functioning	Pre-intervention (2005/06)	Intervention (2011/12)	Intervention versus pre-intervention period [b]	Difference in Difference (Confidence interval) [c]	p-value
Loneliness (Mean ± SD)					
High-intensity target districts	2.4 ± 2.7	3.2 ± 3.3	0.8	-	-
Low-intensity target districts	1.0 ± 1.3	1.3 ± 1.3	0.3	-	-
Control districts	1.7 ± 2.3	1.9 ± 2.4	0.2	-	-
High-intensity target districts versus Control districts [a]	-	-	-	0.6 (-0.3-1.5)	0.22
Low-intensity target districts versus Control districts [a]	-	-	-	0.2 (-2.0-2.3)	0.88
Social engagement (%, yes)					
High-intensity target districts	68.5	75.5	7.0	-	-
Low-intensity target districts	66.7	60.0	-6.7	-	-
Control districts	83.8	82.2	-1.6	-	-
High-intensity target districts versus Control districts [a]	-	-	-	6.7 (-7.8-21.3)	0.37
Low-intensity target districts versus Control districts [a]	-	-	-	2.6 (-32.0-37.1)	0.88
Social isolation (%, yes)					
High-intensity target districts	22.2	34.0	11.8	-	-
Low-intensity target districts	11.1	0.0	-11.1	-	-
Control districts	11.1	16.0	4.9	-	-
High-intensity target districts versus Control districts [a]	-	-	-	6.4 (-4.8-17.5)	0.26
Low-intensity target districts versus Control districts [a]	-	-	-	-17.8 (-44.2-8.6)	0.19
Physical active lifestyle (Mean ± SD)					
High-intensity target districts	55.4 ± 46.7	49.1 ± 50.5	-6.3	-	-
Low-intensity target districts	51.4 ± 35.7	55.7 ± 40.2	4.3	-	-
Control districts	71.3 ± 90.9	64.1 ± 74.6	-7.2	-	-
High-intensity target districts versus Control districts [a]	-	-	-	2.2 (-28.6-32.9)	0.89
Low-intensity target districts versus Control districts [a]	-	-	-	11.3 (-63.3-86.0)	0.77
Anxiety symptoms (Mean ± SD)					
High-intensity target districts	3.8 ± 3.3	3.3 ± 3.2	-0.5	-	-
Low-intensity target districts	1.3 ± 1.5	1.5 ± 1.7	0.2	-	-
Control districts	2.9 ± 3.0	2.9 ± 3.0	0.0	-	-
High-intensity target districts versus Control districts [a]	-	-	-	-0.5 (-1.7-0.6)	0.38
Low-intensity target districts versus Control districts [a]	-	-	-	-0.2 (-2.9-2.5)	0.88

Table 3: Comparisons of indicators of functioning among older adults between pre-intervention and intervention period in high-intensity target districts, low-intensity targets and control districts.

Indicators of functioning	Pre-intervention (2005/06)	Intervention (2011/12)	Intervention versus pre-intervention period [b]	Difference in Difference (Confidence interval) [c]	p-value
Depressive symptoms (Mean ± SD)					
High-intensity target districts	10.0 ± 8.7	9.0 ± 6.1	-1.0	-	-
Low-intensity target districts	4.3 ± 4.5	5.5 ± 7.5	1.2	-	-
Control districts	7.3 ± 6.8	7.9 ± 6.9	0.6	-	-
High-intensity target districts versus Control districts [a]	-	-	-	-1.7 (-4.2-0.7)	0.17
Low-intensity target districts versus Control districts [a]	-	-	-	0.1 (-5.7-6.0)	0.96

[a] The control districts are the reference category.

[b] The pre-intervention period is the reference category.

[c] Adjusted for age, gender, partner status, educational level, employment status, mobility disability and population density.

Table 4: Comparisons of indicators of functioning among older adults between pre-intervention and intervention period in target and control districts in the municipality of Amsterdam.

Indicators of functioning	Target districts			Control districts				
	Pre-intervention (2005/06)	Intervention (2011/12)	Intervention versus pre-intervention period [a]	Pre-intervention (2005/06)	Intervention (2011/12)	Intervention versus pre-intervention period [a]	Difference in Difference (Confidence interval) [b]	p-value
Loneliness (Mean ± SD)	2.4 ± 2.6	2.9 ± 3.1	0.5	2.0 ± 2.6	2.2 ± 2.6	0.2	0.6 (-0.5-1.6)	0.27
Social engagement (%, yes)	68.3	73.0	4.7	72.8	74.5	1.7	1.2 (-17.0-19.4)	0.90
Social isolation (%, yes)	20.6	28.6	8.0	22.8	23.5	0.7	5.8 (-9.1-20.7)	0.45
Physical activity (Mean ± SD)	54.8 ± 45.1	50.1 ± 48.8	-4.7	76.9 ± 96.2	74.7 ± 118.8	-2.2	-3.6 (-41.7-34.5)	0.85
Anxiety symptoms (Mean ± SD)	3.4 ± 3.1	3.0 ± 3.1	-0.4	2.9 ± 3.0	2.7 ± 2.8	-0.2	-0.1 (-1.3-1.0)	0.82
Depressive symptoms (Mean ± SD)	9.2 ± 8.5	8.4 ± 7.3	-0.8	8.0 ± 6.6	8.3 ± 6.8	0.3	-1.0 (-3.7-1.8)	0.50

[a] The pre-intervention period is the reference category. The difference score has been calculated as the intervention score minus the pre-intervention-score.

