ORIGINAL ARTICLE

# The impact of a social network based intervention on self-management behaviours among patients with type 2 diabetes living in socioeconomically deprived neighbourhoods: a mixed methods approach

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## Abstract

*Aims:* This paper aims to explore the effect of the social network based intervention *Powerful Together with Diabetes* on diabetes self-management among socioeconomically deprived patients. This 10-month group intervention targeting patients and significant others aimed to improve self-management by stimulating social support and diminishing social influences that hinder self-management. *Methods*: This intervention was evaluated in a quasi-experimental study using a mixed methods approach. Of 131 socioeconomically deprived patients with suboptimal glycaemic control, 69 were assigned to the intervention group and 62 to the control group (standard diabetes education). 27 qualitative in-depth interviews with the participants and 24 with their group leaders were held to study the subjective impact of the intervention. Further, self-management behaviours (medication adherence, diet and physical activity) were assessed at baseline, 10 and 16 months. Data were analysed using framework analyses and a linear mixture model. *Results*: Qualitative data showed that the intervention group had a better understanding of the way self-management influences diabetes. The intervention group showed more complex self-management behaviours, such as planning ahead, seeking adequate food and physical activity alternatives, and consistently taking their diabetes into consideration when making choices. In participants with complete follow-up data, we found a significant increase in physical activity in the intervention group (3.78 vs. 4.83 days) and no changes in medication adherence and diet. ***Conclusions*: This study indicates that an intensive support group and simultaneously involving significant others might improve diabetes self-management behaviours among socioeconomically deprived patients. More studies are needed to justify further implementation of the intervention.**
This study is registered in the Dutch Trial Register NTR1886. http://www.trialregister.nl/trialreg/admin/rctview.asp?TC=1886

*Key Words:* diabetes self-management, socioeconomically deprived neighbourhoods, type 2 diabetes, social network, social influences and social support

## Background

People in lower socioeconomic groups are disproportionally affected by type 2 diabetes and its complications [1]. The poorer glycaemic control related to less-adequate self-management behaviours partly accounts for these increased risks [2,3]. Coping with type 2 diabetes requires extensive self-management skills: adherence to dietary advice and medications, engaging in regular physical activity, quitting smoking and prevention or treatment of hypoglycaemia [4]. However, compliance with and maintaining such

complex health regimens is especially challenging for socioeconomically deprived patients due to their lower health literacy, low knowledge of blood glucose targets and lower self-efficacy [3, 5–7].

Interventions that focus on self-management behaviours seem to contribute to short term-glycaemic control, even among socioeconomically deprived patients, but long-term sustainable effects are scarce [8–11]. Socioeconomically deprived patients seem to experience difficulties with maintaining newly learned behaviour after participating in an intervention.

Interventions that target social influences on self-management behaviours might be promising in terms of sustainability of the desired behaviour change. Social interactions with friends and family members have a major impact on self-management. Social support can positively influence self-management, but significant others can also hinder self-management by nagging about or paying too much attention to self-management [12] Socially deprived patients seem to have fewer sources of social support in their social environments and often receive insufficient social support, which is needed to improve adherence [6, 13, 14]. In addition, they are often confronted with social influences from their immediate social environments that hinder self-management (e.g. peer pressure, specific cultural beliefs and expectations, and fewer positive role models) [11, 15].

These patients might benefit from an intervention focusing on social support and social influences on self-management. To the best of the authors' knowledge there are no interventions that focus on social support and hindering social influences at the same time. Therefore, *Powerful Together with Diabetes* (PTWD) was developed and focused on increasing social support for self-management and decreasing social influences that hinder self-management to improve self-management behaviours.

Further, our needs assessment showed that patients from socioeconomically deprived groups have specific educational needs that need to be targeted [unpublished], such as low motivation and low outcome expectations regarding education, difficulties with remembering new information, a low priority for diabetes self-management (DSM), a desire for practical information, reading and writing difficulties, and differences in knowledge about diabetes. This is confirmed by an increasing number of studies that recognize these groups might need interventions that go much further than traditional diabetes education regarding time, costs, effort and interactions with professionals [10, 11].

Based on this needs assessment, the intervention was specifically targeted to patients from socioeconomically deprived neighbourhoods, and culturally targeted to the Dutch, Turkish, Moroccan and Surinamese patients in this group. It lasted 10 months and was delivered as group based.

In the evaluation of this intervention we use a mixed methods approach. We adjusted our research methods to our target population. Previous studies show that socioeconomically deprived patients often have difficulties understanding and filling out questionnaires. Other questionnaire formats (e.g. open questions) might be more suitable [16].

Further, existing questionnaires often focus on self-management to explain potential differences in metabolic control. This might be useful to explain changes in glycated haemoglobin (HbA1c), but might also limit the possibility to study other changes in self-management that might provide important starting points to understand the effects of an intervention. Therefore, we chose a broader evaluation of this intervention by using both qualitative and quantitative methods.

This paper reports on the effects of this intervention on medication adherence, diet and physical activity. To study these changes, we used both qualitative and quantitative data.

## Methods

The PTWD intervention was evaluated in a quasi-experimental study with a control group that received a standard group based educational intervention. The design is described elsewhere [17]. As the intervention required the participants to live close to each other and the recruitment of participants proved to be difficult, (cluster) randomization was impossible. The intervention and control groups were matched on gender, ethnicity and organization of diabetes care in the General Practitioner (GP) practice. The main outcome measures were HbA1c, collected from participants' medical files, and quality of life.

The intervention group followed PTWD and the control group followed *Know Your Sugar* (KYS) This study was approved by the Medical Ethics Committee of the Academic Medical Centre (AMC) in Amsterdam and is registered in the Dutch Trial Register NTR1886.

