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Factors associated with dropout in a lifestyle modification program for weight management in children and adolescents

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ABSTRACT

Background: Significant dropout rates remain a serious concern in pediatric weight control program, but few studies have identified predictors of dropout.
Aims: The objective of the study is to identify factors associated with dropout from a pediatric lifestyle modification weight control program at different phases.
Methods: Data on overweight and obese participants (n = 242) aged 11–18 years in the Intervention for Childhood and Adolescent Obesity via Activity and Nutrition (ICAAN) study were collected at baseline, 6-months, and 24-months through self-report and a laboratory test. Logistic regression analysis was performed for those who dropped out during the first 6-months, and multivariate generalized estimating equation analysis identified longitudinal factors associated with those who dropped out after 24 months.
Results: Lower family functioning (OR = 2.30, 95% CI [1.18–4.46]), exercise group (OR = 0.36, 95% CI [0.15–0.86]), lower initial attendance rate (OR = 6.09, 95% CI [2.94–12.6]), and non-self-referral pathways (OR = 2.35, 95% CI [1.05–5.27]) were significantly associated with 6-month dropouts. For late dropout, lower family functioning (OR = 1.71, 95% CI [1.06–2.77]) and lower initial attendance rates (OR = 2.06, 95% CI [1.12–3.81]) remained significant.
Conclusion: Family function and initial attendance rate were associated with lower dropout rates. Developing a supportive family environment and focusing on the early-stage factors at the intervention's outset may reduce overall dropout rates in obesity prevention intervention.

Introduction

The global prevalence of obesity in children and adolescents has risen dramatically in recent decades [1,2] from 11 million in 1975 to 124 million in 2016 [2]. Lifestyle changes, increased food intake, and decreased physical activity have resulted in a positive energy imbalance [3]. Moreover, childhood obesity can cause various physical and psychological comorbidities and increase the likelihood of health problems later in life [4]. Several systematic reviews have shown that multidisciplinary approaches to lifestyle modifications and pediatric obesity interventions are the most effective ways to treat childhood obesity, especially over the long term [3,5–8].

Although effective approaches exist, poor intervention engagement can lead to ineffective uses of clinical resources for weight management [9,10]. In other words, although interventions are effective for those who complete them, poor participant engagement is a major concern in long-term interventions [5,10]. Specifically, participants may dropout at various time points throughout the intervention [9]. Dropout rates range from 12 to 50%, especially among pediatric participants [11]. Dropout leads to

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poor disease control and decreases the treatment's effectiveness, eventually impacting health outcomes [10]. Reducing dropout rates in lifestyle modifications in pediatric weight control interventions is thus, critical for long-term behavioral changes.

Few studies investigating the predictors of intervention engagement in a lifestyle modification have comprehensively reviewed the demographic, psychosocial, and clinical factors involved. Although various studies have identified age, race/ethnicity, anthropometrics, health service factors, psychological status, and lack of treatment readiness as predictors of dropout rates, the findings have been mixed [11–21]. Previous studies in obesity intervention have also revealed that psychological distress and lower family functioning could be related to dropout from weight management interventions [15,16,20–22]. However, limited studies have explored the role of younger participants' subjective support from family during the intervention. Also, a recent five-year longitudinal study found that the intervention type was an important predictor of dropout [12]. Similarly, a study of adult participants of weight management interventions found that the intensity of intervention and frequency of visits may be associated with dropping out [20].

To develop a successful intervention program for children and adolescents with obesity, it is important to identify factors related to intervention dropout. To date, little attention has been given to identifying predictors of dropout at different intervention phases by considering situational changes during interventions. Therefore, this study aims to identify these factors during both early and late dropouts during a 24-month longitudinal intervention program for children and adolescents with obesity.

Materials and methods

Study subjects

This study analyzed the baseline data from 242 adolescents (aged ten to 17 years) who participated in the Intervention for Childhood and Adolescent Obesity via Activity and Nutrition (ICAAN) study from November 11, 2016 to April 30, 2019. The ICAAN study is two-year multidisciplinary intervention program including nutrition, exercise, psychological well-being, and behavioral modifications for Korean children and adolescents with obesity. This study is designed to explore the etiology of childhood obesity by assessing lifestyle risk factors and providing a methodological framework for community intervention and public health programs. The intervention is divided into three types of care: usual care, usual care + exercise, and usual care + nutrition. Participants were randomly assigned to one of the three groups. The usual care program provided general care combined with care that was tailored according to intensity, frequency of contact, and the manner of contact (in person or by telephone or text with greater frequency).

