RESEARCH





Effectiveness of a social cognitive theory and family system theory-based intervention in improving eating behaviors in preschool children

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Abstract

Background Eating behaviors in early childhood are crucial for long-term health and weight management. Behavioral interventions grounded in social and family dynamics may play a pivotal role in improving these habits. This study evaluates the effectiveness of a Social Cognitive Theory (SCT) and Family System Theory (FST)-based intervention in modifying eating behaviors in preschool children.

Methods An experimental study was conducted from September 2022 to July 2023 with 120 preschool children in Behbahan City, Iran. Participants were selected using a multi-stage random sampling method. The intervention was delivered to mothers over six educational sessions, focusing on parenting styles and behavior modification strategies. The Child Eating Behavior Questionnaire (CEBQ) was administered at baseline, three months, and six months post-intervention. Data analysis was performed using SPSS version 24.

Results In the intervention group, Satiety Responsiveness (SR) and Slowness in Eating (SE) scores increased by 0.60 and 0.14, respectively, while Desire to Drink (DD), Emotional Over-Eating (EOE), Enjoyment of Food (EF), and Food Responsiveness (FR) decreased by 2.20, 0.85, 0.22, and 0.56 points, respectively. Repeated-measures ANOVA revealed significant differences in SR, DD, and FR across time points (*p* < 0.05), suggesting a sustained effect of the intervention.

Conclusion A family-focused intervention integrating SCT and FST can effectively improve eating behaviors in preschool children by empowering mothers with behavioral and parenting strategies. These findings support the importance of early, structured interventions in preventing childhood obesity.

Research Highlights

- A family-based SCT- and FST-driven intervention improved preschoolers' eating behaviors.
- SR and SE increased, while DD, EOE, EF, and FR significantly decreased (p < 0.05).
- · Parental involvement and behavioral reinforcement were key to intervention success.
- Findings support cost-effective, parent-centered strategies for childhood obesity prevention.

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Background

Eating behaviors in early childhood undergo significant developmental changes, shaped by biological and behavioral processes essential for health and growth [1]. These behaviors encompass food preferences and eating styles, where food preferences reflect children's likes and dislikes while eating style represents a distinct aspect of eating habits [2]. Healthy eating behaviors are fundamental for optimal growth in weight, height, and head circumference [3] and play a crucial role in preventing malnutrition, growth retardation, and acute nutritional issues, as well as long-term health conditions such as obesity, cardiovascular disease, type 2 diabetes, and cancer [4].

The preschool years constitute a critical period during which distinct eating behavior traits emerge [5], presenting an optimal window for establishing healthy eating habits [6]. Behavioral modification in later years becomes increasingly difficult, if not impossible [7]. While factors contributing to excessive weight gain in children are widely recognized, identifying the core behavioral determinants influencing weight status remains challenging [8]. Identifying these behaviors is essential for designing evidence-based interventions to prevent childhood overweight and obesity.

Higher levels of Food Responsiveness (FR), Enjoyment of Food (EF), Desire to Drink (DD), and Emotional Overeating (EOE), combined with lower levels of Satiety Responsiveness (SR) and Satiety Effect (SE), contribute to an increased risk of weight gain over time [9]. Among preschoolers, school-aged children, and adolescents, higher scores in food approach behaviors correlate with greater weight status, whereas higher scores in food avoidance behaviors are associated with lower weight status [5]. Modifying eating behaviors in childhood is crucial for weight management [10]. Over the past decades, childhood overweight and obesity have reached epidemic proportions worldwide, with obese children facing significant social challenges and an increased risk of obesity persisting into adolescence and adulthood, along with the associated chronic health conditions [11]. Preschool-age interventions have demonstrated the greatest effectiveness in preventing obesity [6].

Given the necessity of modifying eating behaviors for effective weight management and the unique opportunity for behavioral change in early childhood, parental education and interventions are essential. Behavior patternbased interventions aim to modify mediating variables that underlie targeted behaviors, with success contingent upon accurately identifying and appropriately altering these variables [12].