Patients were selected from the records of 39 general practices in socioeconomically deprived neighbourhoods in four Dutch cities when they met the following criteria: age ≥ 35 years, type 2 diabetes for ≥ 1 year, suboptimal glycaemic control (HbA1c > 53
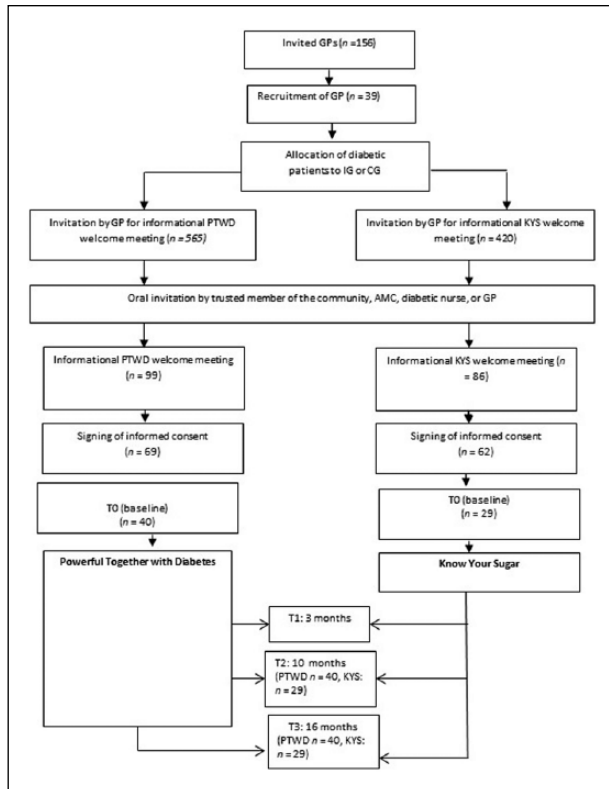
Figure 1. Flow of the Diabetes in Social Context Study with regard to diabetes self-management measures.
PTWD, *Powerful Together with Diabetes*; KYS, *Know your Sugar*; GP, general practitioner; AMC, Academic Medical Centre

mmol/mol). Excluded were patients with severe psychiatric disorders, those unable to come to the intervention location or those planning to stay abroad for ≥ 6 weeks during the intervention period [17]. All the potential participants that fit the eligibility criteria were invited to an information meeting by a letter from their GP. As an incentive, this letter contained a lottery ticket with which the potential participants could win a gift certificate (20 euros) when attending the information meeting. After this meeting, they decided on participation and provided written or oral consent (Figure 1).

*The intervention and control groups*

Both interventions were conducted in groups with 7–10 participants, guided by a trained group leader and culturally targeted to Dutch, Surinamese, Turkish and Moroccan patients [17].

*PTWD: Intervention group.* The intervention PTWD was developed according to intervention mapping [18]. It lasted 10 months and consisted of 24 group meetings for participants, six group meetings for

their significant others and two social network therapy sessions in which both the participant and a significant other were present. The intervention was group based, with 10 participants per group. Each group was guided by a group leader.

The intervention aimed to improve DSM by increasing knowledge, positive outcome expectations, self-efficacy and skills associated with DSM. As our needs assessment showed that the social environment of patients influences these determinants and plays an important role during self-management, important intervention objectives were to get the participants to support and positively influence each other to better manage their diabetes, to handle social influences that hinder self-management and to engage relatives and friends more in self-management [19].

Further, the intervention strategies were tailored to socioeconomically deprived patients. A key aspect of the intervention was the underlying group process. The participants were addressed as a (learning) group, and learned and practised all the new behaviours and coping strategies together to stimulate social support, be more receptive to learning and make learning more fun. The group leaders used an inductive educational approach (the participants practiced with a problem while the group leader added information and theory to their understanding if necessary) to increase curiosity and tailor the information to the participants' needs. Particular attention was paid to recognizing and dealing with influences on self-management in the immediate social environment (peer pressure, social norms).

Further, non-traditional intervention strategies were used, such as games, quizzes, role playing, skills training with guided practice and (fun or relaxing) energizers to optimize the attention span. To ensure a close connection to their interests, the group leaders actively involved participants in the intervention through active learning. A limited amount of information was provided at each meeting and information from previous meetings was repeated (Boxes 1 and 2).

PTWD was realized in 10 groups from August 2010 through December 2011. All the groups finished the intervention, except for the Moroccan male group which ended due to lack of motivation among the participants.

*KYS: Control group.* In the Netherlands, standard education for patients with type 2 diabetes consists of information and education about type 2 diabetes and self-management from the GP, GP assistant or

Box 1. Program components: phase 1 of the newly developed intervention *Powerful Together with Diabetes*.

**Review of the last meeting and exchange of experiences: 10–15 min**
At the start of each meeting, the group leader discusses how the period since the last meeting has been experienced and how the participants worked on their homework. The participants were stimulated to ask questions, exchange experiences and help each other with their homework.

**Collection of questions: 5–10 min**
To guarantee that the meeting fits the needs of the participants, the group leaders start with a short description of the meeting and write down the participants' questions on this topic. At the end of the meeting, the group leader checks whether all questions have been addressed.

**Sharing positive news: 5 min**
To make participants more open for new information, they share their positive news of the week with each other (self-affirmation). This news could be anything, as long as it was experienced as being positive by the participant.

**Diabetes game: 15–35 min**
Many meetings contained a knowledge game. The participants participate in a quiz or a game, often teaming up and competing with each other. The group leader provides only the information that participants asked for themselves. The aim is to provide participants only with information that they need, and prevent giving an overload of information. The information provided was supported by large-sized posters/visual aids on diabetes-related topics.

**Nutrition game: 60 min**
The participants were divided in groups and given plastic cards with photographs of dishes and foodstuffs, divided into breakfast, dinner, lunch, snacks, beverages and others. Each card could be placed on one of three piles: green (eat as often as you like), orange (eat to a limited extent) and red (try to avoid, eat very rarely). The assignment was to place these cards on the appropriate pile; this was followed by discussing with each other the placing of the cards.

**Letter of the week: 20–45 min**
The "letter of the week" is a fictional letter received from someone with diabetes who has a problem that needs to be solved. The participants were invited to brainstorm together about the problem and help solve the problem. The letter of the week was used to uncover tacit views of participants and provide them with solutions that they could also apply themselves.

**Role playing: 20 min (on average)**
Every meeting contained a role-playing exercise in which the participants practised a difficult situation together. The participants could also provide role-playing scenarios themselves (e.g. difficult situations they were personally confronted with). Each exercise ended with the exchange of advice and tips and tricks the participants could use in their own situations.

**Energizers: 5–15 min**
Energizers included passing a ball along and giving the person who receives the ball a compliment, balancing on a balloon to feel all the muscles in the body, playing "web of life" (a game illustrating that we need each other), keeping a balloon up in the air, etc. The aim of these energizers is to stimulate bonding between group members and refresh the participants to enable them to absorb new information again.

**Exercising with participants: 30 min**
To show the participants how to exercise for 30 min and let them experience this, group leaders walk with the participants in the neighbourhood (i.e. the participant's own neighbourhood) for 30 min of each meeting . The group leaders were instructed to walk among the participants, so that they could talk to everyone.

