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Patient-centered innovation

Change is possible: How increased patient activation is associated with favorable changes in well-being, self-management and health outcomes among people with type 2 diabetes mellitus: A prospective longitudinal study

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ABSTRACT

Objective: To examine the relationship between risk factors for low patient activation and change in patient activation, well-being, and health outcomes in people with type 2 diabetes mellitus (T2DM).
Method: A longitudinal prospective study was conducted with measurements at baseline and 20-week follow-up among 603 people with T2DM participating in a group-based walking intervention. Patient activation and risk factors were assessed using online questionnaires. Health outcomes were assessed in participants' general practices.
Results: No association was found between risk factors for activation and change in patient activation. Patient activation significantly increased ($t(602) = 2.53$, $p = 0.012$) and was associated with an increase in emotional well-being ($\beta = 0.22$), exercise behavior ($\beta = 0.17$), general diet behavior ($\beta = 0.20$), and a reduction in BMI ($\beta = -0.28$), weight ($\beta = -0.29$), and HbA1c ($\beta = -0.27$).
Conclusion: Favorable changes in patient activation, self-management, well-being, and health outcomes occurred during a walking intervention, despite highly prevalent risk factors for low activation and less engagement in self-management.
Practice implications: Group-based walking interventions might empower people with T2DM to begin taking a larger role in their self-care and improve (mental) health outcomes. Vulnerable groups of patients (with multiple risk factors for low activation) can change and presumably need this kind of interventions to be able to change.

1. Introduction

Day-to-day self-management is considered essential for people with type 2 diabetes mellitus (T2DM) to realize healthy glucose levels, minimize the impact of the disease on their health and daily life, and reduce the risks of developing complications [1,2]. Key elements of T2DM self-management include medication taking, maintaining a healthy diet, regular physical activity, foot care and blood glucose monitoring for people using insulin [2,3]. Performing these self-management behaviors can be highly demanding and burdensome. For people in less optimal socio-economic, psychological or health circumstances, self-management has been found even more difficult. Previous studies demonstrated that low health literacy [4], depressive symptoms [5–7], lower education [6,7], comorbidity and diabetes-related complications [5,8–10] are related to less engagement in self-management behaviors and unfavorable health outcomes in people with T2DM.

Besides socio-demographic, psychological and health correlates, self-management has been found to be influenced by 'one's competence and willingness to manage the disease', also referred to as

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'Patient Activation'. Patient activation can be defined as the level of knowledge, skills and confidence someone has that is needed for adequate self-management of a chronic disease [11]. People with high patient activation are better able to manage their disease, actively take part in decision-making, and engage in self-management behaviors needed for improvement of their health and daily functioning [11–13]. Additionally, higher levels of patient activation have been found to relate to favorable health outcomes (e.g. less depressive symptoms or remission from depression, more frequent use of healthcare services, and healthy glucose levels) and cost savings in people with T2DM or other chronic conditions [14–16]. In contrast, lower levels of patient activation are associated with unhealthy behavior (e.g. physical inactivity) and less favorable health outcomes (e.g. higher glucose levels) in people with T2DM [12,14,15,17].

Behavior change interventions have been shown to increase patient activation and engagement in self-management behaviors [18–21]. Group-based educational interventions are some of the strategies used to increase patient activation, by informing people how to perform self-management behaviors, help with problem solving, and provide peer support [21,22]. However, a substantial proportion of patients with chronic diseases does not appear to respond to such interventions [23,24].

Previous studies have aimed to identify risk factors of low patient activation in people with chronic conditions such as T2DM. Patient activation has been found lower in people with older age, low education level, low health literacy, depression, and low health status, and higher in people with higher quality of life, who are living alone and report more social support [12,14,23,25–27]. Some studies suggest that patient activation changes over time in older people with chronic diseases even without intervention [14,18]. Experiencing depression, being retired or unemployed, being older, and reporting a lower health status have been related to a greater decline in patient activation in older people with one or more chronic diseases [14,28].

Despite increased understanding on patient characteristics related to low patient activation, little is known about patient characteristics that potentially influence the degree of change in patient activation, and whether vulnerable groups of patients (with multiple risk factors for low activation) are more resistant to change in patient activation.

