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Changing psychosocial determinants of physical activity and diet in women with a history of gestational diabetes mellitus

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Abstract

Background: To investigate how a behavioural lifestyle intervention influences psychosocial determinants of physical activity and dietary behaviours in a population at risk of type 2 diabetes (T2DM).

Methods: Fifty-nine women with a body mass index of ≥25 kg/m^2 and a history of gestational diabetes mellitus (GDM) participated in a randomized controlled study. The intervention group (n = 29) received 2 face-to-face and 5 telephone lifestyle-counselling sessions with a health professional. The control group (n = 30) received care as usual. At baseline and 6 months, psychosocial determinants related to physical activity and diet were measured with a self-administrated questionnaire. Linear regression analyses were applied to test for intervention effects.

Results: The intervention was effective in improving social support (β = 3.5, P < 0.001; β = 2.1, P = 0.02), modifying self-efficacy (β = -2.2, P = 0.02; β = -4.3, P < 0.001), and reducing barriers (β = -3.5, P = 0.01; β = -3.8, P = 0.01) for, respectively, physical activity and diet from baseline to 6-month follow-up in the intervention group compared with the control group. The intervention reduced the following barriers to a physically active lifestyle: lack of energy and lack of motivation. Physical activity barriers like lack of time and lack of childcare were unchanged. The intervention reduced the following barriers to a healthy diet: lack of time, costs, having unhealthy snacks at home, and having cravings for sweets.

Conclusion: This lifestyle intervention influenced psychosocial determinants relevant for overweight women with a history of gestational diabetes mellitus (GDM) in prevention of T2DM.

Disciplines
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1 **Changing psychosocial determinants of physical activity and diet in women with a**
2 **history of gestational diabetes mellitus**
3
4 Short title: changing psychosocial determinants
5

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34 **Abstract**
35 **Aim:** To investigate how a behavioural lifestyle intervention influences psychosocial
36 determinants of physical activity and dietary behaviours in a population at risk of type 2
37 diabetes (T2DM).
38 **Methods:** 59 women with a body mass index of ≥25 kg/m² and a history of gestational
39 diabetes mellitus (GDM) participated in a randomized controlled study. The
40 intervention group (n=29) received two face-to-face and five telephone lifestyle-
41 counselling sessions with a health professional. The control group (n=30) received care
42 as usual. At baseline and six months, psychosocial determinants related to physical
43 activity and diet were measured with a self-administrated questionnaire. Linear
44 regression analyses were applied to test for intervention effects.
45 **Results:** The intervention was effective in improving social support ($\beta=3.5$, $p<0.001$;
46 $\beta=2.1$, $p=0.02$), modifying self-efficacy ($\beta=-2.2$, $p=0.02$; $\beta=-4.3$, $p<0.001$) and reducing
47 barriers ($\beta=-3.5$, $p=0.01$; $\beta=-3.8$, $p=0.01$) for respectively physical activity and diet from
48 baseline to six months follow-up in the intervention group compared to the control
49 group. The intervention reduced the following barriers to a physically active lifestyle:
50 lack of energy, and lack of motivation. Physical activity barriers like lack of time and
51 lack of childcare were unchanged. The intervention reduced the following barriers to a
52 healthy diet: lack of time, costs, having unhealthy snacks at home, and having cravings
53 for sweets.
54 **Conclusion:** This lifestyle intervention influenced psychosocial determinants relevant
55 for overweight women with a history of GDM in prevention of T2DM.
56 **Trial registration:** in Australian New Zealand Clinical Trials Registry
57 (ACTRN12614000539639)
58
59
60 **Keywords:** Gestational diabetes mellitus; Overweight; Psychosocial determinants;
61 Physical activity; Diet; Lifestyle

1. Introduction:

Women with a history of gestational diabetes mellitus (GDM), which is defined as a glucose intolerance of variable severity occurring or diagnosed for the first time during pregnancy [1], have a 6-7 fold elevated risk of developing type 2 diabetes (T2DM) later in life [2,3]. Women with a history of GDM also have an almost four fold increased risk of the metabolic syndrome [4]. Being overweight or obese is another important although modifiable risk factor for T2DM [5] and metabolic syndrome [6]. Overweight and obese women with a history of GDM are at high risk for developing T2DM and cardiovascular disease.

Decreasing body weight through a healthy intervention is an effective way to prevent T2DM, and thus cardiovascular disease risk [7]. Since providing information on T2DM risk and the importance of a healthy lifestyle during routine consultation has been shown to be insufficient to change the behaviour of women with a history of GDM [8], focused lifestyle interventions need to be developed to improve the effectiveness of preventive actions [9].

To date, the few randomized controlled lifestyle interventions conducted in this at-risk group all shown favourable impacts on dietary outcomes, such as intake of total fat, fibre, and glycaemic load, while the effect in (leisure time) physical activity has been inconsistent [10-12]. However, actually implementing lifestyle changes can be difficult, especially when a mismatch exists between a woman's risk perception after diagnosis of GDM, her self-health perception, her knowledge on how to take preventive action, and how to implement healthy behaviour [13].