Social Cognitive Theory (SCT) is a widely utilized framework for behavioral change interventions, including those addressing eating behaviors [13]. SCT is particularly effective in predicting and explaining eating behaviors in children [14]. Additionally, Family System Theory (FST), introduced by Broderick in 1993, provides a framework for understanding how family systems influence children's and adolescents' health behaviors. FST conceptualizes family functioning along a continuum, ranging from healthy to dysfunctional interactions. To foster optimal family health, parents must have access to resources and choices that promote positive parenting strategies and facilitate behavioral changes [15]. FSTbased interventions emphasize positive parenting skills, including parenting styles, supervision, and communication. Recent interventions incorporating FST, particularly those emphasizing positive and authoritative parenting styles, have been effective in promoting obesity-preventive health behaviors [16]. Parenting styles play a crucial role in shaping children's eating behaviors [1, 17], underscoring the need to understand how and why parents respond differently to children's eating patterns when designing obesity interventions [5].

Interventions incorporating SCT and FST have effectively promoted healthy eating behaviors among adolescents [16]. Knowlden et al. utilized SCT to empower mothers in preventing obesity in children aged 4 to 6 years, focusing on parenting skills and styles [18]. However, most nutrition-related interventions do not integrate parenting skills, styles, or family functioning components. Since these factors have proven effective in weight management interventions, incorporating them into prevention programs may enhance outcomes. Future prevention strategies should evaluate the impact of these variables on intervention effectiveness [19].

Mothers play a pivotal role in shaping children's nutritional behaviors among family members, highlighting their significance in dietary interventions [18]. No prior study has investigated modifying preschool children's eating behaviors through a combined SCT- and FSTbased intervention. Therefore, this study evaluates the effectiveness of an intervention integrating SCT and FST in improving eating behaviors among preschool children.

Materials and methods

Study design

This experimental study included children aged 4 to 6 years residing in Behbahan City, Khuzestan Province, Iran.

Sampling and sample size

The sample size was determined based on Knowlden's study [18], using a significance level (α) of 0.05, a power (β) of 0.1, and an effect size of 0.5. Initially, 54 children were allocated to both the intervention and control groups. To account for a potential 10% dropout rate, the final sample size was increased to 60 participants per group.

Participants were selected using a multi-stage random sampling method. First, four healthcare centers were randomly chosen from Behbahan City and randomly assigned to either the intervention or control group. Subsequently, a list of preschool children aged 4 to 6 years was compiled for each selected center. Thirty children from each center were randomly selected using a simple random method based on a random number table.

Inclusion and exclusion criteria

Inclusion criteria required the absence of metabolic disorders, such as thyroid dysfunction, and non-participation in concurrent weight management programs. Exclusion criteria included maternal withdrawal from the study and failure to attend at least two educational sessions.

Data collection tools

Data were collected using the Child Eating Behavior Questionnaire (CEBQ), developed by Wardle et al. [20], alongside a demographic questionnaire. The CEBQ assesses eating behaviors in children aged 3 to 12 years and evaluates variations in eating styles. It consists of 35 items across eight domains, covering both food approach (DD, EOE, EF, and FR) and food avoidance (SR, SE, FF, and EUE) behaviors [21]. Responses were rated on a 5-point Likert scale ranging from "never" (1) to "always" (5). Each sub-scale score was calculated by summing the relevant item scores and dividing by the number of items within the sub-scale. The CEBQ has demonstrated strong validity and reliability [22, 23, 24]. This study focused on FR, SR, EOE, DD, EF, and SE as potential contributors to overweight risk over time [9].

Procedure

In the pre-test phase, mothers completed the questionnaires after providing informed written consent. Given the importance of needs assessment in improving eating behaviors, pre-test data were analyzed, and the findings were integrated into the intervention design and educational content.

The intervention was implemented for the intervention group and three and six months later, both groups completed the questionnaire. After the final assessment, educational sessions were provided to the control group to uphold ethical standards. Figure 1 presents a visual representation of the study flow.

Intervention

A total of six 60-minute sessions were conducted over six weeks for mothers in the intervention group. These sessions incorporated lectures, group discussions, Q&A sessions, practical demonstrations, and role-playing exercises. The content focused on fostering a healthy lifestyle, promoting healthy eating behaviors, and developing essential skills, including monitoring, effective communication, reinforcing desirable behaviors, problem-solving, and behavior management. Additionally, the sessions covered parenting styles and guided modifying SCT constructs.

