



Effect of Game-Based Learning Approach on Improving Healthy Food Choices Among Preschool Children

Hala Mohamed Sliem Abo-El Saud¹, Amany Sobhy Sorour², and Maha Mahmoud Abdelaziz³

¹M. Sc. Nursing, Zagazig University

²Professor of Community Health Nursing, Faculty of Nursing at Zagazig University

³ Assistant Professor of Community Health Nursing, Faculty of Nursing at Zagazig University

*Corresponding author: Hala Mohamed Sliem Abo-El Saud

Article History

Volume 6, Issue 12, 2024

Received: 02 June 2024

Accepted: 31 July 2024

doi:

10.48047/AFJBS.6.12.2024.6053-6069

Abstract

Background: Good nutrition in the early childhood years is vital. Children's early experiences of healthy food choices play an important part in shaping later eating habits, and good eating habits support healthy growth and development. The **aim** of the present study was to evaluate the effect of game-based learning approach on improving healthy food choices among preschool children. **Subjects and methods:** A quasi-experimental design was used to conduct the present study where 70 child were selected by using multistage cluster sampling technique from three governmental nursery schools in Zagazig city. **Data** were collected by using an interview questionnaire developed by the researchers in the light of the current related literature and composed of demographic data, child dietary habits, and a standardized healthy food choices pictorial scale for kindergarten child. The study **results** revealed that a statistically significant positive predictors between intervention and healthy food choices scores. The study **concluded** that, the healthy food choices scores among preschool children improved after the application of the game-based learning approach. Therefore, it is **recommended** that further researches based on the predictors affecting of healthy food choices to assist in building more effective and more tailored intervention for preschool children.

Key words: Healthy food choices, game-based learning approach, and preschool children.

Introduction:

Preschool is a crucial period for physical and emotional growth and cognitive development. During this period, adequate nutrition and a balanced food intake are important factors affecting healthy growth and development. Furthermore, it is critical to cultivate proper eating habits, because eating habits formed during this period (Mi Cha & Youn Kim, 2023).

A well-balanced diet is essential for preschool children's optimal growth and development. Reduced consumption of micronutrient dense fruits and vegetables is linked to

undernutrition and micronutrient deficits in young children. Furthermore, higher consumption of high energy but low nutrient meals and beverages increases the risk of malnutrition in preschool children. Therefore, establishing good food choices in preschool children is crucial for prevention (**Said et al., 2023**).

A recent study on food-related interventions among preschool children in low and middle income countries has shown that family or parent's perception, household food availability, and family income are all essential modifiable factors to promote healthy eating choices. As parents are the sentinel of their children's eating habits, it's vital to understand parents' perceptions on the issues that influence their children's food choices. Parents have a significant impact on children's early food experiences. Hence, it is vital to understand what factors motivate parents to choose certain foods for their children (**Sirasa et al., 2023**).

Game-based Learning (GBL) is an approach in the form of interactive education that can support the development of children's learning in a world. (GBL) is being employed in education, whether online or in the classroom, to foster physical, mental and cognitive development among children (**Aslan et al., 2022**).

The significance of game-based learning is strongly supported by established pedagogical theory. Although playing games for adults mean fun, enjoyment and exercise, in early childhood it has many other distinct purposes such as; learning new skills, developing imagination, creativity, confidence, critical thinking and social skills. Children who engage in quality play experiences are more likely to have well-developed memory skills, language vocabulary, and are able to manage their emotions, that lead to better execution of further school assignments (**Zolkipli et al., 2023**).

A game-based learning approach might provide a good chance to stimulate children's abstract thinking during the process of cognitive development, further foster their higher order thinking ability, and able to boost motivation owing to some characteristics, such as adventure, challenge and freshness. Games which focus on nutritional education in nursery schools lead to the learning motivations and achievements, competences, and knowledge of the children can be increased. Additionally, children's learning interests are promoted and guided to actively improve their food habits (**Adipat et al., 2021**).

The community health nurse helps to find the needs of preschool children and support the family in making the future plan. Developing a nursing plan that cover and analyze all the factors of preschool child's growth and development as well as good nutrition. The community health nurses able to integrate health lessons throughout the school day (**Clay, 2019**). Moreover, community health nurses are in a unique position to offer multilevel approaches to the development of healthy food choices by providing classroom activities through using game-based learning to improve health (**El-hasry et al., 2023**).

Significance of the study

Good food is important during the whole life course, it is especially important during the first years of life, since these are the most crucial years for normal physical and mental development. Additionally, proper food choices in kindergarten is also crucial for shaping the correct eating habits of children and can prevent the later development of many diet-related diseases (**Orkusz, 2022**). Establishing healthy behaviors in early childhood can lay the foundation for a lifetime of healthy nutrition and may have greater impact on long-term health than attempting to change entrenched adult behaviors (**Baker et al., 2019**). Educational games are considered to have the potential to attract children to any topic, allowing active participation in the learning process (**Tahir & Wang, 2020**). Game-based learning is an innovative educational paradigm that utilizes games as a model for transferring learning. In addition, the main benefits of game-based learning are to develop children's social and emotional abilities. Playing not only makes learning more entertaining but also encourages

children participation in class and fosters their attitude towards learning (**Oktavia et al., 2019**). Hence, the present study would be designed to evaluate the effect of game-based learning approach on improving healthy food choices among preschool children.