Behaviour change theories such as the Social Cognitive Theory [14] and the Health Action Process Approach [15] attempt to explain the mechanisms and determinants of behaviour change. From these models psychosocial factors including risk perception, health beliefs, social support and self-efficacy have been associated with the adoption of health behaviours in cross sectional studies among women with a history of GDM [13]. Additionally, Razee et al. (2010) [16] stressed that both the cultural and psychosocial context should be taken into account while developing lifestyle interventions for women with a history of GDM, which is especially important in Australia with its ethnic diverse population. Up until now, only one web-based intervention measured psychosocial outcomes [17] demonstrating no effect, therefore more research is needed to understand the role of psychosocial determinants in changing lifestyle behaviours through well conducted studies [18].

Our group recently conducted a randomized controlled study among overweight and obese women with a history of GDM living in Australia who were exposed to a comprehensive behavioural lifestyle intervention promoting physical activity and a healthy diet [19]. After six months women achieved improvements in dietary behaviours, notably total energy, total fat, saturated fat, and carbohydrate intake.

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106 However, no changes in physical activity were found. To develop a better understanding
107 of the effective components of a lifestyle intervention and explain these findings, the
108 objective of this secondary analysis was to establishing how a lifestyle intervention
109 affects psychosocial determinants and barriers of physical activity and diet in this
110 population at risk of T2DM.

2. Materials and Methods:

2.1 Study design and study population:
As reported earlier [19] a randomized controlled trial was conducted with 59 overweight
or obese women (body mass index (BMI) 25 kg/m^2 or higher), who had a history of
GDM as diagnosed by the Australian Diabetes in Pregnancy Society guidelines at the
time (fasting blood glucose level ≥5.5 mmol/l or a 2 hour level of ≥ 8.0 mmol/l after a
75-gram glucose tolerance test) [20], and had given birth in the previous 6-48 months.
Women had to indicate their intention to improve their physical activity and/or dietary
lifestyles, as assessed with a stage-of-change questionnaire [21]. Exclusion criteria
were: already developed diabetes; currently pregnant or planning pregnancy within six
months; unable to exercise due to chronic illness; medication use that may affect
glucose or weight control; poor English proficiency.

Women who had attended the Diabetes in Pregnancy Service at Westmead, Nepean and
Blacktown Hospitals in the previous 48 months were sent an invitation letter. All those
interested were asked to self-report their weight and height for BMI calculation and to
complete two brief stage-of-change questionnaires for physical activity and diet [22] to
assess their eligibility for the study.

Participants were randomly assigned to the intervention or control group condition after
baseline assessment. Randomization was done in permuted blocks of eight with equal
numbers in each group. Written informed consent was obtained from all participants.
The study was approved by the Sydney West Area Health Service Human Research
Ethics Committee and registered with the Australian New Zealand Clinical Trials
Registry #12614000539639.

2.2 Intervention:
A lifestyle counsellor with dietetics qualifications conducted a one hour face-to-face
counselling session with the participants in the intervention group within 4 weeks after
baseline measurement. The first session took place either in the home, hospital or an
alternative venue such as a community centre. The focus of the intervention was on
improving physical activity and dietary behaviours and followed the patient centered
counselling model [23]. The results from the baseline assessment, health priorities, and
lifestyle barriers formed the basis of the session, in which women were encouraged to
set behaviour change goals with the counsellor. A 'lifestyle journal' was used in the
counselling sessions to support women with monitoring and achieving the healthy
lifestyle goals. This journal included recommendations and benefits of physical activity

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and a healthy diet, strategies for making long lasting lifestyle changes, links to relevant websites, healthy recipes, and information on reading food labels. In addition, participants received a pedometer accompanied by a pedometer logbook and user instructions to facilitate goal setting and self-monitoring of physical activity. Two weeks after the first counselling session the lifestyle counsellor contacted participants by telephone to discuss their progress, which was followed by providing advice and encouragement to assist in reaching the goals set earlier. A second face-to-face session took place four weeks after the first session to address aspects of behaviour change that required further attention. In the remaining five months four more telephone conversations at weeks 8, 11, 16 and 20 were conducted to offer support and advice. In addition women received five text messages (at weeks 5, 9, 12, 17 and 21) on their cell phone and four mailed postcards (at weeks 6,14,18, 22) both with the intention to encourage and inform women about healthy lifestyles and diabetes prevention. In table 1 a timeline of the intervention is presented of a participant starting 3 weeks after the baseline measurement.

Participants randomized to the control group received no intervention, although after the follow up measurement all controls were offered individualized physical activity and dietary advice.

2.3 Measurement of psychosocial determinants:

A lifestyle survey developed among women with a history of GDM was completed at baseline and after six months [24,25]. The self-administered survey included questions on beliefs and attitudes towards physical activity and diet. Descriptive information included parity, marital status, level of education, age, country of birth and employment status. Participants also visited the hospital to record weight and height for the calculation of BMI (kg/m^2).

