Effectiveness of the Promising Neighbourhoods community program in 0-to 12-year-olds: A difference-in-difference analysis

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c A B S T R A C T

Objective: The purpose of this study was to evaluate a collaborative community-based program that aims to a) increase the health, safety and talent development of youth, and b) contribute to the reduction of socioeconomic inequalities.

Methods: A difference-in-difference design with two separate cross-sectional samples in 2018 (n = 984) and 2021 (n = 413) among 0- to 12-year-olds with an intervention and comparator condition was used. The program, called Promising Neighbourhoods, consists of collaboration with community stakeholders, data-based priority setting, knowledge- and theory-based policies, and evidence-based interventions. The program was implemented in three neighbourhoods which were compared with three similar comparator neighbourhoods in which the program was not implemented. Logistic difference-in-difference regression was used to test effectiveness of the intervention on informal parenting support, outdoor-play, sport club membership, general health and risk of emotional and behavioral difficulties.

Results: A significant intervention effect of the Promising Neighbourhoods program after two years was found for outdoor-play (OR 0.61; 95% CI 0.37, 0.99). No other significant intervention effects were found for other outcomes. No different intervention effects were found for children with a lower or higher socioeconomic status on outcomes.

Conclusion: The findings of this study indicate a positive intervention effect for one of the outcomes in 0- to 12-year-olds. Further mixed-methods evaluation research and using longer follow-up periods are needed to examine the value of these type of programs. Further development of Promising Neighbourhoods seems warranted.

Trial registration: This study was prospectively registered in the Netherlands National Trial Register (Number: NL7279) on 26 September 2018.

1. Introduction

Socioeconomic status (SES) influences the development and health of youth (Arcaya et al., 2015; Braveman et al., 2011). Socioeconomic inequalities have been demonstrated in the youngest age groups and often continue in adult life (Cheng et al., 2015; Marmot and Bell, 2012, 2016). Therefore, investing in the reduction of socioeconomic inequalities in children is of utmost importance (Marmot & Bell, 2019). Although much research has been performed on the magnitude and causes of socioeconomic inequalities, relatively less is available on effective approaches to reduce them (Macintyre et al., 2020; Marmot & Bell, 2019).

The Ottawa Charter already mentioned in 1986 that community involvement and creating supportive conditions and environments could be strategies to reduce inequalities and to increase health and well-being of the community (Kickbusch, 2003; World Health Organization, 2009). Intersectoral collaboration, community participation, creating healthy settings, political commitment, funding and infrastructure, employing multiple strategies and actions at multiple levels and awareness of the socio-environmental context were found to be key to the effectiveness of health promotion programs. (Jackson et al., 2006; National Academies of Science Engineering, 2019) The important role local governments can play in reducing health inequalities has also been stressed by the World Health Organization (WHO) as they have a...
Collaborative community-based programs typically comprise many of the key actions mentioned above. They employ multiple interventions, involve key-leaders and networks, and aim to strengthen the community (Merzel & D’Afflitti, 2003). Therefore, they can be regarded as promising in reducing socioeconomic inequalities in the healthy and safe development of youth (Merzel & D’Afflitti, 2003; Wallerstein & Duran, 2010; Fagan et al., 2018).

In the past years there has been an increasing focus on local integrated community-based programming approaches (Halfon et al., 2022). An example is the EPODE-program for the Promotion of Health Equity (EPHE) which focused on reducing socioeconomic inequalities (Borys et al., 2016; Mantziki et al., 2014). In this program, communities developed and implemented tailored lifestyle interventions to the needs of different socioeconomic groups (Borys et al., 2016; Mantziki et al., 2014). The EPHE-program was successful in changing behaviour of children with a lower SES and with a higher SES (Borys et al., 2016). Another example is the Communities that Care (CTC) program that aimed to reduce problem behaviour among children and adolescents and was implemented at the neighbourhood level. In this program, they formed community coalitions, performed a needs assessment and chose which interventions needed to be implemented. CTC reduced health-risk behaviour in the United States of America and Australia (Hawkins et al., 2014; Rowland et al., 2018; Toubourou et al., 2019; Oesterle et al., 2014; Oesterle et al., 2018; Rhew et al., 2013). In the United Kingdom and the Netherlands, the results were less favourable (Brown et al., 2007; Brown et al., 2011; Jonkman et al., 2009; Steketee et al., 2013). Results of these programs indicate that, indeed, community engagement and tailored programs could be promising but more research is needed to increase the evidence-base.

The Promising Neighbourhoods collaborative community-based program partly builds on the experience of earlier methodologies such as CTC and the EPODE-program (Arthur et al., 2010; Borys et al., 2016). The program was developed by the municipality of Rotterdam with the aim to increase the health, safety and talent development of youth living in Rotterdam, and to contribute to the reduction of socioeconomic inequalities (Wiering, 2015). The Promising Neighbourhoods program consists of collaborating with community stakeholders, data-based priority setting, knowledge-and theory-based policies and evidence-based interventions (Boelens et al., 2019). The results of the effect evaluation of this program on health outcomes and on health inequalities in 0-to 12-year-olds are described in this paper.