Of the 242 initial participants who were overweight or obese, 163 participants continued in the trial for a 6-month period, and 110 participants continued in the trial for over a 24-month period. This study used 242 complete sets of baseline data as well as 163 and 110 follow-up surveys for 6- and 24-month groups, respectively, conducted with the students and their parents or legal guardians. All the procedures involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964's Helsinki Declaration and its later amendments or comparable ethical standards. Ethics approval was obtained from [blinded for review] Institutional Review Board (approval number: 2015-I134 and 2016-I135). Written Informed consent was obtained from each individual participant included in the study.

Measures

The dropout pattern was assessed by identifying participants who discontinue the program during early dropouts (0–6 months) or late dropouts (7–24 months). We operationalized these as early dropout and late dropout, respectively, based on follow-up data obtained after administration of a medical check-up (which included follow-ups at 6 and 24-months). Based on previous studies, we comprehensively explored factors associated with dropout, including sociodemographic factors and psychological and clinical factors.

Age was measured as a continuous variable, and household income was categorized by tercile (low, middle, and high income). Distance from home to the clinic was calculated using the Google Maps Distance Calculator by obtaining information from participants' home address and the hospital. The distance from the home to the clinic was categorized as ≤4.99 km or >5 km, which required personal transportation or public transit (studies examining adherence indicated that longer travel distances were barriers to session attendance) [22,23].

Participants' weight status was determined using age- and sex-specific BMI percentiles based on the 2007 Korean National Growth Chart., height was measured using a stadiometer, and body weight was measured with an InBody 720. Using the participant's height and weight, BMI was calculated using the following formula: BMI = kg/m^2, where kg is a person's weight in kilograms and m^2 is his or her height in squared meters. Weight status was categorized as overweight-to-moderate obesity (85th–95th percentile and 95–120% of the 95th percentile, respectively) or severe obesity (≥120% of the 95th percentile) [24].

The severity of depression symptoms was measured as a psychological factor using the Child Depression Inventory (CDI), which was self-reported by the participants. The CDI was developed by Kovacs and Beck and has been confirmed as having high reliability and validity [25]. It consists of a 27-item questionnaire and evaluates cognitive, affective, and behavioral signs of depression in children and adolescents aged ten to 17 years. The Korean version of CDI was validated by Cho and Lee and is widely used in clinical evaluations and research in Korea [26]. Each factor consists of three statements that are assigned a score from 0 (no symptom) to 2 (definite symptom) on a Likert scale; the total score ranges from 0 to 54 points. We classified the highest (third) tercile of CDI scores (a score of 12 or higher) as the group with higher levels of depressive symptoms, and first and second tercile were categorized as the group with lower levels of depressive symptoms.

Parental psychological stress was measured using self-reported Psychological Well-Being Index Short-Form (PWI-SF) for both parents. The PWI-SF consists of 18 questions to measure multiple facets of psychological functioning. This tool evaluates the level of psychological stress in the general population of South Korea and had a test-retest reliability of 0.72 and Cronbach's alpha of 0.93 [27]. A higher PWI-SF score indicated higher psychological stress and scores higher than 27 were considered to be highly distressed [27].

Family functioning was measured using children and adolescent participants' self-reported family Adaptability, Partnership, Growth, Affection, and Resolve (Family APGAR) Test to assess the satisfaction with the support from their families [28]. Responses to the questions, corresponding with each of the five parameters, were scored along a scale from 0 (hardly ever) to 2 (almost always); higher scores indicated a greater degree of satisfaction with the familial relationship. Highly functional families were defined as having a score of 7 or more [28]. To assess the availability of resources, the mother's work status was included and categorized as working or non-working mothers.

To understand the role of contextual factors in the treatment process, we included three groups of the ICAAN study: usual care

group, exercise group, and nutrition group. Participants were randomly categorized into one of the three groups. The usual care program provided general care combined with care that was tailored according to intensity, frequency of contact, and the manner of contact (in person or by telephone call or text with a greater frequency).