2.3.1 Lifestyle survey:

Barriers. Barriers for physical activity were assessed with eleven items. These barriers included lack of motivation, lack of time, lack of energy, lack of help with childcare, lack of a convenient place, not having anyone to do physical activity with, family demands, work demands, being overweight, feeling you should put the needs of others in your family before yours, and not having your extended family nearby to give you support.

Barriers for diet were assessed with nine items. These barriers were related to lack of time to prepare healthy food, knowledge how to prepare healthy food, dislike of healthy food by others in the household, costs of fresh fruit and vegetables, difficulty of cooking different meals for different family members, eating food prepared by others, eating culturally prescribed foods, having cravings for sweets and having unhealthy snack foods at home.

Subjects were asked to indicate how often (1= never; 5 = very often) these barriers prevented them from being physically active or from eating a healthy diet. Overall scores were calculated by summing the scores of all items for both physical activity and

194	diet separately. The items of this lifestyle survey had good internal consistency for diet
195	(Cronbach's alpha 0.80) and acceptable internal consistency for physical activity
196	(Cronbach's alpha of 0.74). Test-retest reliability showed a strong correlation
197	(Spearman's correlation of 0.81 for diet barriers; 0.69 for physical activity barriers)
198	[24].
199	
200	*Social support*. Social support for physical activity was assessed with five items. These
201	items were related to how often family or friends performed physical activity together
202	with them, encouraged them to keep regularly physically active, looked after their
203	children so they could be physically active or did household chores so they could be
204	physically active, and how often a doctor or health professional encouraged them to be
205	physically active.
206	Social support for diet was assessed with four items. These items asked how often
207	family or friends helped prepare healthy foods, ate healthy foods themselves to make it
208	easier for them to do as well or encouraged them to eat a healthy diet, and how often a
209	doctor or health professional encouraged them to eat a healthy diet.
210	Subjects were asked to score social support on a five point scale (1= never; 5 = very
211	often) on how often they had any of the following support. Overall social support was
212	calculated as the sum of responses across these items for both physical activity and diet
213	separately. The items of this lifestyle survey had acceptable internal consistency for diet
214	(Cronbach's alpha 0.73) and good internal consistency for physical activity (Cronbach's
215	alpha of 0.82). Test-retest reliability showed a strong correlation (Spearman's
216	correlation of 0.70 for social support diet; 0.78 for social support physical activity) [24].
217	
218	*Self-efficacy.* Self-efficacy for physical activity was assessed with nine items. These
219	items were related to how confident they felt to be physically active when dealing with
220	the following circumstances: feeling tired; feeling they did not have time; feeling
221	stressed; facing the demands of their young child; dealing with other demands at home;
222	having household chores to do; feeling alone; feeling lazy; and feeling depressed.
223	Self-efficacy for diet was assessed with eight items. These items were related to how
224	confident they felt to eat a healthy diet when dealing with the following circumstances:
225	being in a hurry; having others around them eat unhealthy foods; eating out; feeling
226	alone; feeling too lazy to cook; feeling depressed; visiting friends or family; and having
227	other demands at home.
228	Subjects were asked to score self-efficacy on a four point scale (1= very confident; 4=
229	not confident) to be physically active or eat a healthy diet in a variety of situations.
230	Overall self-efficacy was calculated as the sum of the responses across these items for
231	both physical activity and diet separately. The items of this lifestyle survey had good
232	internal consistency (Cronbach's alpha of 0.86 for self-efficacy diet; 0.81 for self-
233	efficacy physical activity) and showed strong correlation for test-retest reliability
234	(Spearman's correlation of 0.66 for self-efficacy diet; 0.62 for self-efficacy physical
235	activity) [24].
236	
237	**2.4 Data analysis:**

Baseline characteristics were described using percentages for categorical variables and means ± standard deviations (SD) for quantitative variables. Group comparisons were made using Chi-square tests for categorical variables and independent t-tests for continuous variables.

Linear regression analyses were performed for all outcome measures at six month follow up with baseline outcome measure as covariate. We adjusted for baseline values to prevent unwanted 'regression to the mean' effects. Further adjustments were made for the potential confounders of BMI and the number of children. All analyses were performed on an intention to treat basis (carrying baseline data forward for participants who missed six month measurements) and on a per protocol (excluding all participants with missing follow up data) analyses. Analyses were carried out with IBM SPSS statistics version 20.1.

The problem of multiple comparisons arises in this trial, increasing the risk of type 1 error (falsely rejecting the null hypothesis). Bonferroni-corrected alpha (i.e. $0.05/46 = 0.0011$) might be too conservative, due to a high probability of correlation between outcomes. We therefore decided to calculate unadjusted p-values and interpret the results as following: a) $p \geq 0.05$: no effect; b) $0.01 < p < 0.05$: results indicate that there may be a positive effect. However the indication is not strong; c) $0.001 < p < 0.01$: results indicate that there may be a positive effect; d) $p < 0.001$: results strongly indicate that there may be a positive effect.