1.1. Research questions

1: What is the effectiveness of the Promising Neighbourhoods program in 0- to 12-year-olds on health outcomes (informal parenting support, outdoor-play, sport club membership, general health and risk of emotional and behavioural difficulties)?
2: What is the effectiveness of the Promising Neighbourhoods program in 0-to 12-year-olds on reducing socioeconomic inequalities in these health outcomes?

1.2. Study hypothesis

We hypothesize that the Promising Neighbourhoods program leads to improved health outcomes and to reduced socioeconomic inequalities on these outcomes in intervention neighbourhoods compared to comparator neighbourhoods. As integrated interventions will be offered by multiple stakeholders to individual and groups of children and their parents but specific for each neighbourhood, we expect not only benefits at the individual level but also on the neighbourhood level.

2. Methods

2.1. Study design

The study design has been described elsewhere (Boelens et al., 2019). Briefly, this study utilizes a difference-in-difference design with two separate cross-sectional samples with an intervention and comparator condition. Measurements took place before implementation (T0) between May–July 2018 (T0) and at after implementation (T1) between April–July 2021.

This study was prospectively registered in the Netherlands National Trial Register (Number: NL7279) on 26 September 2018.

2.2. Setting

The setting has been described in a protocol paper for this study (Boelens et al., 2019). Briefly, this study took place in Rotterdam, the second largest city of the Netherlands (650 thousand inhabitants in 2020 of which 14% is between 0 and 12 years of age (Municipality of Rotterdam, 2020). Rotterdam is a multicultural city as 52% of the inhabitants has a migrant background (Municipality of Rotterdam, 2020). Rotterdam is one of the poorest cities in the Netherlands (12.8% of its inhabitants) (Statistics Netherlands, 2021). The city of Rotterdam has a low SES score and the differences in SES between neighbourhoods is high (Statistics Netherlands, 2022). Rotterdam comprises 14 city areas’ including 42 different neighbourhoods.

Neighbourhoods were defined administratively, based on their postal code. We did not use statistical techniques such as propensity score matching to select neighbourhoods. Rather, to ensure a sufficient diversity of SES and youth health problems in the neighbourhoods, we categorized neighbourhoods as low, middle or high degree of problems. The degree of problems is based on the percentage of low-educated inhabitants of <17 years-old, children with a non-Dutch migrant status, children aged 4 and 12 years old with a high score on the Strengths and Difficulties Questionnaire (SDQ) (e.g. emotional and behavioural difficulties) and the percentage of overweight children in grade two of primary school in the neighbourhoods. From each category an intervention neighbourhood was selected resulting in three intervention neighbourhoods. Similarly, from each category a comparator neighbourhood was chosen. Intervention and comparator neighbourhoods were comparable (See Supplemental Table 1). See Fig. 1 for a geographical overview of the intervention and comparator neighbourhoods. One comparator neighbourhood decided to implement common programming comparable to the Promising Neighbourhoods program on its own initiative. Therefore, one new comparator neighbourhood was chosen from the same category. The comparator neighbourhood that started with the common programming is used in the sensitivity analyses for comparison.

2.3. Study population

Data of 984 children aged 0-to 12-years old and were available at T0 and 413 at T1. Within these cross-sectional samples, respectively, 649 and 268 were 4- to 12-year-olds.

Invitations to participate to the cross-sectional surveys in 2018 and 2021 were done by drawing a random probability sample (representative for age and gender) from the municipal population register. Children living in a healthcare institution were excluded. Parents received invitations for one child only. All parents were living in Rotterdam when the survey was administered. At T0 the response rate for 0- to 4-year-olds was 40.6% (n = 6,771) and for 4-12-year-olds the response rate was 37.7%(n = 10,029). At T1 the response rate for 0- to 4-year-olds was 37.0%(n = 160) and for 4- to 12-year-olds the response rate was 31.8%(n = 274). No information about characteristics of non-responders was available.

A power calculation to determine the sample size of the data needed
to determine small effect sizes ($f^2 = 0.02$) has been previously described (Boelens et al., 2019; Cohen, 2013). A sample of 818 (409 at T0 and 409 at T1) evenly distributed over the intervention and comparator neighbourhoods would provide sufficient power.

The sample at T0 was larger than that was needed to provide sufficient power and than the sample at T1. This was because we used data collected by the municipality for our T0 sample. This sample was also collected for other research and monitoring purposes.