For the initial attendance rate, participants were categorized by their attendance rate in the first three months of the intervention, with those in the highest tercile of attendance classified as high sporadic attendees and the remaining participants classified as low sporadic attendees. We also investigated the referral pathway, which was dichotomously categorized as self-referral and non-self-referral. Self-referral included voluntary participation via newspaper advertisements, internet presence, and flyers without seeing anyone else. Non-self-referral included non-voluntary participation through pediatrician referral or a school health teacher's suggestion after seeing an official document from a provincial education office.

Method

From the demographic data, descriptive statistics were calculated, including frequencies, means, standard deviations, and percentages of responses, measured at baseline in terms of early and late dropout. Further analyses were performed to investigate the factors associated with dropout. Socio-economic variables, age, gender, and monthly household income were adjusted, and exploratory analyses were completed as a first step. The explanatory variables included family functioning (APGAR score), intervention type, initial attendance rate, and referral pathways. Early dropout was analyzed using multivariate logistic regression of baseline characteristics. For late dropout, a generalized estimating equation (GEE) with logit link function and independent correlation structure was used to determine whether there were associations between late dropout and related factors; GEE models adjust standard error to produce valid estimates, accounting for potential correlation within subjects (such as repeated measurements in a longitudinal study) [29]. For late dropout, the socioeconomic variables were adjusted, and the exploratory analyses were completed as a first step. The explanatory variables included maternal work status, depressive symptoms, family functioning, intervention type, and initial attendance rate. The odds ratios (ORs) and 95% confidence intervals (CIs) were evaluated to find associations between dropout and associated factors. We evaluated the odds ratios (ORs) and 95% confidence intervals (CIs) for the associations found between adherence and associated factors. For all analyses, $p < 0.05$ was considered statistically significant. All statistical analyses were carried out using STATA software version 12.0.

Results

Pediatric weight control program dropout was defined as whether participants dropped out during 6-month and or 24-month. Dropout rates for these periods were 32.6% at 6-month and 45.9% at 24-month, respectively. Table 1 presents participants' general characteristics for completers and dropouts. Of the participants who dropped out of the program at 6-month, 40.5% were boys and 59.5% were girls. For dropouts at 24-month.

Regarding psychosocial variables, depressive symptoms were significantly associated with dropping out of the program. Completers were significantly more likely to be non-depressive; higher levels of depressive symptoms were associated with higher dropout rates. Lower family functioning was associated with early and late dropout. Regarding the intervention type, a lower dropout rate was seen among those following one of the combined programs (exercise program) than among those following the usual care program. Also, low attendance rates during the first three months increased higher risk of dropping out of the program. Non-self-referral participants were significantly associated with greater dropout until the 6-month point, but no associations for late dropout were observed.

Table 2 presents the ORs for the predictors of the ICAAN program dropout, obtained by regressing the follow-up status at 6-month on related factors. After adjusting for confounding factors (which are gender, age, and income), the results showed that poor attendance in the initial three months of the intervention was significantly associated with a greater risk of dropout (OR = 6.09, 95% CI [2.94−12.6]). Also, lower family functioning was significantly associated with higher odds for dropout (OR = 2.30, 95% CI [1.18−4.46]) and non-self-referral was associated with an increased tendency for early dropouts (OR = 2.35, 95% CI [1.05−5.27]). Lastly, being allocated to the exercise group reduced the risk of dropping out of intervention (OR = 0.36, 95 % CI [0.15−0.86]).

Table 3 presents the factors associated with late dropout in the intervention fitting the GEE (24-month; these factors are slightly different from those of the early dropouts (6-month. After adjusting for confounding factors, low attendance rate in the initial three months showed higher odds for later dropout (OR = 2.06, 95% CI [1.12−3.81]). Lower family functioning was significantly associated with higher odds for later dropouts (OR = 1.71, 95% CI [1.06−2.77]).