3. Results:

3.1 Study population:

Of the 698 women who were contacted for potential participation, 358 were excluded (42% due to BMI below 25kg/m^2) and 273 declined to participate (69% due to lack of time). There were 59 women who gave informed consent and completed baseline measurement. These women were randomized into either the intervention group (n=29) or the control group (n=30).

Table 2 displays participant characteristics of the study sample at baseline, showing that they were largely university educated (59.3%) married women with a mean age of 35 years. Notably, two-thirds of the sample were born outside of Australia. The women were on average 26 (± 11) months post their GDM pregnancy. Randomization resulted in no significant differences between groups regarding age, level of education, marital status, employment, number of children and time post GDM pregnancy. The BMI of the intervention group was slightly higher, although non-significant (p=0.07). Adherence to the intervention was high [19].

Nine participants (four in the intervention group and five in the control group) lacked follow up questionnaire data, which were imputed with the baseline value carried forward. There were no significant differences on baseline characteristics between those with imputed data and those with complete data at six months. Analyses of the intention to treat and per protocol basis showed similar results; therefore only intention to treat results are presented.

3.2 Barriers:

Total barriers for the intervention group compared to the control group were reduced for diet (β=-3.8, 95%CI= -6.5 to -1.1). The intervention decreased two of the barriers for diet that were experienced most; the problem of having unhealthy snacks at home and the cravings for sweets (Table 3). Furthermore, the barriers of the costs involved in buying fresh fruit or vegetables and lack of time to prepare healthy foods both were reduced in the intervention group. Although this intervention tended to improve knowledge on preparation methods of healthy food and providing participants with examples of healthy alternatives, these changes were non-significant (p=0.072).

Total barriers for the intervention group compared to the control group were reduced for physical activity (β=-3.5, 95%CI=-6.2 to -0.8). A significant reduction in the lack of motivation and lack of energy for physical activity was evident after the intervention, but despite the fact that this intervention also targeted a reduction in barriers related to either not having sufficient time, family demands or a lack of childcare, none of these were significantly changed (Table 4).

3.3 Social support:

Total social support for the intervention group compared to the control group increased for diet (β=2.1, 95%CI= 0.3 to 3.8). The social support women received from their health professional or doctor regarding diet increased (Table 3).

Total social support for the intervention group compared to the control group increased for physical activity (β=3.5, 95%CI=1.8 to 5.2). The social support women received from their health professional or doctor regarding physical activity increased. Additionally, intervention participants reported an increase in receiving encouragement from family and friends to be active, either by being physically active with them or taking care of the woman's children (Table 4)

3.4 Self-efficacy:

Total self-efficacy for the intervention group compared to the control group improved for diet (β=-4.3, 95%CI= -6.0 to -2.6). Women in the intervention group showed improved confidence to adopt healthy eating practices when in a hurry, eating out, feeling alone, feeling too lazy to cook, depressed, when visiting family or friends and dealing with other demands at home (Table 3). Nevertheless the lack of confidence to eat healthy foods when others around them ate unhealthy foods remained unchanged (Table 3).

Total self-efficacy for the intervention group compared to the control group improved for physical activity (β=-2.2, 95%CI=-4.1 to -0.3). Confidence to be physically active was significantly changed post intervention especially when they felt they had no time, when their children demanded something from them, when they felt lazy, when they were tired or had household chores to attend to (Table 4).

4. Discussion:

This lifestyle intervention study aimed to improve confidence, support and behavioural management skills in order to improve physical activity and dietary behaviours of overweight and obese women who had a history of GDM. The intervention successfully lowered barriers, increased self-efficacy and improved social support to adopt changes both in physical activity and diet, which is a promising result in the light of a population at high risk of T2DM. However, this study also shows the complexity of influencing outcomes even when the theoretical mediators all show intervention induced changes.

Time and financial constraints [26,27] have been frequently mentioned in the literature as barriers for a healthy diet, and both were effectively changed as a result of the intervention. In addition this intervention was effective in altering the barriers that were mostly related to the unnecessary intake of calories (i.e., cravings for sweets and availability of snacks at home), which was consistent with the lower total energy, total fat, saturated fat and carbohydrate intake reported for this trial [19]. The intervention might have changed food purchasing habits, perhaps women spend their money rather on fresh foods (e.g. fruit and vegetables) than on buying unhealthy products (e.g. fast food, snacks). Furthermore, the health professional who provided the women with details about a healthy lifestyle was an accredited practicing dietician with expertise in dietary behavioural change. This might have resulted in the women gaining in confidence and experiencing fewer barriers to consuming a healthy diet. Interestingly though, the study exposed an effect in both dietary changes and encouragement (social support) provided by a health professional. This has implications for the clinical setting and would emphasize the importance for the training of health personnel in a range of disciplines related to lifestyle.