The current study aimed to examine whether patient characteristics, found to be related to (low) patient activation, also relate to (lesser) changes in patient activation in people with T2DM. More specifically, we assessed the relationship between age, sex, work status, education, comorbidity, exercise history and change in patient activation. Additionally, the association between change in patient activation and changes in diabetes self-management behaviors, emotional well-being, and health outcomes (weight, body mass index (BMI), glycated hemoglobin (HbA1c), hip size, abdominal circumference) was assessed. This was examined within the context of a yearly 20-week group-based walking intervention in the Netherlands: the National Diabetes Challenge (NDC) [29].

2. Methods

2.1. Design

This was a prospective longitudinal, 20-week follow-up study.

2.2. Participants and procedure

Data was collected among people with T2DM who participated in the NDC in 2017 in the Netherlands. Inclusion criteria were: T2DM, age ≥ 18 years and written informed consent. At baseline, all participants received an information letter by e-mail with a link to an online questionnaire. Participants who completed the baseline questionnaire received an invitation to also fill in the follow-up questionnaire after 20 weeks. The questionnaires included items on participant characteristics (e.g. socio-demographic factors, comorbidity and exercise history), patient activation, emotional well-being, and diabetes self-management behaviors.

In addition, health outcomes (HbA1c, weight, BMI, hip size, abdominal circumference) were assessed at baseline and 20-week follow-up in a subgroup of 128 participants with T2DM from ten primary care practices involved in the NDC (out of a total of 162 NDC locations). Healthcare providers of these practices personally invited their patients to participate in the study and performed the health outcome assessments.

2.3. Ethical approval

This study was approved by the Medical Ethical committee of the Isala general hospital (Zwolle, the Netherlands; ref nr. 180341).

2.4. Intervention

In 2017 the NDC consisted of a 20-week group-based annual walking intervention aiming to improve the quality of life and health of people with T2DM by increasing their physical activity behavior. During this intervention people with diabetes participated in a weekly group walk which was organized and attended by their own primary healthcare providers (e.g. general practitioners, practice nurses, physiotherapists) in 162 different locations across the Netherlands. Participants gradually worked towards walking 5, 10, 15, or 20 kilometers. Although the NDC was open to all people with T2DM, it specifically aimed to include people with lower exercise history, who had previously been unable to change their sedentary behavior. Apart from limited experience with exercise, a majority was confronted with multiple risk factors for low patient activation, having lower education and health status and high comorbidity. Despite these risk factors, preliminary positive effects of the NDC on health and well-being have been described. A detailed description of the NDC can be found elsewhere [29].

2.5. Measures

2.5.1. Participant characteristics

Participant characteristics included age, sex, education level (low, intermediate, high), work status (employed, not employed), comorbidity, and self-reported exercise history indicating prior experience with physical activity (none, almost none, neutral, reasonable, extensive).

2.5.2. Patient activation

The Dutch version of the short form Patient Activation Measure (PAM-13®) was used to measure level of patient activation [13]. In this 13-item questionnaire, participants are asked to indicate to what extent they agree (totally disagree to totally agree or not applicable) with statements about knowledge, skills, and confidence about managing their health and disease (e.g. "I am confident that I can take actions that will help prevent or minimize some symptoms or problems associated with my health condition"). The scoring guidelines of Insignia Health® were followed, which were also used in a Dutch validation study [13]. A mean score on a 0–100 scale was computed, with a higher score indicating a higher level of patient activation. This score could not be computed if more than seven items were missing or when all 13 questions were answered with totally disagree or totally agree. Based on their total score, participants were categorized into four levels of patient activation: at level 1 people are passive and believe that their role regarding their health is not important, at level 2 people have some knowledge and confidence but still do not believe they have control over their health, at level 3 people begin to take action and built skills, knowledge, and confidence, and at level 4 people adopted the new behaviors into their daily life [11,13]. Hibbard and colleagues [30] consider a change of four points on the PAM scale a clinically important difference. The PAM-13 showed good internal consistency in this study (α = 0.81).