2.4. The Promising Neighbourhoods program

The collaborative community-based program has been described extensively in the study protocol (Boelens et al., 2019). Briefly, the aims of the program are to increase the health, safety and talent development of youth (Wiering, 2015). The program is a collaborative community-based approach that includes community stakeholders, works with data-driven priority setting, knowledge- and theory-based policies and focuses on implementation of evidence-based interventions (Arthur et al., 2010; Borys et al., 2016). This program is continuously further developed and adjusted. Also during this study the program was further developed. The program is seen as a learning process.

The program is managed by municipal district advisors (Wiering et al., 2019). Each municipal district advisor is assigned to a different neighbourhood and coordinates and monitors the program. Together with community stakeholders and key-leaders from the neighbourhood network the municipal district advisor plans and develops a tailored intervention package for the neighbourhood. This package can consist of parenting support, preventive (health) interventions, youth welfare, preventive measures and activities to improve health, safety and talent development among youth.

The program consists of multiple steps (Wiering et al., 2019). Step 1 is a needs-assessment of the neighbourhood based on local quantitative registry and survey data. In step 2, the needs-assessment is discussed with the neighbourhood network to match the conclusions with qualitative insights based on their daily experiences and to gain local support by setting joint goals. In step 3, the needs-assessment is adapted based on the insights from step 2. Based on this assessment priorities for the neighbourhood are determined (data based-priority setting). Table 1 shows the priorities that have been set for the intervention neighbourhoods. In step 4, municipal district advisors and the neighbourhood network inventoried the current interventions, policy measures, actions and agreements in the neighbourhood and checked the evidence-base of the intervention in the database of Effective Youth Interventions of the NYI (https://www.nji.nl/nl/Databank/Databank-Effectieve-Jeugdinterventies). In step 5, the most appropriate and available interventions, policy measures, actions and agreements for the priorities are chosen by the municipal district advisors and neighbourhood network. A detailed neighbourhood intervention-package plan including the needs-assessment, priorities and policy measures, interventions and activities is developed in step 6. Table 1 shows the interventions, policy measures, actions and agreements that have been chosen in the intervention neighbourhoods for youth aged 0–18 year old. In step 7, this plan is implemented in the neighbourhood. Step 8 consists of continuous monitoring and evaluation.

The collaborative community-based program started in the summer of 2018 after the T0 measurement. This means the municipal district advisors started with step 1. We have the information regarding the selected interventions, policy measures, actions and agreements for the priorities that have been chosen. Insight in the actual implemented interventions is lacking. Consequently, we have no reliable information on reach of implemented interventions. The collaborative community-based program is still carried on. We did not study the costs of the program.

2.5. Comparator neighbourhoods

In the comparator neighbourhoods no collaborative community-
Introduction

Interventions, policy measures, actions and agreements have occurred as part of the Promising Neighbourhoods program, a comprehensive approach to address social problems in urban areas. The priorities differed between intervention neighbourhoods, with the focus on various aspects ranging from mental health to social-emotional skills, delinquency, and safety.

Table 1
Overview of the priorities, interventions and policy measures, actions and agreements in intervention neighbourhoods for children aged 0- to 18-years old.

| Priorities | Interventions | Policy measures, actions and agreements among partners |
|------------|---------------|-------------------------------------------------------|
| 1) More children have better social-emotional health | 4 interventions for 0-4 year olds, mainly focused on parenting skills and socio-emotional skills | 1) Training teachers on social emotional development. |
| 2) Reduced risk of psychosocial problems | 10 interventions for primary school-aged children mainly focused on parenting skills, low SES and/or social emotional skills | 2) Improving collaboration and awareness and knowledge of preventive interventions on social emotional skills between schools and other partners. |
| 3) Reduced problem behaviour of the child | 3 interventions focused on children of divorced parents | 3) Improving knowledge and awareness of parents and professionals about alcohol and drug use during pregnancy and parenthood. |
| 4) Fewer children are angry | 4 interventions focused on children with parents who suffer from psychiatric problems or addiction | 4) Improving parenting skills, healthy lifestyles and reduce risk behaviour of children by providing more information to parents. |
| 5) Fewer children are bullied | 7 interventions for youth from 12 to 25 mainly focused on socio-emotional skills | 5) Implementing media classes as schools. |
| 6) 50% of all children participate in a training for social emotional development as part of the school curriculum | | 6) Actively promoting the pedagogical neighbourhood values at school and in the neighbourhood. |
| 7) More children are playing outside | 6 interventions for parents mainly focused at parenting skills | 7) Square/playground programming on the various squares/playgrounds. |
| 8) An increase of children that participate in sports after school | 2 interventions focused on domestic violence and fights at home | 8) Improve early identification of conduct problems. |
| 9) More children have a better general health | 16 interventions for parents mainly focused at parenting skills | 9) Focus on pregnant women and young families in collaboration with partners in neighbourhood. |
| 10) More parents have informal parenting support | 2 interventions focused on domestic violence | 10) Increase sport participation among primary school aged children by increasing the opportunities for sport through sport clinics, by increasing awareness on sport facilities, and by increasing accessibility. |
| 11) An increase in children that grow up in a safe home environment | 6 intervention only given at primary school focused at socio-emotional skills and resilience | 11) Stimulate children to participate in sport, culture or side jobs using role models, by offering locations, offering work-learning trajectories, offering side jobs, and organizing activities for and with youth and training in language improvement for parents and children. |
| 12) More young people perform better at school and obtain their school diploma | 1 intervention only given at secondary school focused at socio-emotional skills and resilience | 12) Reducing poverty and debt by increasing the reach of a debt-reduction program and by subsidies for sport and other activities using municipal funds. |
| 13) reduced relative school absence | 2 intervention focused on delinquency and safety | 13) Improved collaboration of schools with truant officers, police officers and social welfare teams to reduce school absenteeism and delinquency. |
| 14) The burden of crowd forming/hanging out on the streets among older youth is diminishing | 2 interventions focused on participation | 14) Good and sufficient homework guidance through, among other things, the use of community centers. |
| 15) A decrease in youth criminality | 1 Intervention focused on poverty and debts | 15) Improve collaboration between youth workers. |
| | Total – 57 interventions of which 3 interventions fell in two categories | 16) Expand collaboration among care and support professionals in the neighbourhood (general practitioners, physiotherapists, dietitians, etc) and schools. |
| | | 17) Aligning the attention from neighbourhood network partners to language improvement. |
| | | 18) Discuss approach for pupils that live in other neighbourhoods with higher problem levels. |