Discussion

This study explored the factors associated with dropout rates in a multidisciplinary lifestyle modification intervention for children and adolescents with obesity. The results indicated that lower family functioning, intervention type, and lower initial attendance rates were significantly associated with both early and late dropout, while non-self-referral pathways were additionally associated with early dropout rates,

A poor-quality family relationship at baseline was also associated with higher rates of both early and late dropout, which is consistent with many other qualitative and quantitative studies of adherence. Previous studies have found that late dropout in childhood interventions is associated with lower parental involvement [16,17,21,22,32–36]. Participants are likely to be most highly motivated to lose weight during the very early phases of an intervention; this may explain why parental involvement factors are less likely to predict early dropout. Spence et al. [16] reported that family functioning was critical for intervention adherence which is consistent with other findings that lower family functioning is significantly associated with barriers to intervention engagement in parental interventions, and that a static adaptability family structure can independently predict long-term attrition, causing higher dropout rates [15,16]. Sawamoto et al. [33] found that low maternal care scores on a parental bonding assessment predicted dropout rates. Family members can thus play a crucial role in determining overall intervention attendance, especially in longer-term interventions [33]. Therefore, there is a need for policies and specific strategies based on the family unit, rather than at the individual level, that promote children to enhance healthy behaviors during the intervention.

We also found that poor attendance during the first three months was associated with both early and late dropout. This finding is consistent with previous studies that have reported an association between high attendance rates during a program's early phase and better attendance during later phases, even if later sessions were held less frequently [15,43]. One study even used early attendance rates as a proxy for intervention fidelity [12] Overall, these results suggest that strong early attendance increases

Table 1
General characteristics of the study participants according to early and late dropout.

	6-month follow-up			24-month follow-up		
	Dropouts (n = 79)	Completers (n = 163)	p	Dropouts (n = 132)	Completers (n = 110)	p
Gender						
Boys	48(60.8)	97(59.5)	0.852	78(59.1)	67(60.9)	0.774
Girls	31(39.2)	66(40.5)		54(40.9)	43(39.1)	
Age (years)	10.9 ± 1.94	10.8 ± 2.16	0.871	11.0 ± 2.02	10.6 ± 2.15	0.097
BMI Z score	2.29 ± 0.49	2.31 ± 0.51	0.709	2.30 ± 0.52	2.31 ± 0.49	0.870
BMI Z score change (3 months)	−0.08 ± 0.02	−0.02 ± 0.03	0.556	−0.10 ± .025	−0.07 ± 0.19	0.421
Intervention type						
Usual care	34(43.0)	50(30.7)	0.020	45(34.1)	39(35.5)	0.663
Exercise	15(19.0)	59(36.2)		38(28.8)	36(32.7)	
Nutrition	30(38.0)	54(33.1)		49(37.1)	35(31.8)	
Initial attendance rate						
High sporadic attendee	14(17.7)	96(58.9)	0.000	40(44.9)	77(70.6)	0.000
Low sporadic attendee	65(82.3)	67(41.1)		49(55.1)	32(29.4)	
Self-referral						
Yes	66(83.5)	115(70.6)	0.029	33(25.0)	28(25.5)	0.935
No	13(16.5)	48(29.5)		99(75.0)	82(74.6)	
Depressive symptoms in participants						
Lower	38(56.7)	103(66.0)	0.186	67(57.8)	33(30.8)	0.078
Higher	29(43.3)	53(34.0)		49(42.2)	74(69.2)	
Monthly household Income						
Lowest (< 3 million KRW)	13(18.6)	29(18.1)	0.832	29(23.8)	13(12.0)	0.055
Middle (3–6 million KRW)	31(44.3)	65(40.6)		45(36.9)	51(47.2)	
Highest (>6 million KRW)	26(37.1)	66(41.3)		48(39.3)	44(40.7)	
Maternal work status						
Working	44(66.7)	98(63.2)	0.625	77(66.4)	65(61.9)	0.488
Non-working	22(33.3)	57(36.8)		39(33.6)	40(38.1)	
Family functioning						
Higher functioning	28(41.8)	102(65.4)	0.001	61(52.6)	69(64.5)	0.072
Lower functioning	39(58.2)	54(34.6)		55(47.4)	38(35.5)	

Notes. Depressive symptoms of participants were assessed using the Child Depression Inventory (CDI); highest (third) tertile group of scores (≥12) indicates higher levels of depressive symptoms, and first and second tertile groups were categorized as lower levels of depressive symptoms; Initial attendance rate was categorized by their attendance rate in the first three months of the intervention, with those in the highest tertile of attendance classified as high sporadic attendees and the remaining participants classified as low sporadic attendees. Data are presented as means ± standard deviation or frequencies (percentage), as appropriate; Family functioning was assessed using the family adaptability, partnership, growth, affection, and resolve (APGAR) test, score ≥ 7 indicates higher functioning, and score <7 lower functioning.