**Weighing pros and cons: 15–20 min**
To change outcome expectations, participants brainstorm with each other about the pros and cons of certain behaviours (e.g. refusing food at a party). This is achieved through group discussions, sometimes using a whiteboard to count the pros and cons. The group leader aims to emphasize the pros to stimulate positive outcome expectations.

**Homework**
The participants received homework at the end of each meeting. They were encouraged to pay attention to certain things (e.g. are there times when you smoke more than usual), or to try to meet up with individual participants outside the group meetings.

**Cook book**
The recipes of all the participants were collected and complied as a cook book and given to participants during the intervention. The cook book also contained information about choosing healthy ready-to-eat meals for participants who did not cook.

**Summarizing the results and complimenting participants: 10 min**
To help participants feel they have spent their time well, helped each other and have learned a lot, at the end of each meeting the group leader summarizes what the participants have learned. Group leaders also tell the participants how proud/appreciative they are of all their achievements.

diabetic nurse. Further, patients are advised to quit smoking, to exercise regularly, to lose weight when they have a body mass index > 25 kg/m² and to eat healthily, for which they are referred to a dietician [20]. KYS aimed to provide the participants with the information they needed to manage their diabetes, based on the standard education in the Netherlands as described here. KYS lasted six weeks and consisted of six group meetings of two hours. The groups consisted of a maximum of ten participants.

KYS was realized in nine groups (each being offered six meetings) from January 2011 through to November 2011. The intervention took place in a community centre. The groups were led by group leaders (see below). All the groups finished the intervention; however, the Moroccan male group did not start due to a lack of interest among the potential participants. Though it provided the participants with the opportunity to get to know other patients, to influence each other and to exchange

Box 2. Program components: phase 2 of the newly developed intervention *Powerful Together with Diabetes*.

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**Homework**

In phase 2, the participants' homework consists of keeping diaries, working on behavioural goals and staying in contact with each other in the weeks without an intervention meeting.

**Keeping a diary**

For this intervention, special diaries were developed. They consisted of an outline of each day, which participants were asked to fill in: for this purpose, participants could use stickers, drawings or, if possible, writing. For example, for smoking there were stickers showing cigarettes, for physical activity stickers with a '10' (for 10 min) and stickers of different colours were used for various medications. The nutrition diaries could be filled in by writing or with a drawing.

**Group exercise: 30–45 min**

The group exercises consisted of assignments the participants were asked to do in small groups (about three participants). The aim was to let the participants practice and ask each other for feedback in a non-threatening environment, before sharing their experiences in the group. The exercises also aimed to make clear what the participants were struggling with, and provide group leaders with guidelines for further explanations.

**Action plan**

The action plan comprised six parts: it contained many pictures and consisted of outlines the participants had to fill in. Participants who could not write were teamed up with someone that could. The participants were not given all the parts of the action plan at once, to prevent them from getting discouraged. They were given a portfolio in which they added a part of their action plan each meeting; in this way, they were not confronted with all the work they still had to do, but could see their work growing.

Part 1: Choosing a behavioural goal, making it specific, determining who could help with this goal and thinking of a reward when achieving this goal.

Part 2: Determining two important barriers to achieve the behavioural goal (some of the barriers were already mentioned in the action plan for the participants to mark). For each barrier, the participant had to create five solutions (with group members).

Part 3: Determining important barriers in the immediate social environment to achieve the behavioural goal and thinking of solutions.

Part 4: Thinking about ways significant others can help with diet, physical activity, taking medications, monitoring of blood glucose and quitting smoking or smoking less.

Part 5: Updating the action plan according to keeping a diary and comparing this diary with the one filled out at the start of phase 2.

Part 6: Determining risky situations in the near future (the coming 2 weeks) and making plans to overcome these risky situations.

Part 7: Determining two new risky situations in the near future (the coming 2 weeks) and making plans to overcome these risky situations.

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social support, it did not specifically target these determinants or intervene in the immediate social environments of the participants.

Both interventions were guided by different group leaders who were matched with the participants based on ethnicity and gender. The group leaders were recruited through an advertisement and selected based on their prior experience with group-based education. The group leaders of the Dutch PTWD and KYS groups were diabetic nurses, GP assistants and physician assistants. The group leaders of the Moroccan, Turkish and Surinamese PTWD and KYS groups were lay health educators. Prior to the intervention, the group leaders of the intervention group received an eight-hour training and the group leaders of the control group a two-hour training. Both trainings focused on the implementation of the intervention. They differed in length due to the length (10 months) and complexity of PTWD.

### Study design of this paper

This paper reports on the data of the secondary outcome measures: medication adherence, diet and physical activity. We used both qualitative and quantitative data to explore the effects of the intervention on these self-management behaviours, using a mixed methods approach [21]. Firstly, we explored what effects on self-management were reported by participants. Then, we checked if we could confirm these findings quantitatively.

### Part 1: Qualitative study

*Recruitment of participants.* In-depth semi-structured qualitative interviews were held with the participants from the intervention and control groups, and with the group leaders between January 2011 and January 2012. As this study population is hard to reach, the group leaders were asked to select and invite the respondents. We asked them to invite two participants that had been attending the intervention regularly and who had significant others that also participated in the intervention.

In total, 27 participants agreed to be interviewed: 17 participants from eight intervention groups (11 Dutch, two Turkish women, two Moroccan men and two Surinamese) and 10 participants from six control groups (seven Dutch, two Moroccan women and

Table I. Background characteristics of the participants in this study.