The priorities differed between intervention neighbourhoods. Interventions, policy measures, actions and agreements differed between the intervention neighbourhoods.

Results

Based on the interventions, policy measures, actions and agreements of the Promising Neighbourhoods program, children's social-emotional skills, delinquency, and safety have improved. The outcomes collected from the surveys at T0 (2018) and T1 (2021) showed a positive impact on children's well-being.

2.7. Measures

The outcome measures were collected using the surveys at T0 (2018) and T1 (2021). Three outcome measures were measured in 0- to 12-year-olds (informal parenting support, outdoor-play and general health) and two in 4- to 12-year-olds (sport club membership and risk of emotional and behavioural difficulties). Subscales and subscale items reflecting the priorities that were set for the intervention neighbourhoods were additionally explored.

2.8. Outcome measures in 0- to 12-year-olds

2.8.1. Informal parenting support

Informal parenting support was measured by the item: ‘Can you talk to your family, friends, acquaintances or neighbours about (problems with) raising your child?’ Answer categories were: Yes often, Yes regularly, Yes occasionally or No hardly ever or Never. This was dichotomized as ‘Yes’ (Yes often, Yes regularly) and ‘No’ (Yes occasionally, No hardly ever, Never). The first category was used as reference.
2.8.2. **Outdoor-play**

Outdoor-play was measured by two items. The first item was: ‘On how many days per week does your child play outdoors?’ Answer categories were: My child did not play outdoors last week, but would usually do that in an ordinary week, Never, 1, 2, 3, 4, 5, 6 or Every day. The second item assessed the time their child usually spends playing outdoors. Answer categories were: Less than half an hour per day, Half an hour to an hour per day, 1–2 h per day, 2–3 h per day or 3 h per day or longer. For both questions we asked parents to base their answer on the past week. We dichotomized these questions to: ‘Outdoor-play for ≥60 min for ≥5 days a week’ or ‘No’. The first category was used as reference.

2.8.3. **General health**

General health was measured by the item ‘How would you describe your child’s general health’ (Very good, Good, Alright, Not very good or Poor); this was dichotomized as ‘Good’ (Very good, Good, Alright) or ‘Poor’. The first category was used as reference.

2.9. **Outcome measures in 4- to 12-year-olds**

2.9.1. **Sport club membership**

Sport club membership was measured by the item ‘How many days per week does your child sports with a club’. Parents were asked to base their answer on the past week. Answer categories were: Never, My child did not do any sports last week, but would usually do that in an ordinary week, 1, 2, 3, 4, 5, 6, or Every day. This was dichotomized as ‘Sports at a sport club for ≥1 day a week’ or ‘No’. The first category was used as reference.