Given the diversity of SCT constructs and the complexity of behavioral interventions, construct selection was deliberate and strategic [25]. The selected SCT constructs included environmental structures, outcome expectations, emotional coping, self-control, and self-efficacy. Table 1 provides a detailed summary of the educational content aligned with these constructs.

The control group received six educational sessions using the same instructional methods. However, these sessions covered general nutrition-related topics, including healthy eating principles, vitamins and minerals, dietary diversity, the food pyramid, and hydration, without addressing parenting strategies or SCT constructs. After completing the final questionnaire at the third assessment, mothers in the control group participated in FST- and SCT-based educational sessions to uphold ethical standards.

Statistical data analysis methodology

Data were analyzed using IBM SPSS version 24, applying descriptive and inferential statistical methods. The Chisquared test, independent t-test, and repeated-measures analysis were employed to assess group differences and intervention effects. Assumptions required for variance analysis with repeated measures were rigorously evaluated, including normality of variable distributions (Kol-mogorov-Smirnov test), equality of variances (Levene's test), homogeneity of covariance matrices (Box's test), and sphericity (Mauchly's test). A *p*-value < 0.05 was considered statistically significant.

	Randomized	(n=120)			
	Allocati	on			
Control Group		Intervention G	Group		
Allocated to control (n=60)		Allocated to intervention (n=60)			
Received allocated to intervention (n=0)		Received alloc	cated to intervention (n=60)		
Did not received allocated intervention (Just the intervention group received the intervention) (n=60)		Did not received allocated intervention (due to not participating in the session) (n=0)			
		Absence of more than 2 sessions) (n=0)			
	Follow-Up (3 months)			
Lost to follow-up (n=0)	v-up (n=0)				
Discontinued intervention (due to unwillingness to continue participation) (n=0)		Discontinued intervention (due to moving to another city) (n=0)			
	Follow-Up	(6months)			
Lost to follow-up (n=0)			Lost to follow-up (n=0)		
Discontinued intervention (due to unwillingness to continue participation) (n=0)		Discontinued intervention (due to moving to another city) (n=0)			
	Ana	lysis			
Analyzed (n=60)		Analyzed (n=60)			
Excluded from analysis (n=0)		Excluded from analysis (n=0)			

Fig. 1 Flowchart of the Study

 Table 1
 Summary of education provided based on SCT constructs

Construct	Definition	Goal	The Methods of Modification	Learning Domain	Educational Technique	
Environment	Physical circumstances or con- ditions that surround a person Adapting the child's The mother creates opportunities ties to overcome personal and conditions to improve (Physical surroundings) [26] conditions to improve eating behavior. situational obstacles to improve a child's eating behavior.		The mother creates opportuni- ties to overcome personal and situational obstacles to improve a child's eating behavior.	-Cognitive -affective -psychomotor	Lecture, group discussion, prac- tical demonstra- tion, role-playing	
Emotional coping	Techniques employed by the person to control the emo- tional and physiological states associated with the acquisition of new behavior (Managing emotions) [26]	s employed by the Controlling and managing -Self-discipline training control the emo- emotional and physiMeditation physiological states ological states related to -Stress management techniques with the acquisition improving a child's eating havior (Managing behavior. [26]		-Cognitive -affective -psychomotor	Lecture, ques- tion and answer, group discus- sion, practical demonstration, role-playing	
Outcome expectations	Anticipation of the probable outcomes that would ensue as a result of engaging in the behavior under discussion (Expected results) [26]	able Inspiring the mother to -Values discussion nsue understand the positive -Critical thinking n the physical outcomes of -Role-playing on improving a child's eating behavior.		-Cognitive -affective	Lecture, ques- tion and answer, group discussion T role-playing	
Self- efficacy	cy Confidence in one's ability to pursue a behavior (Behavioral confidence) [26] The mother's confidence -Changing the child's eating behavior in small steps -Using encouragement and reinforcement for small chan		-Changing the child's eating behavior in small steps -Using encouragement and reinforcement for small changes	-affective	Questions and answers, group discussion	
Goal setting or self-control	Setting goals and developing plans to accomplish chosen be- haviors (Establishing goal) [26]	ting goals and developing Setting goals and creating -Providing opportunities to set programs by the mother iors (Establishing goal) [26] behaviorProviding rewards to reinforce goal achievement		-Cognitive -affective -psychomotor	Lecture, ques- tion and answer, group discus- sion, practical demonstration, role-playing	