2.5.3. Emotional well-being

Emotional well-being was measured with the World Health Organization well-being index (WHO-5). Participants are asked to indicate on a 6-point Likert scale from zero (not present) to five (constantly present) which answer best reflects how they felt in the past two weeks for five statements about their mental well-being. A total score on a 0–100 is computed, with higher scores indicating higher emotional well-being. A score equal or below 50 is considered to indicate lower emotional well-being and the occurrence of depressive symptoms [31]. The WHO-5 showed good internal consistency (α = 0.87).

2.5.4. Diabetes-self-management

Diabetes self-management behaviors were measured with the Summary of Diabetes Self-Care Activities (SDSCA) [32]. In this 11-item questionnaire, participants are asked to indicate how many days in the past week they have been engaged in self-care activities. Based on the answers, subscales can be computed on six self-care activities: exercise behavior, general diet behavior, specific diet behavior, foot-care, blood glucose monitoring, and smoking status. Considering the heterogeneity of diabetes treatment modalities and self-management recommendations in our sample, we only looked at exercise behavior (α = 0.78) and general diet behavior (α = 0.76), both showing acceptable internal consistency. Higher scores indicated more days spent on performing the activities and thus more engagement in diabetes self-management behaviors.

2.5.5. Health outcomes

HbA1c (mmol/mol), weight (kg), BMI (kg/m^2), hip size (cm) and abdominal circumference (cm) were measured by healthcare providers at the intervention locations. HbA1c reflects the average blood glucose level over a period of the past two or three months. An HbA1c of > 53 mmol/mol was considered elevated.

2.6. Statistical analyses

Analyses were performed using IBM SPSS Statistics version 26 (SPSS INC, Chicago, IL, USA). A p-value of < 0.05 was considered statistically significant. All test assumptions were checked and approved. Participant characteristics, emotional well-being, self-management behavioral, and health outcomes at T0 and T1 were described using descriptive statistics and compared per level of patient activation with chi-square and ANOVA tests. P-values of post-hoc comparisons were adjusted for multiple testing with the Bonferroni adjustment. Given the low number of missing data, no imputation was performed.

To examine changes in patient activation, emotional well-being, diabetes self-management behaviors, HbA1c, BMI, weight, hip size and abdominal circumference T0 and T1 scores were compared using paired-samples *t*-tests. A separate paired-sample *t*-test was performed on change in patient activation for both participants with low activation (level 1 and 2) and high activation (level 3 and 4) at baseline, to see whether there was a significant change in those participants who were already activated at baseline.

A multiple linear regression analysis was performed to examine the association between age, sex, education level, work status, self-reported exercise history, number of comorbid diseases and change in patient activation (dependent variable).

Multiple linear regression analyses were performed to examine the association between change in patient activation and change in emotional well-being, self-management behavior, and health outcomes. Change scores (T1-T0) were computed for patient activation as continuous independent variable, and for emotional well-being, exercise behavior, general diet behavior, HbA1c, BMI, weight, hip size and abdominal circumference as continuous dependent variables. Age, sex, comorbidity, and educational level were included as covariates. These covariates were selected based on previous research indicating a possible association between these demographics and diabetes self-management, emotional well-being, and health outcomes [5–8,33–36]. To examine whether the association between change in patient activation and both change in emotional well-being and change in HbA1c was stronger for people with lower emotional well-being and people with elevated blood glucose levels at baseline, separate regression analyses were conducted.

3. Results

3.1. Participant characteristics

Six-hundred thirty-two patients with T2DM were included in the study. Twenty-nine participants were excluded because of incomplete PAM scores at baseline and/or follow-up. Hence, 603 participants were included in the analysis.

Table 1 shows the baseline characteristics of the total study sample and per level of patient activation. Participants had an average age of

Table 1
Baseline characteristics of total sample and per patient activation level.