2.9.2. **Risk of emotional and behavioural difficulties**

Risk of emotional and behavioural difficulties was measured using the SDQ (Strengths and Difficulties Questionnaire) which was embedded in the surveys. This is a validated questionnaire to measure risk of emotional and behavioural difficulties and consists of five subscales: emotional problems, conduct problems, hyperactivity, peer-problems and prosocial behaviour (Goodman, 2001; Goodman & Goodman, 2009; Theunissen et al., 2016). We calculated the total difficulties score by adding the scores of all domains except for prosocial behaviour (Cronbach’s alpha = 0.75). We dichotomized the total difficulties score using age dependent cut-offs to either ‘Normal score’ or ‘High risk’ with the normal score as reference category. For 4- to 7-year-olds a cut-off of ≥15 and for 7- to 12-year-olds a cut-off of ≥14 indicates risk of emotional and behavioural difficulties (Goodman, 2001; Goodman & Goodman, 2009; Theunissen et al., 2016). We used the SDQ guidance and Dutch cut-offs for computing the scores and categorized outcomes.

Several subscales and scale items were additionally explored. The subscale emotional problems (Cronbach’s alpha = 0.67) consists of five items about somatic symptoms, worries, feeling unhappy, being nervous in new situations and being anxious. The subscale conduct problems (Cronbach’s alpha = 0.50) consists of five items about tantrums, obeying, bullying, lying, and stealing. Answer categories were: Not true, Somewhat true, or Certainly true. We computed subscale scores by adding the scores of all five items. We dichotomized these scores using age dependent cut-offs to either ‘Normal score’ or ‘High risk’ with the normal score as reference category. A score of 4–10 indicates emotional problems. A score of 3–10 indicates conduct problems (Goodman, 2001; Goodman & Goodman, 2009; Theunissen et al., 2016). We also used the following individual items: anxiety from the subscale emotional problems, tantrums, bullying, and stealing from the subscale conduct problems and being bullied from the peer-problem subscale. These were dichotomized as ‘No’ (Not true) or ‘Yes’ (Somewhat true, Certainly true) with the first category as reference.

2.10. **Covariates**

2.10.1. **Sociodemographic measures**

Age was measured continuously in years. Gender was measured as ‘Boys’ or ‘Girls’ using the first as reference category.

2.10.2. **Socioeconomic status (SES)**

Parental educational level was used as indication of SES and was defined as highest parental educational level obtained and categorized as ‘Higher’ (Higher vocational training, University degree, or Higher) or ‘Lower and intermediate’ (No education, Primary school, ≤4 years general secondary school, >4 years general secondary school or Intermediate vocational training). For the categorization we used the Dutch standard classification of education 2016 which is ISCED-F 2013 (Statistics Netherlands, 2016). The first category was the reference category.

2.11. **Statistical analysis**

Participant characteristics and health outcomes were described at T0 and at T1 for the intervention and comparator neighbourhoods. Differences were tested using chi-square or Mann-Whitney U tests (p < 0.05).

Multiple imputation (m = 5) using a fully conditional specified model (iterative Markov chain Monte Carlo (MCMC) method) based on the relationships between the variables included in this study was used for missing values. Multiple imputation was performed for variables measured for 0-12-year olds (2.1% missing values) and for variables measured for 4-12-year olds (0.6% missing values). We used 5 imputations as the amount of missing values was quite low.

Logistic difference-in-difference regression analysis was used to test intervention effects for the outcomes as well as differences in intervention effects according to SES (parental education). Difference-in-difference regression is a useful technique when randomization on the individual level is not possible. Difference-in-difference regression requires data from pre-/post-program implementation, such as repeated cross-sectional data. The approach removes biases in post-intervention period comparisons between the intervention a group (i.e. neighbourhoods) and comparator group (i.e. neighbourhoods) that could be the result from permanent differences between those groups, as well as biases from comparisons over time in the intervention group (i.e. neighbourhoods) that could be the result of trends due to other causes of the outcome. For the difference-in-difference regression analyses we computed two models. We also visualized the historical time trend assumption using data from 2014 on all outcome variables besides informal parenting support, that was rephrased in the 2018 version. In 2014 a similar Public Health survey as in 2018 was administered by the municipality of Rotterdam. The outcomes in 2014, 2018 and 2021 were plotted in a scatterplot in excel (See Supplemental Figs S1–4). Trends between 2014 and 2018 seem comparable for intervention and comparator neighbourhoods.

In the first model we examined the intervention effect. The coefficient β3 of the interaction term between the condition (intervention or comparator) and time of measurement (T0 or T1) depicts the intervention effect on the outcome. We adjusted for SES (parental education), gender and age. This model can be written as:

$$
\gamma = \beta_0 + \beta_1 \times \text{time of measurement} + \beta_2 \times \text{condition} + \beta_3 \times \text{time of measurement} \times \text{condition} + C \ (SES, \ gender \ and \ age)
$$

The second model examined if the intervention effect differed according to SES (parental education). A three-way interaction between time of measurement, condition and SES (parental education) was added and all possible underlying two-way interactions. We also adjusted for age and gender. In this model β7 is the key-parameter. This model can be written as:
Pooled effect estimates (odds ratios [ORs] and 95% confidence intervals [CIs]) from these five datasets were reported. Two-sided p-values indicated statistical significance (p < 0.05).