Demographic Factors		Intervention group		Control group		P-value
		N	%	N	%	
Child's gender	Male	30	50	36	60	0.27
	Female	30	50	24	40	
Child's age (year)	4	14	23.3	6	10	0.12
	5	27	45	35	58.3	
	6	19	31.7	19	317	
Mother's educational level	≤Diploma	34	56.6	25	41.6	0.48
	Associate &Bachelor	24	40	32	53.3	
	≥ Master	2	3.3	3	5	
Mother's occupation status	Housewife	53	88.3	47	78.3	0.11
	Employed	7	11.7	13	21.7	

Table 2 Demographic characteristics of the study population

Table 3 Results related to eating behavior subscales by grouping and at different measurement levels

Follow-up (6 months)		Post-test (3 months)		Pre-test		Variable	
SD	м	SD	М	SD	м		
2.98	10.56	3.26	10.91	2.58	9.96	Intervention	Satiety responsiveness
2.75	9.10	3.39	9.86	3	8.81	Control	
2.91	5.70	2.57	4.48	2.76	7.90	Intervention	Desire to drink
3.02	6.71	3.20	6.35	3.31	6.56	Control	
4.38	3.38	3.86	2.70	4.32	4.23	Intervention	Emotional Overeating
3.10	3.90	3	3.53	3.15	3.64	Control	
3.51	8.01	3.64	7.88	3.33	8.23	Intervention	Enjoyment of Food
3.05	7.43	3.23	7.48	3.49	7.45	Control	
4.49	9.90	4.52	9.60	4.13	10.46	Intervention	Food responsiveness
4.99	12.08	4.89	11.73	5.43	11.75	Control	
2.58	7.90	2.61	7.98	2.47	7.76	Intervention	Slowness in Eating
2.84	7.50	2.95	7.61	2.15	8.56	Control	

Table 4 Results of analysis of variance with repeated measures to examine the effectiveness of educational intervention on eating behavior subscales

Effect size (Eta)	Significance Level	F- value	Mean Squares	Degrees of freedom	Source	Variable
0.04	0.01	5.78	134.44	1	Group	Satiety responsiveness
0.11	0.001	15.32	30.13	2	Measurement Stages	
0.12	0.04	2.02	24.02	1	Group	Desire to drink
0.34	0.001	62.25	99.59	2	Measurement Stages	
0.001	0.76	0.08	3.40	1	Group	Emotional overeating
0.16	0.001	23.15	17.13	2	Measurement Stages	
0.008	0.32	0.99	31.21	1	Group	Enjoyment of food
0.005	0.57	0.55	0.80	2	Measurement Stages	
0.03	0.03	4.72	313.60	1	Group	Food responsiveness
0.06	0.001	7.64	6.28	2	Measurement Stages	
0.001	0.98	0.001	0.01	1	Group	Slowness in Eating
0.03	0.01	4.60	7.24	2	Measurement Stages	

Results

The mean age of mothers in the intervention group was 32.1 ± 3.73 years, while in the control group, it was 33.6 ± 5.2 years. The independent t-test showed no statistically significant differences between the groups regarding demographic characteristics (p > 0.05). Table 2 presents detailed demographic information.

Assessment of satiety responsiveness (SR) SR scores across groups and measurement points

The mean SR score in the intervention group steadily increased by 0.60 points from the pre-test to the sixmonth follow-up (Table 3).