| | Quantitative study (n=131) | | Qualitative study (n=27) | |
| --- | --- | --- | --- | --- |
| | Intervention group (n=69) | Control group (n=62) | Intervention group (n=17) | Control group (n=10) |
| **Age in years (SD)** | 61.15 (10.4) | 62.3 (9.9) | 60.5 (7.86) | 62.9 (10.94) |
| **Gender** | | | | |
| Female | 66.1% | 69.8% | 73.3% | 77.8% |
| **Total household income per month** | | | | |
| €454–€1,270 | 34.8% | 46.8% | 18.8% | 30% |
| €1,270–€1,906 | 30.4% | 25.8% | 37.5% | 40% |
| More than €1,906 | 10% | 9.7% | 31.3% | 20% |
| Would rather not say | 24.6% | 17.7% | 12.5% | 10% |
| **Ethnicity** | | | | |
| Ethnic Dutch | 40.6% | 27.4% | 47% | 50% |
| Surinamese | 11.6% | 32.3% | 23.5% | 30% |
| Turkish | 10.1% | 16.1% | 11.8% | 0% |
| Moroccan | 15.9% | 6.5% | 11.8% | 20% |
| Other | 8.7% | 9.7% | 5.9% | 0% |
| Missing | 13% | 8.1% | 0% | 0% |
| **Education** | | | | |
| No formal education/primary education | 50% | 52.6% | 37.6% | 30% |
| Lower secondary vocational education or preparatory secondary vocational education | 20.3% | 21.1% | 25% | 30% |
| **How would you describe the state of your diabetes?** | | | | |
| Very good | 5% | 4.4% | 33.3% | |
| Good | 36.7% | 40.4% | 46.7% | 55.6% |
| Reasonable | 40.0% | 44.4% | 13.3% | 44.4% |
| Poor | 13.3% | 11.1% | | |
| Very poor | 5% | 0% | | |
| **HbA1c at baseline % (SD)** | 7.80 % (1.1) | 7.95 % (1.7) | 7.6% (0.63) | 7.6 % (0.88) |
| **Duration of diabetes in years (SD)** | 8.36 (8.0) | 11.65 (10.2) | 8.23 (6.2) | 10.3 (6.2) |

SD, standard deviation.

one Surinamese). Of the participants, 11 refused to participate. They lacked the time to participate, were on holiday or felt they had spent enough time on the study procedures (filling out questionnaires and the physical exam). These respondents broadly reflected the wider trial population in terms of age, gender, duration of diabetes and glycaemic control (Table I). Each interview lasted on average 40–60 min.

The response among group leaders (*n* = 15) was 100%. The group leaders of the control group (*n*=6) were interviewed once. The group leaders of the intervention group (*n*=9) were interviewed twice to prevent memory bias that might be caused by the length of the intervention, during the intervention and after the intervention. The interviews lasted on average 60–90 minutes each.

*Data collection.* All the interviews took place at the respondents' homes or, if preferred by the respondents, at the intervention location (a community centre). The interviews were conducted by C.V. and M.J.E.K. with the help of an interpreter (Turkish interviews) or a Moroccan interviewer who had received training prior to the data collection. The Moroccan interviewer met the respondents before and during the other study procedures. The respondents met C.V. and M.J.E.K. during the observations in the intervention. Also, C.V. and M.J.E.K. had regular contact with the group leaders during the implementation of the intervention. The interviewers introduced themselves with little background information and emphasized they had no competing interest while conducting the interviews. They focused their introduction on wanting to evaluate the intervention and wanting to hear all (both positive and negative) experiences with the intervention.

All the interviews were supported by a topic guide and audiotaped, with the respondents' consent. Relevant topics for the participants included experiences with the intervention, and changes in self-management behaviours. Relevant topics for the group leaders included experiences with the intervention, and changes in self-management behaviours among the participants in their groups (Addenda 1 and 2).

**Addendum 1**

*Topic List: Participants*

1. How did you experience the intervention?
   a. Recruitment process?
   b. Group meetings?
   c. Meetings for significant others?
   d. Network meetings?
2. What did you like most? Why?
3. What did you like less? Why?
4. Would you recommend the intervention to other people?
5. Social network meetings?
   a. What was discussed?
   b. Experiences?
6. Meetings for significant others?
   a. How were significant others introduced?
   b. What was their reaction?
7. Group leader?

*Experienced effects*

1. What have you learned?
2. What effect do you think the intervention has had on you?
   a. On your diabetes? What? How did this happen?
   b. On your body? What? How did this happen?
   c. Diabetes self-management? What? How did this happen?
   d. Other things? What? How did this happen?
   e. Where do you think that comes from? What has contributed the most to this?

*Dealing with difficult situations*

1. How did you deal with difficult situations before the intervention?
2. How do you deal with difficult situations now?
3. What do you think about these changes?
4. How do you think these changes occurred? How exactly did you learn that?
5. What could be improved about the way you deal with difficult situations?
6. What do you need for this?

*Contact with group members*

1. What sort of contact did you have with your group members?
   a. How did you experience this?
   b. What did you like/not like?
   c. Do you still see some of the people in your group?
2. Did you make friends during the intervention?

a. With whom?
b. How did that happen?
c. What does this friendship involve?
d. What activities do you do together for diabetes self-management (support, movement, eating)?
e. Do you think you will continue to see each other in the future?
3. You did not make friends: why not? A need for friends? What do you need to make new friends?

*Family and friends*

1. Did your significant other participate in the intervention? What did they think about it?
2. How can you tell that they participated in the intervention?
3. How did they deal with your diabetes before they participated in the intervention?
4. How do they deal with your diabetes now?
5. How do they do that now? Has anything changed? How did this happen? What role did the intervention play?

**Addendum 2**

*Topic list: Group leaders*

1. In general, how did you experience the intervention?
2. How did your participants do during the intervention (discussion of each participant)?
   a. Experiences
   b. Goals they worked on
   c. Changes in participants during the intervention
   d. Social interactions between participants
   e. Which participants did/did not benefit from the intervention and why
3. What was your role in creating the group feeling (adequately promoted? how?)
4. Did you feel that you had sufficient knowledge (e.g. own experience, training, and support from AMC) to carry out the intervention?
5. Experience with the manual (understandable? adequate/not adequate? what could be improved?)
6. Experience with the organization by AMC (availability of material, location, facilities)
7. Facilitators and barriers during implementation? How did you handle these? Do you think sufficient action was taken?
8. What were successful/unsuccessful elements of the interventions? Why?

*Analysis.* Analysis of the interviews with the participants was done by three researchers using

Box 3.  Questions on diabetes self-management.