Although, women previously indicated they believed dietary change is more important in the prevention of T2DM [28-30], the intervention also included a focus on improving physical activity. At six months this led to an improvement of motivation, indicating that women expressed a stronger intention to become physically active, which is a prerequisite for behavioural change [31]. In addition to being more motivated, it is frequently indicated that physical activity could be improved if women have both high social support [28,32-35] as well as high self-efficacy [33-35].

However, while the intervention resulted in improvements in some psychosocial determinants of physical activity, it did not manage to reduce some barriers (particularly lack of time and child care assistance) to physical activity among women with a history of GDM [27,28,30,32,35]. This offers some insights concerning the lack of improvements in physical activity that have been previously reported in this intervention trial [19].

Even though, the confidence in being physically active when they had no time and the perceived assistance from the health professional and encouragement from family or

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370   friends significantly improved throughout the intervention, it is likely to be problematic
371   to find childcare all the time, which needs to be taken into account when helping women
372   to find opportunities to become more physically active. Whether the barriers lack of
373   time and childcare assistance can be addressed in the design of a clinically based
374   intervention is open to further research.
375
376   A limitation of this study was that it was conducted in a small sample of the target
377   population, which needs replication in a larger sample. In addition, participants had a
378   higher than average level of educational attainment, which affects the generalizability of
379   our results. Attracting women to participate in future studies needs further attention.
380   Perhaps women with a history of GDM should be invited as soon as possible after their
381   GDM diagnosis, because at that time they have an increased sense of urgency and
382   motivation to make lifestyle changes. Another limitation was that the control group did
383   not receive any intervention, therefore findings may be in part due to the contact time
384   that the counselors spent with the participants as opposed to being due to the
385   intervention itself.
386
387   Notwithstanding these limitations, this study offers unique insight into psychosocial
388   determinants of physical activity and diet to be addressed in developing future studies
389   targeting this population at high risk of T2DM. A particular strength is that it was
390   conducted in a multi-ethnic population in Australia, especially many women from Asia
391   and the Middle-East who are already at higher risk of developing T2DM. Due to the
392   personalized intervention approach participants from different cultural backgrounds
393   received appropriate guidance adjusted to their own wishes and cultural norms.
394
395   5. Conclusion:
396
397   The results of the present study show that the lifestyle intervention achieved promising
398   changes in psychosocial determinants of physical activity and dietary behaviours, which
399   has previously been shown to result in improvements in diet but not physical activity
400   [19]. It is important to stress that researchers and health professionals should be aware
401   of the complexity involved in changing both physical activity, and dietary behaviours.
402   Achieving improvements in some key behavioural determinants does not necessarily
403   result in actual behavioural change, and the interaction between the key determinants
404   needs to be taken into account. More research is warranted for finding solutions on how
405   to minimize barriers related to leading a physically active lifestyle in the period after a
406   GDM pregnancy, especially those barriers related to time constraints and childcare.
407
408   Abbreviations:
409   BMI: Body mass index; GDM: Gestational diabetes mellitus; T2DM: Type 2 diabetes
410   mellitus.
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429

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530   Table 1. Timeline of the study assessments and intervention

weeks	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Study assessments	■																										■
Intervention contact moments																											
Face-to-face				■				■																			
Telephone						■						■			■					■				■			
SMS									■				■			■					■				■		
Postcard										■								■				■				■	

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532   Table 2. Baseline participant characteristics in women with a history of GDM for both the control and

533   intervention group

	Control N= 30	Intervention N= 29	Total N= 59	P value
Age, mean (SD), years	35.1 (4.2)	35.7 (4.8)	35.4 (4.5)	0.64
Level of education, n/N (%)				
Some high school	2 (6.7%)	5 (17.2%)	7 (11.9%)	
Completed high school	6 (20.0%)	7 (24.1%)	13 (22.0%)	
Trade/technical certificate or diploma	3 (10.0%)	1 (3.4%)	4 (6.8%)	0.52
University	19 (63.3%)	16 (55.2%)	35 (59.3%)	
BMI, mean (SD), kg/m^2	29.48 (5.17)	31.97 (5.27)	30.70 (5.33)	0.07
Marital status, n/N (%)				
Married	28 (93.3)	25 (86.2%)	53 (89.8%)	0.37
De facto, separated, divorced or never married	2 (6.7%)	4 (13.8%)	6 (9%)	
Employment, n/N (%)				
Unemployed	16 (53.3%)	15 (51.7%)	31 (52.5%)	0.31
Part-time (<36hours)	4 (13.3%)	8 (27.6%)	12 (20.3%)	
Fulltime	10 (33.3%)	6 (20.7%)	16 (27.1%)	
Country of birth, n (%)				
Australia	10 (33.3%)	8 (27.6%)	18 (30.5%)	0.86
Asia or Middle East	15 (50.0%)	15 (51.7%)	30 (50.8%)	
Other	5 (16.7%)	6 (20.7 %)	11 (18.6%)	
Children in household, Mean (SD)	2.27 (1.17)	1.93 (0.92)	2.10 (1.06)	0.23
Time post GDM pregnancy, Mean (SD)	25.5 (10.3)	26.5 (11.9)	26.0 (11.0)	0.74