	Total (N = 603)	Level 1 (N = 91)	Level 2 (N = 164)	Level 3 (N = 297)	Level 4 (N = 51)
Age, mean (SD)	62.8 (8.9)	63.2 (7.8)	62.4 (9.4)	63.1 (8.8)	61.4 (9.6)
Sex, n female (%)	322 (53.4)	58 (63.7)	84 (51.2)	152 (51.2)	28 (54.9)
Level of education, n (%)					
Lower educated	425 (71.0)	63 (70.0)	110 (67.5)	220 (74.6)	32 (62.7)
Middle	47 (7.8)	11 (12.2)	8 (4.9)	21 (7.1)	7 (13.7)
Higher educated	127 (21.2)	16 (17.8)	45 (27.6)	54 (18.3)	12 (23.5)
Work status, n not employed (%)	372 (63.5)	61 (69.3)	97 (61.0)	187 (64.7)	27 (54.0)
Number of comorbid diseases, n (%)					
No comorbid diseases	154 (26.5)	17 (18.9)	46 (28.2)	82 (27.8)	14 (27.5)
1–2 comorbid disease	344 (57.4)	49 (54.4)	90 (55.2)	175 (59.3)	36 (58.8)
≥3 comorbid diseases	96 (16.0)	24 (26.7)	27 (16.6)	38 (12.9)	7 (13.7)
Exercise history, n (%)					
None to almost none	198 (33.1)	38 (42.2)	59 (36.2)	85 (28.8)	16 (31.4)
Average	210 (35.1)	31 (34.1)	57 (35.0)	109 (36.9)	13 (25.5)
Reasonable to extensive	191 (31.9)	21 (23.1)	47 (28.9)	101 (34.2)	22 (43.2)
Lower emotional well-being, n (%)	144 (23.9)	48 (52.7)	46 (28.0)	44 (14.8)	6 (11.8)
Obese (BMI ≥ 30 kg/m^2), n yes (%)[a]	68/127 (53.5)	10/26 (38.5)	19/30 (63.3)	34/58 (58.6)	5/13 (38.5)
Elevated blood glucose levels (HbA1c > 53 mmol/mol)[a]	47/127 (37.0)	11/25 (44.0)	7/31 (22.6)	22/57 (38.6)	7/14 (50.0)

Notes. n, number of participants per group of the specific characteristic. %, percentage of total n of the column.
[a] As fewer data on BMI and HbA1c is available, the total n of these variables is noted after the forward (/).

62.8 ± 8.9 years. The majority of the participants were female, lower educated, and not employed (retired or unemployed), 73.4% of the participants had at least one comorbid disease. More than half of the participants had obesity, 37% of the participants had an HbA1c of > 53, 23.9% reported lower emotional well-being.

The majority of the participants reported a PAM level of 3 at baseline (49.3%), indicating they are taking action and are gaining control over their disease management. When divided into groups per baseline patient activation level, the groups did not differ by age ($F(3591) = 0.7$, $p = 0.557$), sex ($X^2(3, n = 603) = 4.9$, $p = 0.183$), work status ($X^2(3, n = 586) = 3.84$, $p = 0.279$), number of comorbid diseases ($X^2(6, n = 599) = 11.21$, $p = 0.082$), exercise history ($X^2(6, n = 599) = 11.14$, $p = 0.084$), obesity ($X^2(3, n = 127) = 5.32$, $p = 0.150$), and blood glucose levels ($X^2(3, n = 127) = 4.37$, $p = 0.224$). There was a significant difference regarding level of education ($X^2(6, n = 599) = 12.70$, $p = 0.048$), however this difference did not hold in post-hoc comparisons with Bonferroni adjustment. Finally, people with lower emotional well-being at baseline were more likely to report a lower level of patient activation than participants with higher emotional well-being at baseline ($X^2(3, n = 603) = 60.83$, $p < 0.0001$).

3.2. Change in patient activation

Patient activation improved significantly in the overall group after the intervention (56.98 ± 9.23–58.04 ± 10.0, t(602) = 2.53, p = 0.012, see Supplementary Table 1). When divided into two groups based on baseline patient activation, participants with low activation at baseline (level 1 and 2) significantly increased after the intervention (48.82 ± 3.72–53.81 ± 7.82, t(254) = 9.92, p < 0.0001). A small but significant reduction in patient activation was found for participants with high activation (level 3 and 4) at baseline (62.96 ± 7.27–61.14 ± 10.29, t(347) = −3.15, p < 0.002). Nonetheless, their postintervention mean score was still within the level 3 range of patient activation.