Repeated-measures ANOVA for SR

Table 4 presents a significant difference in SR scores between the two groups over time. The observed effect

of the educational intervention was statistically significant (F (1, 236) = 5.78, p = 0.018), with an effect size (η^2) of 0.047, indicating that the intervention accounted for 4.7% of the variance in SR. Additionally, mean SR scores across the three-time points (pre-test, three-month post-test, and six-month follow-up) demonstrated statistical significance (F(2, 236) = 15.32, p = 0.001). Bonferroni's post-hoc analysis confirmed a sustained intervention effect on SR.

Assessment of the desire to drink (DD)

DD scores across groups and measurement points

The mean **DD** score in the intervention group showed a declining trend, decreasing by **2.20 points** from the pretest to the six-month follow-up (Table 3).

Repeated-measures ANOVA for DD

Table 4 reveals a significant difference in DD scores between groups over time, indicating a notable intervention impact (F (1, 236) = 2.02, p = 0.043). The effect size (η^2) was 0.123, meaning the intervention accounted for 12.3% of the variance in DD. Furthermore, mean DD scores across the three measurement points exhibited statistical significance (F (2, 236) = 62.25, p = 0.001). Bonferroni's post-hoc analysis confirmed a sustained intervention effect on DD.

Assessment of emotional overeating (EOE)

EOE scores across groups and measurement points

The mean EOE score in the intervention group followed a downward trajectory, decreasing by 0.85 points from the pre-test to the six-month follow-up (Table 3).

Repeated-measures ANOVA for EOE

Table 4 indicates no statistically significant difference in EOE scores between groups (F(1, 236) = 0.087, p = 0.769), suggesting the intervention had no significant effect on EOE. However, within the intervention group, the mean EOE score decreased from 4.23 at baseline to 2.70 post-intervention, reflecting a reduction of 1.53 points, though this change did not reach statistical significance. Despite this, mean EOE scores across the three-time points showed significant variability (F (2, 236) = 23.15, p = 0.001). Bonferroni's post-hoc analysis indicated that the intervention did not have a lasting effect on EOE.

Measurement of enjoyment of food (EF)

EF scores across groups and measurement points

The mean EF score in the intervention group followed a downward trend, decreasing by 0.22 points from the pretest to the six-month follow-up (Table 3).

Repeated-measures ANOVA for EF

Table 4 indicates no statistically significant difference in EF scores between the two groups over time (F (1, 236) = 0.992, p = 0.321), suggesting that the intervention did not substantially impact EF. Within the intervention group, the mean EF score declined from 8.23 at baseline to 7.88 at follow-up, reflecting a 0.35-point decrease, though this difference was not statistically significant. Additionally, the mean EF scores across the three measurement points did not reach statistical significance (F (2, 236) = 0.552, p = 0.576).

Assessment of food responsiveness (FR) FR scores across groups and measurement points

The mean FR score in the intervention group exhibited a downward trajectory, decreasing by 0.56 points from the pre-test to the six-month follow-up (Table 3).

Repeated-measures ANOVA for FR

Table 4 demonstrates a significant difference in FR scores between groups over time, indicating a meaningful intervention effect (F (1, 236)=4.72, p=0.032). The effect size (η^2) was 0.038, suggesting that the intervention accounted for 3.8% of the variance in FR. Additionally, mean FR scores across the three measurement points were statistically significant (F (2, 236)=7.64, p=0.001). Bonferroni's post-hoc analysis confirmed that the intervention sustained impacted FR.

Assessment of slowness in eating (SE)

SE scores across groups and measurement points

The mean SE score in the intervention group exhibited an increasing trend, rising by 0.14 points from the pre-test to the six-month follow-up (Table 3).

Repeated-measures ANOVA for SE

Table 4 shows no statistically significant difference in SE scores between the groups (F (1, 236) = 0.001, p = 0.980), indicating that the intervention did not significantly affect SE. Within the intervention group, the mean SE score increased from 7.76 at baseline to 7.98 post-intervention, reflecting a 0.22-point increase, though this change was not statistically significant. However, mean SE scores across the three-time points demonstrated statistical significance (F (2, 236) = 4.60, p = 0.011). Bonferroni's post-hoc analysis suggested that the intervention did not produce a lasting effect on SE.

An additional table file shows Rapid Measure in more detail (see Additional file 1).