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Table 3: Results of linear regression for the intervention effects on barriers, social support and self-efficacy for diet

Diet

	Control condition (N=30)		Intervention condition (N=29)		Crude model		Corrected model	
	T0 Mean (SD)	T1 Mean (SD)	T0 Mean (SD)	T1 Mean (SD)	T1 β (95% CI)	P	T1 β (95% CI)	P
Total barriers (range 9-45)	23.7 (6.7)	24.1 (5.9)	23.9 (7.1)	20.8 (7.1)	**-3.44 [-5.95;-0.92]**	**0.008****	**-3.83 [-6.51;-1.14]**	**0.006****
How often does…prevent you from eating a healthy diet								
lack of time to prepare healthy food	3.00 (1.08)	2.70 (1.09)	2.79 (1.08)	2.14 (1.06)	-0.44 [-0.90;0.18]	0.060	**-0.53 [-1.02;-0.04]**	**0.036***
knowledge how to prepare healthy food	2.40 (1.22)	2.37 (1.03)	2.31 (1.14)	2.03 (1.12)	-0.29 [-0.77;0.19}	0.234	-0.45 [-0.94;0.04]	0.072
others in your home not liking healthy food	2.30 (1.26)	2.33 (1.21)	2.38 (1.29)	2.10 (1.15)	-0.26 [-0.83;0.32]	0.372	-0.35 [-0.96;0.27]	0.263
cost of fresh fruit and vegetables	2.10 (1.24)	2.20 (1.13)	1.90 (1.11)	1.66 (1.01)	-0.43 [-0.89;0.02]	0.060	**-0.50 [-0.98;-0.03]**	**0.039***
difficulty of cooking different meals	2.60 (1.30)	2.63 (1.25)	2.72 (1.39)	2.52 (1.27)	-0.19 [-0.69;0.30]	0.440	-0.24 [-0.71;0.24]	0.325
eating food prepared by others	2.33 (1.21)	2.70 (1.29)	2.52 (1.24)	2.52 (1.02)	-0.26 [-0.81;0.29]	0.348	-0.38 [-0.97;0.20]	0.192
eating food specific for culture	2.17 (1.46)	2.10 (1.27)	2.59 (1.38)	2.38 (1.15)	0.07 [-0.45;0.59]	0.794	0.09 [-0.47;0.65]	0.748
having unhealthy snacks at home	3.33 (1.12)	3.53 (0.97)	3.38 (1.08)	2.66 (1.20)	**-0.91 [-1.35;-0.47]**	**0.000****	**-0.86 [-1.33;-0.39]**	**0.001****
having cravings for sweets	3.47 (1.14)	3.50 (1.11)	3.31 (1.11)	2.76 (1.09)	**-0.65 [-1.10;-0.19]**	**0.006****	**-0.67 [-1.16;-0.18]**	**0.008****
Total social support (range 4-20)	10.8 (2.7)	10.2 (3.9)	10.7 (3.1)	12.1 (4.3)	**2.06 [0.46;3.67]**	**0.013***	**2.05 [0.31;3.78]**	**0.022***
Family/friends helped to prepare healthy food	2.63 (1.27)	2.37 (1.16)	2.28 (1.36)	2.41 (1.38)	0.25 [-0.31;0.80]	0.378	0.12 [-0.47;0.71]	0.681
Family/friends eat healthy foods	2.97 (0.96)	2.63 (1.13)	2.93 (1.28)	3.21 (1.37)	**0.60 [0.05;1.14]**	**0.034***	0.53 [-0.06;1.11]	0.077
Encouragement family/friends to eat healthy	3.10 (1.06)	3.03 (1.00)	3.21 (1.21)	3.48 (1.46)	0.39 [-0.17;0.95]	0.170	0.40 [-0.20;1.00]	0.186
Encouragement doctor / health professional to eat healthy	2.10 (1.16)	2.13 (1.31)	2.28 (1.39)	3.03 (1.38)	**0.83 [0.18;1.49]**	**0.014***	**0.79 [0.08;1.50]**	**0.029***