During follow-up 49.9% of the participants remained at their baseline level, 29.0% increased one or more level(s), and 21.1% decreased one or more level(s) (see Table 2). Of those who decreased one or more level(s) (n = 127), 18.9% moved from level 4 to level 3. Those who were at level 3 at baseline were most likely to remain in level 3. Participants with level 1 and 2 at baseline were most likely to increase to a higher level of patient activation, with 33.0% moving from level 1 to 2, 31.9% moving from level 1 to 3, and 42.1% moving from level 2 to 3; 42.8% of the people with low activation at baseline (level 1 and 2) reached a higher patient activation level (level 3 or 4).

3.3. Change in well-being, self-management and health outcomes

There was a significant increase in emotional well-being (t(602) = 9.27, p < 0.0001), general diet behavior (t(563) = 3.85, p < 0.0001), and exercise behavior (t(581) = 6.91, p < 0.0001), and a significant reduction in weight (t(126) = −2.31, p = .023), hip size (t(106) = −3.00, p = 0.003), and abdominal circumference (t(106) = −2.54, p = 0.013) after the intervention (see Table 3). Both people with lower emotional well-being at baseline and people with higher emotional well-being at baseline showed a significant increase in emotional well-being, though the increase is more pronounced in the lower emotional well-being group. A significant reduction in HbA1c was only found in people with an HbA1c > 53 at baseline (t(46) = −3.20, p = 0.002). No significant change was found in BMI (t(126) = −1.76, p = 0.080).

Table 2
Change in number of participants per level of patient activation.

Baseline	n	Postintervention			
		Level 1	Level 2	Level 3	Level 4
Level 1	91	29 (31.9)	30 (33.0)	29 (31.9)	3 (3.3)
Level 2	164	24 (14.6)	63 (38.4)	69 (42.1)	8 (4.9)
Level 3	297	23 (7.7)	49 (16.5)	189 (63.6)	36 (12.1)
Level 4	51	2 (3.9)	5 (9.8)	24 (47.1)	20 (39.2)
Total	603	78 (12.9)	147 (24.4)	311 (51.6)	67 (11.1)

Notes. Number of participants (%) per level of patient activation at postintervention categorized by baseline level of patient activation.

3.4. Association of participant characteristics with change in patient activation

Multiple linear regression analysis was performed to predict the change in patient activation based on age, sex, education level, work status, self-reported exercise history, and number of comorbid diseases. There was no significant association between participant characteristics and change in patient activation (see Table S2).

3.5. Association of change in patient activation with change in emotional well-being, self-management behaviors and somatic health outcomes

An increase in patient activation was associated with an increase in emotional well-being (β = 0.22), exercise behavior (β = 0.17), and general diet behavior (β = 0.20), after adjusting for age, sex, comorbidity, and educational level. Change in patient activation explained 5%, 3%, and 4% of the variance in change in emotional well-being, exercise behavior, and general diet, respectively. An increase in patient activation was associated with a reduction in BMI (β = −0.28), weight (β = −0.29), and HbA1c (β = −0.27), after adjusting for age, sex, comorbidity, and educational level, and explained 8%, 8%, and 7% of the variance in change in BMI, weight, and HbA1c, respectively. See Tables S3 and S4 for complete regression models. No significant regression model was found for change in hip size and abdominal circumference.

To examine whether the association between change in patient activation and change in emotional well-being was stronger for people with lower emotional well-being, separate regression analyses were conducted for people with higher emotional well-being at baseline (n = 443) and people with lower emotional well-being at baseline (n = 117, see Table S5). In people with lower emotional well-being at baseline, an increase in patient activation was associated with an increase in emotional well-being (β = 0.29) and explained 8% of the variance in change in emotional well-being, after adjusting for baseline patient activation, age, sex, comorbidity, and educational level. In people with higher emotional well-being at baseline, an increase in patient activation was also associated with an increase in emotional well-being (β = 0.17) and explained 3% of the variance in change in emotional well-being, after adjusting for baseline patient activation, age, sex, comorbidity, and educational level.