Interaction effects between age and the condition were tested (age was dichotomised as 0-9 and 10-12 or 4-9 and 10-12 depending on the outcome variable) in model 2 to check for any differences due to age and none were found (p > 0.05). No further analysis by subgroups of age was needed. We also examined the impact of COVID-19. We checked whether there were significant differences between 2018 and 2021 on the outcome variables and covariates. Further we examined whether parents indicated that they attended less interventions/activities in children aged 0- to 12-year-olds.

Exploratory analyses were performed in the multiple imputed data in a similar way as the main analyses (model 2 and model 3). We repeated our analyses using a complete-case dataset (i.e. without missing values) denoted statistical significance (p < 0.05).

IBM SPSS statistics for Windows, version 25.0 (International Business Machines Corporation, Armonk, New York) was used for all analyses.

### 3. Results

Table 2 shows the characteristics of the study population (Supplemental Table 2 includes missing values and Supplemental Table 3 includes p-values for changes between comparator neighbourhoods at T0 and T1 and for intervention neighbourhoods at T0 and T1). At T0, children in comparator neighbourhoods were on average older than children in intervention neighbourhoods. Further no significant differences at T0 were found. This indicates sufficient comparability between intervention and comparator neighbourhoods. Over time, significantly more parents received informal parenting support in both comparator and intervention neighbourhoods. Outdoor-play significantly reduced over time in comparator neighbourhoods and increased in intervention neighbourhoods.

Table 3 shows the main results. There is an intervention effect of the Promising Neighbourhoods program on outdoor-play. No other intervention effects on the outcomes were found (Model 1). There were no significant different intervention effects for children with a lower or comparator neighbourhood. Further, we examined the distribution of outcomes and covariates across SES (parental education) between intervention and comparator neighbourhoods over time.

### Table 2

| Characteristics of the intervention and comparator neighbourhoods at baseline in 2018 and in 2021. |
|--------------------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| 2018 (n = 984) | Comparator interventions (n =472; 43.4%) | Intervention intervention (n = 557; 56.6%) | p-value for differences at T0 | 2021 (n = 413) | Comparator interventions (n = 243; 58.8%) | Intervention interventions (n = 231; 44.4%) | p-value for differences at T1 |
| Socio-demographic variables | | | | | | |
| Age, continuous | 6.0 (3.0-9.0) | 5.0 (2.0-8.0) | 0.034 | 6.0 (2.8-9.0) | 5.0 (2.0-9.0) | 0.748 |
| Age, dichotomous | 0.027 | | | | | | |
| 0-4 | 132 (30.9%) | 210 (37.7%) | | 59 (34.7%) | 85 (35.1%) | 0.930 |
| 4-12 | 295 (69.1%) | 347 (62.3%) | | 111 (65.3%) | 157 (64.9%) | 0.670 |
| Age, categories | 0.062 | | | | | | |
| 0-4 | 132 (30.9%) | 210 (37.7%) | | 59 (34.7%) | 85 (35.1%) | 0.969 |
| 4-10 | 224 (52.5%) | 254 (45.6%) | | 78 (45.9%) | 118 (48.8%) | 0.251 |
| 10-12 | 71 (16.6%) | 93 (16.7%) | | 33 (19.4%) | 39 (16.1%) | 0.004 |
| Gender | 0.748 | | | | | | |
| Boy | 216 (50.6%) | 276 (49.6%) | | 81 (47.9%) | 116 (47.7%) | 0.004 |
| Girl | 211 (49.4%) | 281 (50.4%) | | 88 (52.1%) | 127 (52.3%) | 0.004 |
| SES | 0.188 | | | | | | |
| Parental education | | | | | | | |
| Higher | 228 (55.6%) | 276 (51.3%) | 104 (61.9%) | 134 (56.3%) | 0.855 |
| Lower and intermediate | 182 (44.4%) | 262 (48.7%) | 64 (38.1%) | 104 (43.7%) | 0.282 |
| Outcomes in 0- to 12-year-olds | | | | | | | |
| Informal parenting support | 0.108 | | | | | | |
| Yes | 238 (56.3%) | 340 (61.4%) | 118 (69.8%) | 171 (70.7%) | 0.967 |
| No | 185 (43.7%) | 214 (38.6%) | 51 (30.2%) | 71 (29.3%) | 0.004 |
| Outdoor-play | 0.281 | | | | | | |
| Yes | 168 (41.6%) | 232 (45.1%) | 49 (31.0%) | 103 (45.8%) | 0.282 |
| No | 236 (58.4%) | 282 (54.9%) | 109 (69.0%) | 122 (54.2%) | 0.282 |
| General health | 0.815 | | | | | | |
| Good | 389 (92.0%) | 509 (91.5%) | 163 (95.9%) | 227 (93.4%) | 0.282 |
| Not good | 34 (8.0%) | 47 (8.5%) | 7 (4.1%) | 16 (6.6%) | 0.282 |
| Outcomes in 4- to 12-year-olds | | | | | | | |
| Sport club membership | 0.764 | | | | | | |
| Yes | 164 (56.7%) | 190 (55.6%) | 65 (59.1%) | 80 (51.6%) | 0.228 |
| No | 125 (43.3%) | 152 (44.4%) | 45 (40.9%) | 75 (48.4%) | 0.142 |
| Risk of emotional and behavioural difficulties | 0.967 | | | | | | |
| Yes | 257 (88.9%) | 302 (88.8%) | 102 (92.7%) | 135 (87.1%) | 0.142 |
| No | 32 (11.1%) | 38 (11.2%) | 9 (7.3%) | 20 (12.9%) | 0.142 |