Discussion

This study evaluated the effectiveness of an SCT- and FST-based intervention in modifying eating behaviors among preschool children. The findings indicate that SR and SE scores increased by 0.60 and 0.14 over the sixmonth follow-up period, respectively, while DD, EOE, EF, and FR scores declined by 2.20, 0.85, 0.22, and 0.56,

respectively. Repeated-measures ANOVA revealed statistically significant differences between groups and across time in SR, DD, and FR (p < 0.05), suggesting a sustained effect of the intervention.

The importance of addressing eating behaviors in childhood

Recognizing the pivotal role of eating behaviors in childhood obesity prevention, researchers and policymakers emphasize the need to target dietary composition and behavioral patterns that shape long-term health outcomes [27]. While many obesity prevention strategies focus on what children eat, emerging evidence underscores the importance of how they eat [28, 29]. The preschool years represent a critical window for instilling lifelong healthy eating behaviors, as attitudes and habits formed during this period can persist into adulthood [3].

Impact of SR, SE, DD, EOE, EF, and FR on childhood obesity

SR enables children to regulate food intake based on satiety cues, reducing the risk of overeating [30]. SE further enhances satiety recognition by allowing more time for physiological signals of fullness to manifest, promoting healthy portion control and weight management [31]. Reducing DD mitigates excessive consumption of sugar-sweetened and high-calorie beverages, leading to improved energy balance and weight regulation [32]. EOE, characterized by eating in response to emotional distress, is a well-documented contributor to poor dietary habits and obesity; its reduction is linked to healthier eating patterns and improved weight control [33]. EF, or eating for pleasure rather than physiological hunger, can lead to overconsumption, making its regulation a critical component of obesity prevention [34]. Similarly, FR, which reflects a child's responsiveness to external food cues, is strongly associated with increased caloric intake and the development of unhealthy eating behaviors [35]. Given these associations, effective obesity prevention strategies should increase SR and SE while decreasing DD, EOE, EF, and FR to foster healthier eating behaviors in children.

Theoretical justification: SCT and FST in behavioral modification

Behavioral modification is necessary and achievable through structured educational interventions [26]. Applying theory-driven approaches in designing interventions enhances their effectiveness by identifying and targeting key behavioral determinants [36]. SCT, widely recognized for its ability to predict and explain nutritional behaviors in children [37], provides a structured framework for understanding why and how behaviors develop and offer actionable modification strategies [26]. FST-based interventions focusing on the family unit have successfully promoted preventive health behaviors, particularly those related to obesity prevention [16]. Previous studies highlight the efficacy of parenting skill-based interventions in mitigating obesity risk in preschool children [18]. The present study, therefore, integrates SCT and FST to enhance eating behavior modification strategies in early childhood.

Parental influence on children's eating behaviors

The home environment and parental influence play a defining role in shaping a child's dietary habits and weight status. Parents function as gatekeepers, regulating food availability and establishing norms influencing longterm eating behaviors [38]. The concept of family health climate, which reflects shared perceptions and attitudes toward health-related behaviors, provides insight into how parenting practices are shaped within the home environment [39, 40]. Educating parents on effective parenting strategies can empower them to cultivate a supportive environment that promotes sustainable behavior change [41].

Parenting styles encompass a range of strategies that influence the quantity, timing, and composition of children's diets [40]. Gevers et al. identified several foodrelated parenting practices, including monitoring, encouragement, reward, and regulation, each shaping children's dietary habits [42]. However, some parental feeding practices may inadvertently promote unhealthy behaviors. For example, using food as a reward or a means to regulate emotions is associated with increased emotional overeating in children, as demonstrated in cross-sectional and longitudinal studies [43]. Furthermore, maternal feeding styles significantly influence children's dietary quality [44].

Interventions addressing both general parenting styles and food-specific parenting strategies have yielded positive outcomes on child weight status [45]. General parenting, which encompasses broad behavioral strategies beyond food-related practices, defines the emotional context in which children are raised and influences parent-child interactions, attitudes, and beliefs [40, 46]. Tung and Yeh demonstrated that authoritative parenting styles strengthened the impact of food monitoring, whereas authoritarian parenting had a less pronounced effect [47]. These findings underscore the need for integrating general parenting strategies into interventions targeting food-specific behaviors. By addressing both aspects, family-based interventions can optimize the effectiveness of behavioral modification strategies, equipping parents with the skills to foster healthy eating behaviors in their children.