To examine whether the association between change in patient activation and change in HbA1c was stronger for people with elevated blood glucose levels (HbA1c > 53), separate regression analyses were conducted for people with an HbA1c of > 53 (n = 46) and an HbA1c of ≤ 53 (n = 75) at baseline (see Table S6). Change in patient activation was not associated with change in HbA1c in people with an HbA1c of ≤ 53 at baseline. In contrast, in people with an HbA1c of > 53 at baseline, an increase in patient activation was associated with a reduction in HbA1c (β = −0.49) and explained 22.9% of the variance in change in HbA1c, after adjusting for age, sex, comorbidity and educational level, albeit in a small sample.

4. Discussion and conclusion

4.1. Discussion

This study showed that within a group of people with T2DM, in which risk factors previously associated with low activation

Table 3
Baseline, postintervention, and change scores of well-being, self-management and health outcomes.

	n	Baseline	Postintervention	Change (CI 95%)	t (df)	p
Emotional well-being	603	65.28 ± 18.16	71.22 ± 15.68	5.94 (4.68, 7.20)	9.27 (602)	< 0.0001
Lower well-being	144	38.64 ± 11.91	57.92 ± 18.14	19.28 (16.09, 22.46)	11.96 (143)	< 0.0001
Higher well-being at baseline	459	73.64 ± 9.81	75.39 ± 12.14	1.75 (0.96, 2.82)	3.23 (458)	0.001
General diet	564	4.28 ± 1.94	4.58 ± 1.80	0.30 (0.15, 0.45)	3.85 (563)	< 0.0001
Exercise	582	3.94 ± 1.89	4.48 ± 1.66	0.55 (0.39, 0.70)	6.91 (581)	< 0.0001
BMI (kg/m^2)	127	31.02 ± 5.42	30.83 ± 5.45	-0.19 (−0.40, 0.02)	-1.76 (126)	0.080
BMI < 30 at baseline	59	26.64 ± 2.33	26.57 ± 2.40	-0.07 (−0.37, 0.23)	-0.48 (58)	0.635
BMI ≥ 30 at baseline	68	34.82 ± 4.36	34.51 ± 4.58	-0.29 (−0.60, −0.02)	-1.90 (67)	0.062
Weight (kg)	127	90.65 ± 19.01	89.94 ± 19.22	-0.71 (−1.31, −0.10)	-2.31 (126)	0.023
Hip size (cm)	107	109.63 ± 11.54	108.54 ± 10.97	-1.09 (−1.81, −0.37)	-3.00 (106)	0.003
Abdominal circumference (cm)	107	107.79 ± 13.45	106.64 ± 12.87	-1.16 (−2.06, −0.25)	-2.54 (106)	0.013
HbA1c	127	52.02 ± 10.09	51.28 ± 9.28	-0.73 (−1.86, 0.40)	-1.29 (126)	0.201
HbA1c ≤ 53 at baseline	80	46.10 ± 4.83	46.88 ± 5.83	0.78 (−0.45, 2.0)	1.26 (79)	0.212
HbA1c > 53 at baseline	47	62.09 ± 8.62	58.79 ± 9.28	-3.30 (−5.37, −1.22)	-3.20 (46)	0.002

[12,14,23,25–27] and less engagement in self-management behaviors [4–7] were highly prevalent, participant characteristics were not associated with change in patient activation during a walking intervention. Despite the high prevalence of risk factors for low activation in our sample (e.g., low education level, high comorbidity, lower well-being, limited prior exercise experience), participants were willing to take part in this intervention and able to increase their patient activation. We observed a clinically meaningful change of approximately 5 points in people with a lower activation at baseline; Almost half of the people with a lower activation level at baseline reached a higher level (level 3 and 4) after the intervention, reflecting more sense of competence and self-control in properly managing illness and care [13]. We could not replicate findings from previous studies that older age, being retired or unemployed are related to a greater decline over time [14,28]. The association between an older age and work status, and decline in patient activation might be counteracted once people are actively approached to participate in and activated by an intervention.