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**Diet**
How many of the last SEVEN DAYS have you followed a healthful eating plan?
0 1 2 3 4 5 6 7
On average, over the past month, how many DAYS PER WEEK have you followed your eating plan?
0 1 2 3 4 5 6 7
On how many of the last SEVEN DAYS did you space carbohydrates evenly through the day?
0 1 2 3 4 5 6 7
On how many of the last SEVEN DAYS did you eat five or more servings of fruits and vegetables?
0 1 2 3 4 5 6 7
On how many of the last SEVEN DAYS did you eat high fat foods such as red meat or full-fat dairy products?
0 1 2 3 4 5 6 7
**Exercise**
On how many of the last SEVEN DAYS did you participate in at least 30 minutes of physical activity? (Total minutes of
continuous activity, including walking.)
0 1 2 3 4 5 6 7
On how many of the last SEVEN DAYS did you participate in a specific exercise session (such as swimming, walking, biking)
other than what you do around the house or as part of your work?
0 1 2 3 4 5 6 7
**Medications**
On how many of the last SEVEN DAYS did you take your recommended insulin injections?
0 1 2 3 4 5 6 7
On how many of the last SEVEN DAYS did you take your recommended number of diabetes pills?
0 1 2 3 4 5 6 7

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MAXQDA [22]. The first coding was done by C.V. and checked by M.J.E.K.; consensus was reached by discussion. Another researcher (M.A.H.) who was blinded for the intervention or control group, randomly checked their coding to preclude bias.

We constructed an initial conceptual framework based on the self-management behaviours targeted by the intervention (medication adherence, physical activity and diet). The data were coded according to this framework [23]. To determine whether the intervention's general objectives had been achieved, the interviews were searched for patterns regarding the subgoals. When a pattern was found in one group, the researchers tried to find the same pattern in the other group as well. When patterns, or differences in patterns, were found only in the intervention group, they were considered to be an indication that these patterns had been caused by the intervention of PTWD.

The interviews with the group leaders were used to check and consolidate the findings that emerged from the interviews with the participants through data triangulation [24]. After determining the relevant patterns in the interviews with the participants, we checked if these findings could be confirmed by the interviews with the group leaders.

*Part 2: Quantitative study*

*Data collection.*  A structured questionnaire was administered at baseline, 10 and 16 months [17]. The questionnaire consisted of existing questionnaires that were validated among this target population or a population related to the target population. The questionnaire was administered in the mother tongue of the participants (Dutch, Turkish, Berber or Moroccan Arabic). As an incentive, the respondents were offered a grocery voucher (10 euros) for participation in the 10 and 16 month measurements.

DSM was measured using the Summary of Diabetes Self-Care Activities Measure (SDSCA) which covers the following behaviours: (a) medication adherence (two questions), (b) diabetes-specific diet (three questions), (c) general diet (two questions) and (d) physical activity (two questions) [25]. Respondents could assess their adherence to self-management skills for each item on a scale ranging from 0–7 days in the previous week and, for one question on diet, also the average days per week in the previous month (Box 3). We excluded questions on insulin injections, foot care and smoking because not everyone in the intervention used insulin and foot care or smoked, and none of these were the main focus of the intervention.

Educational level was indicated by the highest educational level attained, using nine categories ranging from no formal education/primary education to scientific/university education. Total household income consisted of the summed income of every member of the household after the deduction of taxes. Ethnicity was established by asking the respondents for their own country of birth, and that of their father and mother. Respondents who were born in the Netherlands and whose parents were both born in the Netherlands, were assumed to be of Dutch origin. A subjective assessment of the diabetes status was measured using five categories ranging

Table II. Characteristics of study participants included and excluded from analyses per intervention arm.

| | Intervention group (*n*=69) | | Control group (*n*=62) | |
|---|---|---|---|---|
| | Included in analysis (*n*=40) | Excluded from analysis (*n*=29) | Included in analysis (*n*=29) | Excluded from analysis (*n*=33) |
| **Age in years** | 60.7 (10.0) | 61.5 (10.6) | 64.3 (8.8) | 57.4 (9.8) |
| **Gender (%)** | | | | |
| Female | 67.5 | 62.1 | 55.2 | 72.7 |
| **Income (%)** | | | | |
| €454–€1270 | 27.5 | 34.5 | 41.4 | 45.6 |
| €1270–€1906 | 32.5 | 6.9 | 38 | 21.2 |
| Higher than €1906 | 32.5 | 10.3 | 10.3 | 9 |
| Unknown | 7.5 | 48.3 | 10.3 | 24.2 |
| **Education (%)** | | | | |
| No education/primary education | 41 | 59.1 | 41.4 | 51.9 |
| Lower vocational education | 23.1 | 18.2 | 27.6 | 18.5 |
| **Ethnicity (%)** | | | | |
| Ethnic Dutch | 40 | 41 | 44.8 | 12 |
| Surinamese | 20 | 0 | 34.5 | 30 |
| Turkish | 12.5 | 7 | 10.3 | 21 |
| Moroccan | 12.5 | 21 | 3.4 | 10 |
| Other | 15 | 0 | 7 | 12 |
| Missing | 0 | 31 | | 15 |
| **How would you describe the state of your diabetes? (%)** | | | | |
| Very good | 7.5 | 0 | 6.9 | 0 |
| Good | 35 | 27.6 | 48.3 | 12.1 |
| Reasonable | 37.5 | 31 | 37.9 | 27.3 |
| Poor | 12.5 | 10.3 | 6.9 | 9 |
| Very poor | 7.5 | 0 | 0 | 0 |
| Missing | 0 | 31 | 0 | 51.5 |
| **HBa1c % (SD)** | 7.6 (0.9) | 8.0 (1.3) | 7.8 (1.1) | 7.8 (1.9) |
| **Duration of diabetes in years (SD)** | 9.7 (8.8) | 5.65 (5.4) | 14.6 (11.7) | 8.6 (7.3) |

SD, standard deviation.

from "very good" to "very poor". The duration of diabetes (in years) was self-reported. Data on HbA1c levels of the participants were obtained from the medical files [17].

Internal consistency was calculated for all sub-scales of the SDSCA. Based on these analyses, we excluded the third question related to the diabetes-specific diet and decided not to combine the items for general diet. The two questions on medication adherence were combined into one variable, because of a negative covariance.

*Analyses.* In the current analyses, we included those who participated in the baseline measurement, and the follow-up measurements at 10 and 16 months (Figure 1). To evaluate a potential selection bias, baseline characteristics of the participants included in the analyses were compared with those excluded from the analyses (Table II).

A linear mixture model was used to describe the changes in means within and between the intervention group and control group. We adjusted for baseline scores on medication adherence, physical activity, diabetes-specific diet and fruit, vegetable and consumption of full-fat products. The group to which the participant belonged during the intervention was chosen as a level in the model.

All analyses were performed using SPSS 19.0 (SPSS Inc., Chicago, Illinois, USA) and R2 13.1 (R Foundation for Statistical Computing). A *P*-value of <0.05 was considered to be statistically significant.