Comparison with previous research

Due to the novelty of this study, direct comparisons with previous research are limited. However, the findings align with existing literature [48, 49]. Magarey et al. reported no significant differences in certain behavioral measures between intervention and control groups, consistent with the present study's findings on EF [50]. Similarly, Ahmad et al. observed only modest changes in EF following an SCT-based intervention [40].

Numerous SCT-driven interventions targeting preschool-aged children have effectively modified eating behaviors and promoted healthier nutrition [18, 51]. The core constructs of SCT—including self-efficacy, outcome expectations, and self-regulation—are widely acknowledged as key predictors of health behaviors, particularly in dietary adherence. Among these, self-efficacy plays a central role in behavior change, as individuals with greater confidence in their ability to adhere to dietary recommendations are more likely to sustain behavior modifications over time. Additionally, self-efficacy indirectly influences other SCT constructs, reinforcing positive behavioral changes and increasing the likelihood of long-term dietary adherence [52].

Study limitations and recommendations for future research

Despite its novel approach, this study has limitations that should be acknowledged. The research was conducted within a specific geographic region with a relatively small sample size, which may limit the generalizability of the findings. Additionally, paternal involvement was not considered, despite evidence suggesting that fathers play a critical role in shaping children's dietary behaviors. Future studies should examine the impact of paternal engagement in educational interventions to provide a more comprehensive understanding of parental influence. Given the longitudinal nature of behavioral change, extended follow-up periods are recommended to evaluate the long-term sustainability of intervention effects. Further research should also focus on assessing the effectiveness of SCT- and FST-based interventions on broader health indicators and BMI, identifying determinants of effective parenting practices, and refining theoretical models that best explain the development of healthy eating behaviors in preschoolers.

Conclusion

This study aimed to improve preschool children's eating behaviors through a family-based intervention integrating SCT and FST. As a pioneering approach, this research provides valuable insights into the effectiveness of theory-driven interventions in shaping early childhood eating behaviors. The findings contribute to the growing body of evidence supporting family-centered strategies in dietary behavior modification.

The results highlight the importance of integrating key parenting components (parenting styles, behavioral reinforcement, monitoring, and modeling) and SCT constructs to enhance intervention outcomes. By leveraging SCT constructs, this study underscores the costeffectiveness and feasibility of equipping mothers with structured training to promote healthy eating habits in children.

Implications of findings

The findings provide practical recommendations for parents, healthcare professionals, clinicians, and policymakers, emphasizing the need for:

- Early intervention to modify eating behaviors and prevent childhood obesity.
- Theory-based frameworks to enhance the efficacy and sustainability of interventions.
- Parental involvement is a critical component in shaping children's eating behaviors.
- Integration of parenting strategies into nutritionfocused interventions to improve outcomes.
- Revision of national food and nutrition policies, including the nutrition surveillance program and the national nutrition literacy and management guide, based on emerging evidence from this and similar studies.

Abbreviations

- SCT Social Cognitive Theory
- FST Family System Theory
- CEBQ Child Eating Behavior Questionnaire
- SR Satiety Responsiveness
- SE Slowness in Eating
- DD Desire to drink FOF Emotional Over-Fa
- EOE Emotional Over-Eating EF Enjoyment of Food
- FR Food Responsiveness
- FF Food Fussiness
- EUE Emotional Under-Eating

Supplementary Information

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Supplementary Material 1

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Author contributions

D L and B Z: Data analysis. N E: Design the study and revise the manuscript. SH N G and Z R: Critical review of the manuscript. All the authors read and agreed to use its content.

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Data availability

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The study was approved with the ethical code of IR.BHN.REC.1401.025 at Behbahan Faculty of Medical Sciences. All the methods were performed following the relevant guidelines and regulations. Informed consent was obtained from all the subjects and their legal guardians.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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