Table 2
Factors associated with dropout in the intervention at 6-month.

	6-month follow-up			
	Crude OR (95 % CI)		[a]Adjusted OR (95% CI)	
Gender				
Boys	1.05	(0.61–1.82)	1.01	(0.52–1.99)
Girls	1		1	
Age	1.01	(0.89–1.15)	0.91	(0.78–1.07)
Monthly household Income				
Lowest (< 3 million KRW)	1		1	
Middle (3–6 million KRW)	1.06	(0.49–2.32)	1.31	(0.51–3.41)
Highest (>6 million KRW)	0.88	(0.40–1.95)	1.38	(0.52–3.72)
Family functioning (APGAR)				
Lower functioning	2.63	(1.46–4.73)	2.30	(1.18–4.46)
Higher functioning	1		1	
Intervention type				
Usual care	1		1	
Exercise	0.37	(0.18–0.76)	0.36	(0.15–0.86)
Nutrition	0.82	(0.44–1.52)	.669	(0.31–1.45)
Initial attendance rate				
Low sporadic attendee	6.55	(3.40–12.63)	6.09	(2.94–12.6)
High sporadic attendee	1			
Self-referral				
No	2.12	(1.07–4.20)	2.35	(1.05–5.27)
Yes	1		1	

Notes. Depressive symptoms of participants were assessed using the Child Depression Inventory (CDI): highest (third) tertile group of scores (≥12) indicates higher level of depressive symptoms, and the first and second tertile groups indicate lower levels of depressive symptoms; Family functioning was assessed using the family adaptability, partnership, growth, affection, and resolve (APGAR) test, score≥ 7 indicates higher functioning, and score <7 indicates lower functioning; CI: confidence interval; OR: odds ratio; Initial attendance rate was categorized by their attendance rate in the first three months of the intervention, with those in the highest tertile of attendance classified as high sporadic attendees and the remaining participants classified as low sporadic attendees.

[a] Gender, age, and monthly household income were adjusted.

the likelihood that participants will build therapeutic relationships during the intervention, which in turn are associated with better program adherence.

Non-self-referrals were associated with an increased likelihood of dropping out early. Similarly, recent research indicated that the non-self-referral pathway was associated with early dropout

Table 3
Factors associated with dropout in the intervention fitted by GEE.

	24-month follow-up			
	Crude OR (95 % CI)		[a]Adjusted OR (95% CI)	
Gender				
Boys	0.93	(0.55–1.56)	0.89	(0.47–1.69)
Girls	1		1	
Age	1.10	(0.98–1.23)	1.01	(0.88–1.16)
Income				
Lowest (< 3 million KRW)	1		1	
Middle (3–6 million KRW)	0.40	(0.18–0.85)	0.35	(0.14–0.89)
Highest (>6 million KRW)	0.49	(0.23–1.06)	0.50	(0.19–1.30)
Maternal work status				
Working	1.21	(0.70–2.11)	1.36	(0.71–2.62)
Non-working	1		1	
Depressive symptoms				
Higher	1.75	(1.12–2.75)	1.43	(0.85–2.39)
Lower	1		1	
Family functioning (APGAR)				
Lower functioning	2.05	(1.32–3.18)	1.71	(1.06–2.77)
Higher functioning	1		1	
Intervention type				
Usual care	1		1	
Exercise	0.92	(0.49–1.71)	1.18	(0.58–2.44)
Nutrition	1.21	(0.66–2.24)	1.20	(0.58–2.51)
Initial attendance rate				
Low sporadic attendee	3.69	(2.16–6.31)	2.06	(1.12–3.81)
High sporadic attendee	1		1	

Notes. Depressive symptoms of participants were assessed using the Child Depression Inventory (CDI): highest (third) tertile group of scores (≥12) indicates higher level of depressive symptoms, and the first and second tertile groups indicate lower levels of depressive symptoms; Family functioning was assessed using the family adaptability, partnership, growth, affection, and resolve (APGAR) test, score≥ 7 indicates higher functioning, and score <7 indicates lower functioning; CI: confidence interval; OR: odds ratio; Initial attendance rate was categorized by their attendance rate in the first three months of the intervention, with those in the highest tertile of attendance classified as high sporadic attendees and the remaining participants classified as low sporadic attendees.