[b] Adjusted for age, gender, partner status, educational level, employment status, mobility disability and population density.
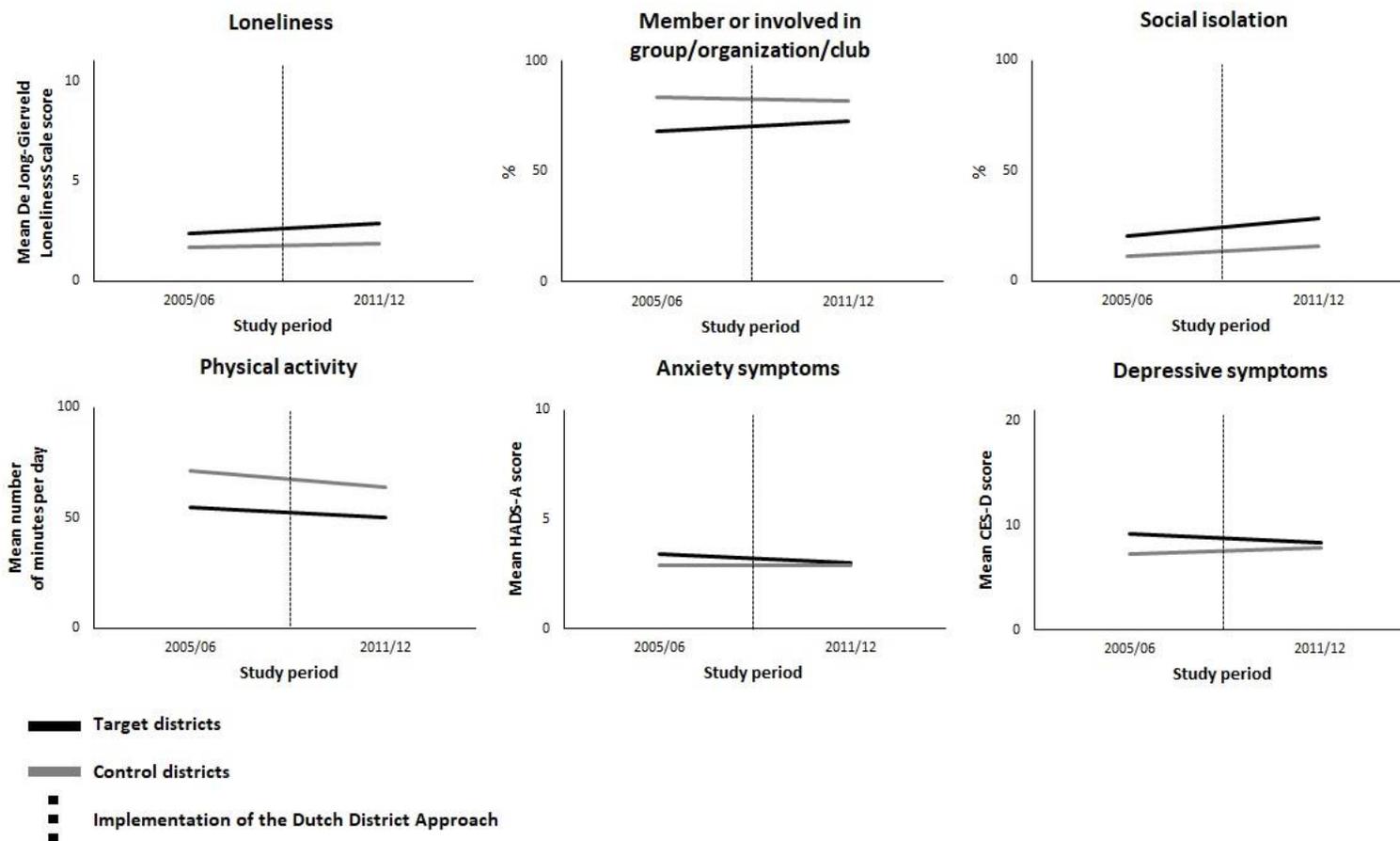
Figure 1: Prevalence rate of various indicators of functioning among older adults during the pre-intervention (2005/06) and intervention period (2011/12).[a]

[a] Abbreviations: HADS-A: Hospital Anxiety and Depression Scale – Anxiety scale; CES-D: Center for Epidemiologic Studies Depression Scale.