P-values computed using chi-square for categorical variables and Mann-Whitney U tests for continuous variables. **Bold** indicates a significant difference between intervention and comparator neighbourhoods (i.e. p < 0.05).
Model 2 is adjusted for age (continuous) gender (ref = boy) and parental education (ref = high), and includes a two-way interaction of time of measurement*condition, time of measurement*parental education, condition*parental education and a three-way interaction of time of measurement*condition*parental education.

Table 3
Logistic difference-in-difference regression analyses.

|                          | Informal parenting support | Outdoor-play | General health | Sport club membership | Risk of emotional and behavioural difficulties |
|--------------------------|----------------------------|--------------|----------------|-----------------------|-----------------------------------------------|
|                          | 0- to 12-year-olds         | 0- to 12-year-olds | 0- to 12-year-olds | 4- to 12-year-olds | 4- to 12-year-olds |
| OR (95% CI)              | OR (95% CI)                | OR (95% CI)  | OR (95% CI)    | OR (95% CI)           | OR (95% CI)                                    |
| for N = 1,397            | for N = 1,397              | for N = 1,397 | for N = 896    | for N = 896           |                                               |

Model 1
Two-way interaction parameter estimates (intervention condition in 2021)
1.25 (0.66, 2.36) 0.61 (0.37, 0.99) 1.55 (0.56, 4.34) 1.18 (0.71, 1.97) 1.95 (0.72, 5.33)

Model 2
Three-way interaction parameter estimates (difference in inequalities for the intervention condition in 2021)
0.59 (0.16, 2.09) 0.96 (0.34, 2.68) 0.82 (0.10, 6.57) 0.41 (0.14, 1.16) 0.95 (0.11, 8.05)

An odds ratio <1.00 indicates a favourable change in the outcome. Bold indicates statistical significance p < 0.05. Model 1 is adjusted for age (continuous), gender (ref = boy) and parental education (ref = high), and includes a two-way interaction of time of measurement*condition. Model 2 is adjusted for age (continuous) gender (ref = boy) and parental education (ref = high) and includes two-way interactions of time of measurement*condition, time of measurement*parental education, condition*parental education and a three-way interaction of time of measurement*condition*parental education.
Finally, it could be that the Promising Neighbourhoods program was not delivered as intended beforehand (Mitchell et al., 2002; Stith et al., 2006). However, the likelihood of demonstrating population level change of collaborative community-based programs can be challenging because of the complexity, context and specific features that make it difficult to use traditional evaluation methods (Lissey et al., 2015). Contextual factor associated with the effectiveness can differ between communities (Lissey et al., 2015). A thorough process evaluation, taking into account the logic model that was set up for this evaluation, will shed more light on the implementation and increase our understanding of barriers and facilitators for the implementation of community-based programs (Dickerson et al., 2019; Evans et al., 2015).

5. Methodological considerations

During the implementation of the Promising Neighbourhoods program in 2019 COVID-19 became a global pandemic. Due to the COVID-19 pandemic, interventions were cancelled, postponed or continued as online intervention. COVID-19 could have influenced the outcome measures in both intervention and comparator neighbourhoods but it may be possible that the effects turned out differently in intervention and comparator neighbourhoods. Moreover, our results regarding the effectiveness of the Promising Neighbourhoods program may not be generalizable to a situation without COVID-19.

Our study has several strengths. For the current analysis we not only studied the effect of the Promising Neighbourhoods program in intervention neighbourhoods compared to comparator neighbourhoods but also whether differences between children with a lower and a higher SES reduced as a consequence of the program. We used a difference-in-difference approach, which is a suitable technique to study effects of such community-based programs. Risk of emotional and behavioural difficulties was measured using the SDQ, which is a validated questionnaire (Goodman, 2001; Goodman & Goodman, 2009; Theunissen et al., 2016). We conducted several additional analyses that are similar to our main findings.