[a] Gender, age, and monthly household income were adjusted.

[18,30], which affected the results of the long-term analysis. Conversely, self-referring patients may show greater readiness for treatment and be highly motivated early in the intervention [18]. In the additional data analysis of this study, comparison between the self-referral and non-self-referral pathways for the stages of readiness for health behavioral change based on the transtheoretical model indicated that the self-referral group showed higher readiness than the non-self-referral group (p = 0.054, data not shown). This indicates that it is critical to enhance referral processes by increasing awareness of obesity prevention intervention programs and their benefits, promoting patients' motivation to seek treatment at the pre-intervention stage [31]. Making self-referrals more widely available could potentially lead to the increased enrollment of participants who are less likely to dropout. Consistent with previous studies, the present results also indicated that baseline factors could be used to predict dropout rates.

This study also found that type of intervention was significantly associated with early dropout. The result showed that exercise group in the type of intervention was a significant predictor of early dropout. The exercise group included weekly physical activity class with circuit training was associated with a lower dropout compared to the monthly care group that performed a monthly face-to-face intervention. Previous studies have also reported that the intervention combined with physical activity were effective over the long term [38–41] and this could be because of program intensity through higher number of visits. In this study, visits to the exercise program were more frequent than in the other groups. The important difference is that the number of visits to the exercise class was higher than the number of 1:1 counseling visits for the other groups. Thus, it is not just because of a combined program that involves the physical activity. Several studies have suggested that increasing the frequency of intervention visits is crucial in managing childhood obesity and that this should be adjusted according to the severity of the child's obesity. Song et al. [37] emphasized the importance of frequent visits for the children whose BMI is in the 95th percentile or above, recommending that health professionals see the patient and family weekly for a minimum of 8–12 weeks [37]. This indicates that the more severe the child's obesity, the more frequent the participation in the intervention program should be. This implies that the feedback obtained from frequent visits during the exercise sessions may have led participants to feel that they were being monitored by health providers and by their peers more often.

This study has several limitations. Although sufficient data were obtained from both children and their parents to explore a range of sociodemographic, psychosocial, and clinical factors at each phase, other potentially significant variables, such as logistical barriers, were outside of the study's scope. Finally, because our sample size was relatively small, our findings are not broadly generalizable to other lifestyle modification interventions. In addition, this study mainly aimed at children with moderate obesity and it does not take into account races, thus, the generalizability of the results is limited. Future studies should use a larger sample to investigate factors associated with intervention dropout rates more broadly.

Despite these limitations, our study has several strengths. First, we comprehensively reviewed a broad array of behavioral, psychosocial, and environmental factors that have been previously associated with dropout rates in interventions targeting children and adolescents who are overweight or obese. We found that complex responses to these factors are needed to reduce intervention dropout. Second, most previous studies on intervention dropout predictors have found personal characteristics to be significant predictors, but they have only measured predictors at baseline. We focused instead on the associations between dropout rates and a variety of factors, which may change over the course of the study. Our results indicated that intervention-related factors, as well as some personal factors, were significantly associated with intervention dropout rates, with important implications for

decreasing dropout rates in future interventions. Lastly, according to the follow-up period, the dropout factors were analyzed separately and we discovered other associated factors at each phase. This study showed that different characteristics predicted dropout at different phases of the intervention.

Conclusions

This study highlights that there is a slight difference in the predictors associated with short-term and long-term dropout in the withdrawal of a long-term intervention program. Particularly, we suggest that it is crucial to focus on the family environment including family function, which also predict early and late dropout, indicating that the program needs to be tailored from the outset to reduce dropout rates. Therefore, for successful intervention through continuous adherence, rather than merely focusing on weight changes, it is important for clinicians focus on adolescent circumstances, particularly the family environment.

Ethical approval

All the procedures involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964′s Helsinki Declaration and its later amendments or comparable ethical standards. Ethics approval was obtained from the Hallym University Sacred Heart Hospital's Institutional Review Board (approval number: 2015-I134 and 2016-I135). Written informed consent was obtained from all individual participants included in the study.