## Results

### Characteristics

The respondents in the qualitative study (*n* = 27) and the respondents in the quantitative study (*n* = 40 in the intervention group, *n* = 29 in the control group) broadly reflected the wider trial population in terms of age, gender, duration of diabetes and glycaemic control, except for the ethnicity of the participants. The intervention and control groups also differed in ethnicity with regard to baseline characteristics, i.e. the intervention group included more participants of Dutch and Moroccan origin, and fewer participants of Surinamese origin (Table I).

*Findings from the qualitative and quantitative study*

HbA1c was one of the primary outcome measures of this study. Contrary to our expectations, HbA1c and other biomedical markers were not measured as regularly by GPs as prescribed by the national GP standard for diabetes care 20. Therefore, the effect on HbA1c could not be studied.

In the qualitative interviews, the respondents not only reported on their medication adherence, physical activity and diet, but also on other aspects of self-management not included in the quantitative analyses, e.g. beverages and carbohydrates, and prevention/treatment of hypoglycaemia.

*Medication adherence.* Both the intervention and control groups indicated that, after the intervention, they changed the way they took their medications (e.g. not on an empty stomach, not with milk). Most participants in the intervention group indicated that they now take their medications on time, which was confirmed by the group leaders (Box 4, citation 1).

Some participants indicated that they now understood medications should always be taken, not only when experiencing discomfort (Box 4, citation 2).

The quantitative results indicate that, at baseline, medication adherence was high in both groups. At 16 months, the intervention group continued their high adherence pattern, compared to a slight decrease in the control group (Table III).

*Physical activity.* The analyses show a greater and more diverse increase in physical activity in the intervention group. Most respondents in the intervention group reported to both walk and do sports more often since the intervention; this was confirmed by the group leaders (Box 4, citations 3 and 4).

For most of these participants, doing sports was something they had never done before, whereas others increased the intensity of the sports they were already doing (Box 4, citation 5).

The quantitative results indicate that at baseline, both groups were physically active for at least 30 min during about half of the week. After 10 months, the intervention group had significantly increased their physical activity, whereas there was a decrease in the control group. The difference between the two groups was statistically significant ($P$=0.03).

*Diet.* Both groups indicated that they were eating more regularly since the intervention. They now eat more snacks in between meals and no longer eat late at night. The intervention group reported more diverse strategies for healthy eating than the control group. Only the intervention group seemed to plan ahead with regard to their blood glucose levels and adjusted their food intake accordingly (e.g. eat a low-carbohydrate snack to prevent their sugar level from being too high in the morning).

The qualitative study indicated that both groups attempted to eat less fat and sugar However, the intervention group reported more diverse and more complex strategies to do so, such as replacing saturated fat with unsaturated fat, i.e. semi-skimmed milk instead of full-fat milk, 30+ cheese instead of regular cheese and so on. Only the intervention group indicated that they drink more water, less alcohol and no soda, lemonade or fruit juice. The group leaders of the intervention group confirmed that their participants had learned to eat healthier and make more deliberate choices regarding their food intake (Box 4, citation 6).

Other more complex strategies used only in the intervention group included choosing the most-healthy alternative at a party, and planning ahead to avoid snacking (Box 4, citation 7).

Further, only the intervention group used more diverse strategies to eat less carbohydrates and replaced products high in carbohydrates with products low in carbohydrates, e.g. replacing white rice with whole grain rice, etc. (Box 4, citation 8).

The quantitative analyses also indicated that both groups improved their diabetes-specific diet. At baseline, both groups adhered to their diabetes-specific diet on five days of the week and improved their adherence at 10 and at 16 months. Fat consumption was low in both groups, mainly due to not eating full-fat dairy products or red meat five days a week. In both groups, fruit and vegetable consumption was high at baseline. Contrary to the qualitative analyses, at 16 months, fat consumption had improved in the control group only. In both groups, fruit and vegetable consumption had decreased at 16 months.

*Other aspects of self-management.* Both groups indicated that they were better able to recognize low blood glucose levels (Box 4, citation 9).

However, only participants in the intervention group reported that they now also know how to deal with low blood glucose levels (Box 4, citation 10).

Finally, they indicated that the intervention helped them to prioritize their diabetes, because they realize that they have to continue to "work hard" for their diabetes. Acceptance of their diabetes as a chronic disease, and therefore a continuous part of their lives, was part of this process (Box 4, citation 11).

## Discussion

The qualitative analyses showed that the intervention group better understood the rationale behind DSM

Box 4. Citations of respondents.

1. *Respondent*: "I've learned to just be patient and calm and take your medicine on time, because sometimes I forgot to do that. Then I got a mobile phone … You know, where I can set the time, so that I wake up in time in the mornings – and then eat something and take my medicines – And, if necessary, I go back to sleep again … but then I have to keep this up, in the afternoons and the evenings.
   *Interviewer*: So you just set the alarm?
   *Respondent*: Yes, I put the alarm on – and now it all works OK."
   [Surinamese woman, 55 years: Intervention group 6]

2. "I didn't know how to use my medication, or maybe I didn't read the leaflets – I don't know, but it just wasn't working. I was a bit … well … not that I denied it, I've never denied it. […]. But with the medication everything just took its own course … I took my medicine whenever I thought about it – and whenever I didn't feel good – because then I thought – you have to take your medication. If you're feeling OK – you don't need to take medicine, right? It's like a headache – when you have a headache you think – I'm against taking medicine so I'm going to see how long I can stand it, and when the pain is too bad I'll take a tablet – but then I delayed it for as long possible. And so I thought – with sugar, with metamorphine – you can also do that – but that was totally wrong."
   [Indonesian woman, 59 years: Intervention group 3]

3. "I've got three people, that's what I like – that we went to 'Movement for Elderly' (a neighbourhood initiative) together and we do that every week now … And they really like it and want to continue to support each other, so then the group carries on – without me."
   [Dutch group leader: Intervention groups 7 and 8]

4. *Respondent*: "Then he (a group member) said – 'Come on ladies we're going walking' – I said damn that! At first, we didn't like walking very much […] because in the beginning I was going 'gasp … gasp' – and then little by little, it just got better."
   *Interviewer*. Yes – you were getting better?
   *Respondent*: Sure – we started walking even faster."
   [Ethnic Dutch woman, 62 years: Intervention group 1]