Several limitations of our study need to be taken into consideration when interpreting the findings. First, contamination between the intervention and comparator neighbourhoods could have occurred. For example, when parents and their children moved from an intervention to a comparator neighbourhood or vice versa. Children and/or parents from comparator neighbourhoods could also attend schools in the intervention neighbourhoods and benefit from implemented interventions. Some intervention and comparator neighbourhoods are in close proximity of each other (See also Fig. 1). This could have influenced the findings of our evaluation. We unfortunately do not have data to check whether this could have been the case. Second, it could be that there were interventions implemented in the comparator neighbourhoods. This could lead to null findings but is inherent to the design of a collaborative community-based program in the real world. For example, community stakeholders in one comparator neighbourhood started themselves with common programming. We have performed the analyses also using this comparator neighbourhood. However, the results were similar. Third, we used parental education as an indicator of SES in our analyses. Other indicators of SES might have yielded different results. The risk of a low income is the highest if the main breadwinner of the family attained lower education. Rotterdam is the city with the highest percentage of households living in poverty in the Netherlands (Statistics Netherlands, 2021). Rotterdam is a city with relatively lower educated inhabitants (i.e. lower 31%, middle 38%, and higher 31%) compared to the average in the Netherlands (i.e. lower 28%, middle 42% and higher 30%) (Municipality of Rotterdam, 2021). This indicates that educational level is related to a low income. However, it could be that we miss SES differences by only looking at differences between lower and higher educated participants. Fourth, the sample size for 4-to 12-year-olds at follow-up was somewhat lower than needed to detect small effect sizes. Fifth, only the SDQ was a validated measure. We cannot be sure that the other outcome measures (i.e. informal parenting support, outdoor-play, general health, sport club membership) measure what they intend to measure or if they are able to measure change (or change across SES). We selected these outcome measures because they matched the priorities that were chosen. For some of the priorities no suitable outcome measure (i.e. youth criminality) was present. Finally, this study took place in neighbourhoods of a large Dutch city. Findings may not be generalizable to other settings such as neighbourhoods in smaller cities, rural areas or other countries.

5.1. Future research

For the evaluation of Promising Neighbourhoods and comparable programs more follow-up measurements or a longer follow-up period is warranted as intervention effects might need a longer implementation period. The effectiveness in older youth still needs to be evaluated.

Several key actions for successful health promotion programs have been reported by Jackson et al. (2006). Collaborative community-based programs like Promising Neighbourhoods include many of these key actions in their design. Perhaps, these key-actions currently were not or not yet adequately incorporated or not sufficiently addressed in the Promising Neighbourhoods program for the program to be effective. Key actions such as intersectoral collaboration and interorganizational partnerships or community participation might just need more time to establish and become effective. It is also possible that there are other key actions needed for effective collaborative community-based programs that have not yet been identified in the study by Jackson et al. (2006). Future research to community-based programs is warranted to provide these necessary insights.

Further, by additionally studying the implementation process of such programs from other perspectives such as interviews with policymakers or content analyses of policy documents will provide more insights in underlying mechanisms. Taking into account the context and how children/families experience the implementation of collaborative community-based programs like Promising Neighbourhoods could also provide relevant insights.

Information on the cost-effectiveness of the Promising Neighbourhoods program and similar programs would further inform local health promotion policies and needs further research.

6. Conclusion

The findings of this study indicate a positive intervention effect for one of the outcomes in 0- to 12-year-olds. Further mixed-methods evaluation research and using longer periods between measurements are needed to examine the value of these type of programs. Further development of Promising Neighbourhoods seems warranted.

Ethics

The medical ethics committee of the Erasmus University Medical Center Rotterdam declared the Medical Research Involving Human Subjects Act does not apply and issued a declaration of no objection for this study (MEC-2018-1506). Parents received information about the study and could refuse participation by not filling out the survey.

Declaration of competing interest

The authors have no conflict of interest relevant to this article to disclose.

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Availability of data and materials
Data used for the T0 measurement in 2018 were obtained from a Dutch Public Health survey carried out in 2018 by the municipal public health service in the city of Rotterdam (Gezondheidsmonitor Kinderen GGD Rotterdam-Rijnmond). The data are protected by the Municipal Health Service of Rotterdam. Data are available under request via: gezon dheidsmonitorbc@rotterdam.nl. Data used for the T1 measurement is available upon request from the corresponding author.

CRediT authorship contribution statement
Mirte Boelens: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft. Hein Raat: Conceptualization, Writing – review & editing, Supervision, Funding acquisition. Harrie Jonkman: Writing – review & editing, Funding acquisition. Clemens M.H. Hosman: Writing – review & editing, Funding acquisition. Denis Wiering: Writing – review & editing. Wilma Jansen: Conceptualization, Writing – review & editing, Supervision, Funding acquisition.

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Appendix A. Supplementary data
Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssmph.2022.101166.

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