This study showed that increasing patient activation in the context of group-based walking was related to increases in engagement in self-management behavior and emotional well-being, and reductions in BMI, weight and blood glucose levels in people with T2DM. Though multiple studies discussed the positive relation between patient activation and health behaviors and outcomes [12,14–17,19,21], a limited number of studies focused on *change* in patient activation in relation to *change* in health behaviors and outcomes [18,37]. These studies were conducted among elderly people with one or more chronic conditions and employees, whereas our study focused on people with T2DM and specific diabetes self-management behaviors and outcomes. The results of the current study underline that targeting patient activation might be an effective strategy to increase engagement in self-management behaviors and health outcomes in people with T2DM [14–16,20,21]. It should be noted that it is quite remarkable that despite being confronted with multiple risk factors for low activation and less engagement in self-management, the current study sample still showed a considerable increase in patient activation and favorable changes in behavioral, psychological and health outcomes. In addition, associations between changes in activation and changes in emotional well-being and blood glucose levels were found stronger for people who reported lower emotional well-being or elevated blood glucose levels at baseline. This suggests that improving patient activation can be an effective strategy to improve health and well-being, for these particular groups.

Strengths of this study included the large sample size. Secondly, the longitudinal design made it possible to assess the longitudinal association between patient activation and intervention outcomes, and examine factors associated with change in patient activation.

The study also had limitations. First, we could not provide causal evidence of the relations found. It remains unclear whether more patient activation may lead to higher emotional well-being, or that people with higher emotional well-being become more activated to perform self-management behaviors. An experimental setup or a longitudinal design with more than two timepoints could help to see if the association between patient activation and emotional well-being changes over time. Secondly, there was a lack of data on non-responders, making it impossible to compare the level of patient activation after the intervention between responders and non-responders, leaving room for a non-response bias. Non-responders might have had lower activation or experienced no change. However, 42.3% of the participants had a low baseline activation, so the associations found in this study were observed within a mixed group that also included less activated people. Furthermore, there may have been other factors that influenced change in patient activation not included in our study such as partner support or health literacy. Some studies found low social support to be associated with low patient activation [14,15,27]; others found that living alone was associated with more patient activation [14,38]. It would be interesting to examine whether such factors influence the degree of change in patient activation during an intervention. Finally, although we found a clinically relevant increase in patient activation, there was a possible response shift bias due to the pre-posttest design. An individual's perception of a concept, in this case patient activation, may change between pre- and posttest as a result of the intervention, possibly leading to underreporting of the real change [39].

4.2. Conclusion

In conclusion, this study showed that increases in patient activation are related to increases in emotional well-being and self-management behaviors, and reductions in BMI, weight and blood glucose levels in people with T2DM. Patient activation can increase within the context of this 20-week group-based walking intervention, independent of potential risk factors for low patient activation and less engagement in self-management behaviors.

4.3. Practice implications

These results contribute to the knowledge on how to increase engagement in self-management behaviors and health in people with T2DM and underlines that patient activation can be an important intervention target, even in vulnerable groups of patients (with multiple risk factors for low activation). Targeting patient activation might be an effective strategy to restrain growing healthcare costs associated with chronic diseases such as T2DM, as people with higher patient activation tend to have lower healthcare utilization and subsequently lower healthcare costs [20,40,41].

To help increase patient activation healthcare providers may need to distinguish between behavior change strategies that are used in the consultation room, (e.g. providing positive feedback, supporting goal setting, action planning) [22] and additional strategies that are needed outside the consultation room (e.g. modeling and practicing behavior, graded exercise, facilitating peer support, observing others performing the same behavior), that literally help people to come into action [29]. Although a control group would be needed to provide more solid evidence for the ability of the NDC to increase patient activation, the results suggest that interventions aiming at practicing self-management behaviors and 'doing', rather than (only) increasing knowledge, could be a means to increase patient activation in people with T2DM.

CRediT authorship contribution statement

Hannah Regeer: Conceptualization, Data curation, Formal analysis, Investigation, Writing – original draft. **Pepijn van Empelen:** Conceptualization, Writing – review & editing. **Henk J. G. Bilo:** Conceptualization, Writing – review & editing, Supervision. **Eelco J. P. de Koning:** Writing – review & editing. **Sasja D. Huisman:** Conceptualization, Writing – review & editing, Supervision.

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Declarations of interest

None.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.pec.2021.07.014.

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