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Author contributions

KHP and JP suggested and conceptualized the study. All authors designed the study and developed the study protocol. KHP and JP analyzed the data and drafted the manuscript. KHP, JP, SW, YSJ, YGS, and HMN interpreted the results and contributed to the critical revision of the manuscript. All authors have read and approved the final manuscript.

Declarations of interest

The authors declare that they have no conflict of interest.

Appendix A. The general characteristics of dropout factors according to phase

	6-month follow-up			24-month follow-up		
	Dropouts (n = 79)	Completers (n = 163)	p	Dropouts (n = 132)	Completers (n = 110)	p
Gender						
Boys	48(60.8)	97(59.5)	0.852	78(59.1)	67(60.9)	0.774
irls	31(39.2)	66(40.5)		54(40.9)	43(39.1)	
Distance from home to clinic						
0–4.99 km	61(77.2)	119(73.0)	0.482	98(74.2)	82(74.6)	0.957
5–9.99 km	18(22.8)	44(27.0)		34(25.8)	28(25.5)	
Age (years)	10.9 ± 1.94	10.8 ± 2.16	0.871			
Monthly household Income						
Lowest (< 3 million KRW)	13(18.6)	29(18.1)	0.832	29(23.8)	13(12.0)	0.055
Middle (3–6 million KRW)	31(44.3)	65(40.6)		45(36.9)	51(47.2)	
Highest (>6 million KRW)	26(37.1)	66(41.3)		48(39.3)	44(40.7)	
Maternal work status						
Working	44(66.7)	98(63.2)	0.625	77(66.4)	65(61.9)	0.488
Non-working	22(33.3)	57(36.8)		39(33.6)	40(38.1)	
Obesity severity						
Not severe	53(67.1)	111(68.1)	0.875	44(33.3)	34(30.9)	0.688
Severe	26(32.9)	52(31.9)		88(66.7)	76(69.1)	
Trans Theoretical Model						
Precontemplation	9(13.8)	15(9.30)	0.184	57(47.5)	46(42.6)	0.605
Contemplation	51(78.5)	121(74.7)		49(40.8)	45(41.7)	
Preparation/Action	5(7.70)	26(16.0)		14(11.7)	17(15.7)	
Depressive symptoms in participants						
Lower	38(56.7)	103(66.0)	0.186	67(57.8)	33(30.8)	0.078
Higher	29(43.3)	53(34.0)		49(42.2)	74(69.2)	
Psychological well-being of the father						
Less distressed	41(80.4)	130(94.9)	0.002	12(13.0)	5(5.21)	0.061
Highly distressed	10(19.6)	7(5.11)		80(87.0)	91(94.8)	
Psychological well-being of the mother						
Less distressed	51(78.5)	127(83.6)	0.371	20(17.4)	19(18.6)	0.813
Highly distressed	14(21.5)	25(16.5)		95(82.6)	83(81.4)	
Family functioning						
Higher functioning	28(41.8)	102(65.4)	0.001	61(52.6)	69(64.5)	0.072
Lower functioning	39(58.2)	54(34.6)		55(47.4)	38(35.5)	
Intervention type						
Usual care	34(43.0)	50(30.7)	0.020	45(34.1)	39(35.5)	0.663
Exercise	15(19.0)	59(36.2)		38(28.8)	36(32.7)	
Nutrition	30(38.0)	54(33.1)		49(37.1)	35(31.8)	
Initial attendance rate						
High sporadic attendee	14(17.72)	96(58.9)	0.000	40(44.9)	77(70.6)	0.000
Low sporadic attendee	65(82.3)	67(41.1)		49(55.1)	32(29.4)	

Self-referral						
Yes	66(83.5)	115(70.6)	0.029	33(25.0)	28(25.5)	0.935
No	13(16.5)	48(29.5)		99(75.0)	82(74.6)	

Notes. Data are presented as means ± standard deviation or frequencies (percentage), as appropriate; Psychological well-being of the parent was assessed using the Psychosocial Well-Being Index Short-Form (PWI-SF), score ≥ 27 indicates highly distressed, and score < 27 indicates less distressed.

Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.orcp.2020.09.002.

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