					Crude model β [CI]	P	Corrected model β [CI]	P
Total self-efficacy (range 8-32)	23.6 (4.6)	24.1 (4.2)	22.6 (4.6)	19.5 (4.2)	**-4.02 [-5.56;-2.48]**	**0.000*****	**-4.28 [-5.95;-2.61]**	**0.000*****
How confident are you to eat a healthy diet when …								
in a hurry	2.90 (0.96)	3.20 (0.71)	2.72 (0.84)	2.41 (0.83)	**-0.71[-1.06;-0.36]**	**0.000*****	**-0.82 [-1.19;-0.45]**	**0.000*****
others around you eat unhealthy foods	3.00 (0.83)	2.97 (0.72)	2.66 (0.81)	2.59 (0.83)	-0.15 [-0.44;0.14]	0.309	-0.12 [-0.43;0.19]	0.438
eating out	3.07 (0.64)	3.20 (0.66)	3.10 (0.72)	2.66 (0.67)	**-0.56 [-0.88;-0.23]**	**0.001****	**-0.55 [-0.90;-0.20]**	**0.002****
feeling alone	2.67 (0.96)	2.57 (0.86)	2.41 (0.87)	2.00 (0.76)	**-0.45 [-0.81;-0.08]**	**0.017***	**-0.50 [-0.89;-0.10]**	**0.014***
too lazy to cook	2.97 (0.93)	2.93 (0.87)	2.83 (0.81)	2.38 (0.82)	**-0.46 [-0.77;-0.15]**	**0.005****	**-0.54 [-0.87;-0.21]**	**0.002****
feeling depressed	3.13 (0.86)	3.23 (0.77)	3.10 (0.77)	2.62 (0.82)	**-0.60 [-0.97;-0.23]**	**0.002****	**-0.73 [-1.12;-0.34]**	**0.000*****
visiting friends or family	2.90 (0.85)	2.97 (0.72)	2.86 (0.88)	2.45 (0.78)	**-0.51 [-0.87;-0.14]**	**0.007****	**-0.46 [-0.83;-0.08]**	**0.018***
having other demands at home	2.93 (0.69)	3.07 (0.64)	2.90 (0.86)	2.38 (0.68)	**-0.67 [-0.95;-0.39]**	**0.000*****	**-0.77 [-1.06;-0.47]**	**0.000*****

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537 Bold values represent statistically significant relationships *: P<0.05, **: P<0.01, ***: P<0.001. Notes: Crude model: adjusted for group allocation and baseline

538 value of outcome measure. Corrected model: crude model adjusted for BMI and number of children. N: number of subjects included in analysis. CI:

539 confidence interval. P: p-value. SD: standard deviation. Negative beta's indicate a positive intervention effect for overall barriers and self-efficacy, for social

540 support positive beta's indicate a positive intervention effect.

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542 Table 4: Results of linear regression for the intervention effects on barriers, social support and self-efficacy for physical activity

Physical activity (PA)

	Control condition (n=30)		Intervention condition (N=29)		Crude model		Corrected model	
	T0 Mean (SD)	T1 Mean (SD)	T0 Mean (SD)	T1 Mean (SD)	T1 β (95% CI)	P	T1 β (95% CI)	P
Total Barriers (range 11-55)	33.5 (6.9)	33.2 (8.0)	33.6 (7.5)	29.8 (7.8)	**-3.51 [-6.01;-1.01]**	**0.007****	**-3.49 [-6.16;-0.82]**	**0.011***
How often does ... prevent you from being PA								
lack of motivation	3.43 (1.00)	3.37 (1.00)	3.10 (1.15)	2.45 (1.18)	**-0.72 [-1.19;-0.25]**	**0.003****	**-0.70 [-1.20;-.20]**	**0.007***
lack of time	3.37 (0.96)	3.43 (0.90)	3.66 (1.05)	3.17 (1.14)	-0.43 [-0.87; 0.01]	0.056	-0.38 [-0.85;0.08]	0.106
family demands	3.90 (1.16)	3.67 (0.99)	3.55 (1.21)	3.07 (1.19)	-0.37 [-0.79; 0.04]	0.079	-0.41 [-0.85;0.03]	0.068
lack of energy	3.17 (1.29)	3.03 (1.19)	3.17 (1.34)	2.55 (1.06)	**-0.49 [-0.96;-0.01]**	**0.044***	**-0.65 [-1.14;-0.16]**	**0.010***
not having anyone to do PA with you	2.37 (1.10)	2.53 (1.20)	2.52 (1.43)	2.34 (1.17)	-0.28 [-0.77;0.22]	0.267	-0.25 [-0.76;0.26]	0.332
lack of childcare	3.63 (1.16)	3.27 (1.14)	3.59 (1.55)	3.24 (1.38)	0.00 [-0.51;0.56]	0.992	-0.15 [-0.69;0.39]	0.578
lack of a convenient place	2.43 (1.14)	2.47 (1.11)	2.45 (1.12)	2.24 (0.91)	-0.23 [-0.72;0.25]	0.343	-0.19 [-0.71;0.33]	0.461
being overweight	2.63 (1.50)	2.63 (1.45)	2.55 (1.45)	2.24 (1.41)	-0.34 [-0.85; 0.18]	0.201	-0.38 [-0.94;0.18]	0.181
work demands	2.10 (1.30)	2.20 (1.45)	2.10 (1.45)	2.31 (1.51)	0.11 [-0.44;0.65]	0.694	0.04 [-0.54;0.63]	0.889
feeling you should put the needs of others in your family before yours	3.90 (1.30)	3.67 (1.27)	3.86 (0.74)	3.41 (0.98)	-0.23 [-0.67; 0.22]	0.316	-0.17 [-0.65;0.31]	0.477
not having your extended family nearby to give you support	2.53 (1.53)	2.97 (1.69)	3.03 (1.27)	2.79 (1.11)	-0.44 [-1.10;0.22]	0.185	-0.54 [-1.23;0.16]	0.128
Total social support (range 5-25)	10.0 (3.9)	10.4 (3.9)	11.1 (3.2)	14.0 (3.5)	**3.03 [1.36; 4.70]**	**0.001****	**3.50 [1.80;5.20]**	**0.000*****
Together with family/friends	1.70 (1.06)	1.63 (0.89)	2.38 (1.29)	2.69 (1.17)	**0.81 [0.29; 1.32]**	**0.003****	**0.95 [0.40;1.50]**	**0.001****
Encouragement family/friends	2.67 (1.24)	2.77 (1.10)	3.07 (1.22)	3.69 (0.97)	**0.77 [0.28; 1.26]**	**0.003****	**0.86 [0.35;1.37]**	**0.001****
Family/friends look after children	1.90 (1.21)	2.07 (1.20)	1.90 (1.11)	2.62 (1.35)	0.56 [-0.06;1.17]	0.074	**0.74 [0.13;1.35]**	**0.018***
Family/friends do household chores	1.67 (0.96)	1.87 (1.11)	1.55 (0.83)	2.21 (1.08)	0.42 [-0.04;0.89]	0.072	0.42 [-0.06;0.91]	0.086
Encouragement doctor or health	2.03 (1.27)	2.03 (1.27)	2.21 (1.29)	2.83 (1.34)	**0.72 [0.09;1.35]**	**0.025***	**0.76 [0.08;1.43]**	**0.028***