5. *Respondent*: The (health) is slightly better – thank God.
   *Interviewer*: How?
   *Respondent*: I feel good, so to speak. I had stopped doing a lot of things – like I said […] Sports too, I do more sports, since K. (the group leader) said that it's good, I do more of it. I go to the gym, I have a yearly subscription. I went two … three days and trained for one and a half hours – now I go five days a week."
   [Moroccan man, 40 years: Intervention group 9]

6. *Respondent*: "I'm someone who likes savoury foods.
   *Interviewer*: What do you really like to eat?
   *Respondent*: Sausage. Especially sausages made from horse meat – horse sausages are not so fatty (laughs) – that's almost stopped now … but I … have found it positive […]. I have the tendency to want to eat something in the evening … a piece of cheese … or … it used to be crisps, nowadays it's Japanese … uh … those Japanese things."
   [Dutch man, 68 years: Intervention group 2]

7. "At the start of the course […] I'd go to work – and then I had such a craving for chips that I went out and bought chips. And that's bad … So … yeah … that's why I always have something in my bag, like a cracker or some fruit – then I've beaten it!"
   [Surinamese woman, 56 years: Intervention group 2]

8. "Um, about brown rice, for example … that it's very good – and that it stimulates your intestines and all that. Because I suffer from constipation … so I thought – OK then. And … what I didn't know was that … earlier – when you ate brown bread, brown bread is healthy … But it's not brown bread that's healthy, it's whole grain bread."
   [ Surinamese woman, 64 years: Intervention group 6]

9. *Respondent*: "And like the hypo – so what happens? How do you get it? I always thought it's because you're just not feeling good, no, well … what I noticed is … first I get really fast heart beats, and then I start sweating – and then I say … oh … I'm getting sick. I thought 'Oh, I can feel my heart', but that's not it – that was because the sugar was suddenly too low. […] And then it seemed like this … [acts as though she is having a heart attack].
   *Interviewer*: Is there something wrong with your heart?
   *Respondent*: No." [laughter]
   [Dutch woman, 61 years: Intervention group 1]

10. *Respondent*: "Normally, you think … oh yeah, just take … what do you call it … a dextro – take a dextran. Instead of … Then I think, but that's not enough, because then you also have to eat something. And … you know … also how you should eat that food …
    *Interviewer*: Oh yeah, so how do you that now? Because first you took a dextro – and then you didn't do anything else?
    *Respondent*: Well, I thought – now I'm not going to take anything any more … Although you have to eat something, and you have to drink … Yes, that sort of thing – and I didn't do that … stupid huh?"
    [Surinamese woman, 49 years: Intervention group 3]

11. "Diabetes means discipline. That's what you know at a certain moment … I just have to take certain steps – otherwise it'll cost me my health."
    [Dutch woman, 59 years: Intervention group 7]

and used more diverse and complex self-management strategies (thinking ahead, replacing foods with other more-healthy alternatives) than the control group. They reported improvements in the ways they take their medications and are more physically active. Further, only the intervention group indicated that they drink more water, less alcohol and no soda, lemonade or fruit juice, and that they use more diverse strategies to eat

Table III. Effect of the intervention on self-management behaviours.

| Medication adherence (days) | Intervention group (*n*=40) mean | Change compared to baseline (CI) | *P*-value | Control group (*n*=29) mean | Difference in change compared to change intervention group | *P*-value |
|---|---|---|---|---|---|---|
| Baseline (mean) | 6.95 | | | 6.97 | | 0.93[a] |
| T1 (mean) | 6.94 | -0.01 (-0.32, 0.31) | 0.96 | 6.84 | -0.12 (-0.6, 0.37) | 0.63 |
| T2 (mean) | 6.85 | -0.10 (-0.42, 0.22) | 0.53 | 6.58 | -0.28 (-0.85, 0.29) | 0.33 |
| **Physical activity (days)** | | | | | | |
| Baseline (mean) | 3.78 | | | 4.66 | | 0.22[a] |
| T1 (mean) | 4.83 | 1.06 (0.26, 1.85) | 0.01* | 4.31 | -1.41 (-2.64, -0.18) | 0.03* |
| T2 (mean) | 4.43 | 0.65 (-0.16, 1.46) | 0.11 | 4.42 | -0.89 (-2.37, 0.59) | 0.24 |
| **Diabetes-specific diet (days)** | | | | | | |
| Baseline (mean) | 5.38 | | | 5.26 | | 0.82[a] |
| T1 (mean) | 5.78 | 0.40 (-0.42, 1.23) | 0.33 | 5.53 | -0.13 (-1.41, 1.15) | 0.84 |
| T2 (mean) | 6.06 | 0.68 (-0.15, 1.51) | 0.11 | 5.71 | -0.23 (-1.74, 1.29) | 0.77 |
| **Fat consumption (days in which no full-fat products or red meat were consumed)** | | | | | | |
| Baseline (mean) | 4.90 | | | 4.54 | | 0.51[a] |
| T1 (mean) | 5.55 | 0.65 (-0.30, 1.60) | 0.18 | 4.48 | -0.71 (-2.19, 0.78) | 0.35 |
| T2 (mean) | 4.86 | -0.04 (-1.01, 0.92) | 0.93 | 4.86 | 0.37 (-1.37, 2.11) | 0.67 |
| **Fruit and vegetable consumption (days)** | | | | | | |
| Baseline (mean) | 5.18 | | | 5.80 5.79 | | 0.26[a] |
| T1 (mean) | 5.32 | 0.14 (-0.68, 0.96) | 0.74 | 5.53 | -0.40 (-1.67, 0.86) | 0.53 |
| T2 (mean) | 4.44 | -0.74 (-1.57, 0.10) | 0.08 | 5.29 | 0.23 (-1.29, 1.76) | 0.76 |

[a]Difference between intervention group and control group at baseline.
*Statistically significant results.

less carbohydrate. Finally, only the intervention group reported to be able to better handle changes in blood sugars and to prioritize their diabetes more.

The quantitative analyses confirmed the increase in physical activity only. Other aspects of self-management did not change (medication adherence), changed in the control group only (fat consumption) or changed in both groups (diabetes-specific diet, and fruit and vegetable consumption).

*Strength and weaknesses*

Ideally, we wanted to evaluate quantitatively the intervention and better understand the results using the qualitative data. Unfortunately, owing to a small sample size and high dropout rates, this was complicated. The qualitative data provide us with interesting insights on the effects, but provide no definite conclusions. Further validation of the results is required. Other studies to confirm these results are necessary before a further implementation of PTWD can be justified.