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					Crude model β [95% CI]	P	Corrected model β [95% CI]	P
professional								
Total self-efficacy (Range 6-36)	27.5 (4.6)	28.4 (4.9)	24.3 (5.0)	23.7 (5.5)	**-1.97 [-3.70;-0.25]**	**0.026***	**-2.19 [-4.06;-0.33]**	**0.022***
How confident are you to be PA when …								
tired	3.27 (0.79)	3.37 (0.67)	2.72 (0.84)	2.69 (0.85)	**-0.29 [-.57;-0.02]**	**0.040***	**-0.32 [-0.62;-0.01]**	**0.040***
don't have time	3.13 (0.78)	3.40 (0.68)	2.97 (0.82)	2.76 (0.79)	**-0.57 [-0.92;-0.23]**	**0.002****	**-0.65 [-1.00;-0.29]**	**0.001****
feeling stressed	3.03 (0.96)	3.10 (0.89)	2.76 (0.83)	2.72 (0.70)	-0.24 [-0.59;0.11]	0.180	-0.29 [-0.66;0.09]	0.135
demands of young baby/child	2.83 (0.91)	3.10 (0.85)	2.72 (0.84)	2.59 (0.83)	**-0.46 [-0.85;-0.08]**	**0.019***	**-0.57 [-0.97;-0.17]**	**0.006****
other demands at home	3.17 (0.79)	3.20 (0.61)	2.93 (0.88)	2.93 (0.88)	-0.15 [-0.48;0.18]	0.377	-0.25 [-0.60;0.09]	0.149
household chores to attend to	2.80 (0.85)	2.97 (0.81)	2.45 (0.91)	2.45 (0.78)	-0.39 [-0.78;0.00]	0.051	**-0.44 [-0.87;-0.00]**	**0.049***
feeling alone	2.63 (0.93)	2.60 (1.04)	2.07 (0.80)	2.07 (0.70)	-0.28 [-0.72;0.17]	0.218	-0.36 [-0.82;0.11]	0.133
feeling lazy	3.33 (0.71)	3.40 (0.72)	2.97 (0.91)	2.76 (0.74)	**-0.45 [-0.77;-0.13]**	**0.007****	**-0.48 [-0.83;-0.13]**	**0.008***
feeling depressed	3.30 (0.84)	3.27 (0.79)	2.76 (0.87)	2.76 (0.83)	-0.13 [-0.44;0.17]	0.387	-0.16 [-0.44;0.20]	0.473

543

544 Bold values represent statistically significant relationships *: P<0.05, **: P<0.01, ***: P<0.001. Notes: Crude model: adjusted for group allocation and baseline

545 value of outcome measure. Corrected model: crude model adjusted for BMI and number of children. N: number of subjects included in analysis. CI:

546 confidence interval. P: p-value. SD: standard deviation. Negative beta's indicate a positive intervention effect for overall barriers and self-efficacy, for social

547 support positive beta's indicate a positive intervention effect.

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