Secondly, we were not able to assign the participants randomly to the intervention or control group. The intervention required the participants to live close to each other which made randomization on an individual level impossible. In this study, multiple cultural groups were included and the intervention was offered in separate groups for Turkish, Moroccan, Surinamese

and Dutch patients. Predicting the number of participants per ethnic group in a specific GP practice proved to be difficult. As a consequence, also cluster randomization was not possible. Therefore, it might be that factors affecting diabetes outcomes or factors mediating the effects of the intervention are not evenly distributed in both groups affecting the results of this study. To gain more insights in these mediating factors and to further study to what extent our study population is representative to the general population of patients from socioeconomically deprived neighbourhoods we also collected the HbA1c levels of a group of patients from socioeconomically deprived neighbourhoods that received no intervention at all (the second control group). However, due to difficulties with the collection of hbA1c data from the participants' medical files, we were unable to compare the HbA1c levels of this group with those of our intervention and control group on baseline, 10 and 16 months. As a result, we have no insights into the comparability of the intervention and control groups with regards to certain confounders affecting diabetes care or the effects of the intervention. This indicates that the quantitative results in this paper should be interpreted with caution.

Further, the respondents for the qualitative study were selected by the group leaders. Because we aimed to study the potential effects of the intervention we aimed to interview participants that had regularly

attended the group meetings and that had significant others who also participated in the intervention. This means that the findings of this study are probably not generalizable to all participants in this intervention and should be interpreted as such.

Further, the respondents were interviewed right after the end of the intervention, which gives no indication of long term intervention effects. Finally, the cultural groups that participated in the intervention were unequally represented in the qualitative study. Therefore, these results cannot be generalized to all cultural groups in this study.

Unfortunately, we were unable to collect HbA1c because it was not measured regularly in the GP practices participating in this study. Grintsova et al. also show that patients from socioeconomically deprived neighbourhoods receive less frequent measurements of HbA1c [26]. To be able (as a researcher but also as a GP) to monitor the health status of socioeconomically deprived patients, this phenomenon need to be studied so attendance among this population in HbA1c measurements increases.

Finally, we did not collect information on diabetes interventions attended prior to participation in this intervention. If known, this would have led to a better characterization of the respondents, which would have increased our insight into the generalizability of the results to other populations.

## Discussion of the results

The intervention group showed more complex and more diverse self-management strategies, that were not observed in the comparison group. One of the distinctive features of PTWD is its focus on the social networks (social support and social influences) of the participants. Further, the intervention strategies were tailored to the educational needs of our target population.

To our knowledge, there are very few interventions focusing on increasing the social support for DSM and decreasing the social influences that hinder DSM at the same time in patients from socioeconomically deprived neighbourhoods. An increasing number of studies recognize the need for this type of intervention [27–30]. Some other innovative interventions report promising (preliminary) results on self-care behaviours, but not all of these interventions focus on disadvantaged groups, use different intervention strategies (mobile phones) and primarily include African American or Thai patients, which makes it difficult to compare the results of these studies to our intervention [31–34].

Previous evaluations showed that the intervention increased emotional social support, diminished hindering social influences and increased the ability of participants to deal with peer pressure and temptations that hindered self-management behaviours [35]. Practising self-management with and the encouragement of group members, walking together and energizers that create a pleasant atmosphere and high levels of trust in the groups contribute to these changes. Also, participants named the fun and pleasant atmosphere as one of the reasons to keep participating in the intervention.

These effects on intermediate outcome measures might explain the effects on self-management behaviours. For example, actively involving (significant) others in self-management seems a successful intervention strategy. The participants regularly discussed and practiced the strategies they formulated in their action plans through role-playing exercises. Making an action plan with the help of others and practicing strategies together probably helped participants to formulate realistic goals and strategies, to receive more social support for self-management and to feel more confident about implementing their action plan; these are important conditions for the action plan to be successful [36].

It also seems likely that the pleasant atmosphere in the groups and the high levels of trust facilitated learning among this population (being able to express opinions and ideas, and ask questions), which might have contributed to the better understanding of the rationale behind DSM in the intervention group.

Finally, the participants were addressed as a group, which might have made overcoming barriers to self-management behaviours easier. The quantitative analyses indicated that physical activity significantly improved in the intervention group. Low self-efficacy, poor health, fear of injury and a lack of access are known barriers for disadvantaged groups to be physically active [37] In our intervention, walking together in the neighbourhood with the group was obligatory. Hesitant participants were stimulated by group members and group leaders to come along; in this way, participants became acquainted with physical activity. It may also have made them aware that they can be physically active in their own neighbourhood. They experienced improvements in their and others' expenditure and being successful together; this probably increased their confidence about performing physical activity [38, 39].

## Conclusion

This study provides a starting point for future research on the effectiveness of this intervention. It indicates that the intervention led to a better understanding of the rationale behind DSM, to the use of more complex strategies in different situations in the intervention group and to an increase in physical activity.

Once better studied, this intervention might be a promising starting point for diabetes education among socioeconomically deprived patients. Parts of this intervention could be introduced in regular diabetes care and might help socioeconomically deprived patients to achieve a basic understanding of diabetes and its management, and to involve their significant others in their self-management.

## List of abbreviations

AMC, Academic Medical Centre
DISC, Diabetes in Social Context
DSM, Diabetes self-management
GP, General practitioner
HbA1c, Glycated haemoglobin
PTWD, Powerful Together with Diabetes
SDSCA, Summary of Diabetes Self-Care Activities Measure
ZonMw, The Netherlands Organisation for Health Research and Development

## Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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## Ethics approval and consent to participate

This study was approved by the Medical Ethics Committee of the AMC in Amsterdam. Potential participants were invited to an information meeting after which they decided on participation and provided written or oral consent All qualitative interviews were audiotaped, with the respondents' consent.

## Consent for publication

Not applicable.

## Availability of data and materials

Patient level data are available from the corresponding author. Informed consent for data sharing was not obtained, but the presented data are anonymized and the risk of identification is very low.

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## Author contributions

C.V. coordinated the study, developed the intervention, constructed the design and drafted the manuscript. V.N. developed the study, constructed the design and revised the manuscript. I.G.M.V. drafted and revised the manuscript. G.N., P.J.M.U. and B.J.C.M. participated in the design of the study and revised the manuscript. K.S. developed the study, constructed the design and revised the manuscript.

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