Aim of the Study

The aim of this study was to:

Evaluate the effect of game-based learning approach on improving healthy food choices among preschool children.

This aim was fulfilled through the following objectives:

- 1- Determine the food choices among preschool children (pre-test).
- 2- Design and implement the game-based learning approach for improving food choices among preschool children.
- 3- Evaluate the effect of game-based learning approach on improving healthy food choices among preschool children (post-test).

Research hypothesis

Healthy food choices scores among preschool children would be improved after the application of the game-based learning approach.

Subjects and Methods

The methodology of the current study was presented under the following four designs: Technical, operational, administrative and statistical design.

I. Technical design

The technical design of this study involves a description of the research design used, the study setting, subjects and tools of data collection.

A. Research design:

A quasi-experimental design with pre and post-test was used to achieve the aim of the present study.

B. Setting:

The present study was conducted at three governmental nursery schools affiliated to the Ministry of Education and randomly selected from two educational zones available in Zagazig city. These nursery schools were namely:

- El-Shahid Tayar "Ibrahim Ali Al-Hadad "nursery school in Shibah village.
- Al-Nakaria Al-Hadetha nursery school.
- Sfitia 2 nursery school.

Setting description:

A study setting composed of the above mentioned nursery schools, where consists of one floor containing 3-4 classrooms where each classroom contains 20 children (one-two classroom for KG1 and two classes for KG2), the library room, manager's office, play garden, and computer labs.

C. Subjects:

The existing study enrolled 70 preschool child, who were recruited from the above mentioned nursery schools according to the following inclusion criteria:

- Age ranged from 5 to 6 years.
- Free from mentally challenged or any cognitive problems.
- Free from behavioral problems (e.g. aggression, and attention deficit hyperactivity disorder)
- Parents agreements regarding participation of their children in the program were obtained.

Sample size:

The sample size is calculated to test for the difference between the expected rates of healthy food before and after implementation of the intervention with a moderate effect size

(Cohen H = 0.30). Using the GPower software program for sample size calculation for a difference between two proportions at 95% level of confidence and 80% power, the required sample size is 58 child. It was increased to 70 to compensate any dropout rate of around 15%. In addition to, 7 children including pilot study.

Sampling technique:

A multistage random sampling technique was used in the recruitment of children in the study sample as follows:

✓ **Phase 1**

This phase involved random selection of three nursery schools from two educational zones:

- The first zone (East administration) includes 34 nursery schools. one nursery school was randomly selected namely Sfita 2 nursery schools.
- The second zone (West administration) includes 48 nursery schools. Two nursery schools were randomly selected namely Al-Shahid Tayar "Ibrhim Ali Al-Hadad "and Al-Nakaria Al-Hadetha nursery schools.

✓ **Phase 2**

This phase involved selection of two classes from each school.

✓ **Phase 3**

This phase involved purposive sample of children from nursery schools according to the above-mentioned criteria. They were as follows:

- Al-Shahid Tayar "Ibrhim Ali Al-Hadad"nursery school (30 children out of 40 child).
- Al-Nakaria Al-Hadetha nursery school (25 children out of 40 child).
- Sfita B nursery school (15 children out of 40 child).

D. Tools of data collection:

Three tools used to carry out the present study, included:

Tool I:

An interview questionnaire developed by the researcher in the light of the current related literature and composed of demographic data.

➤ **Demographic data:** Involved two parts;

- **Child data:** Such as child's age, sex, number of siblings, and birth order of child between siblings. Questions were in the form of open ended questions (Questions 1 & 3) and closed ended questions (Questions 2 & 4).
- **Family data:** Such as parents' age, educational level, occupation, family size, family income, and residence. Questions were in the form of open ended questions(Questions 5, 8 & 12) and closed ended questions (Questions 6, 7, 9, 10,11 &13 to 15).

Tool II:

➤ **Child dietary habits:** Such taking breakfast, taking 3 meals/day, taking fast food, eating while watching TV, good mastication, forced to eat...etc. (Questions 16 to 27).

Scoring system:

Knowledge:For the knowledge items, a correct response was scored 1 and the incorrect zero. For each area of knowledge and for the total questionnaire the scores of the items were summed-up and the total divided by the number of the items, giving mean scores. These scores were converted into percentage score and means and standard deviations and medians were computed. Knowledge was considered healthy if the percent score was 60% or more and unhealthy if less than 60%.

Tool III:

➤ **A standardized healthy food choices pictorial scale for kindergarten child.**

This scale was developed by **Ibrahim(2023)**. It was used to evaluate healthy food choices among children aged 5-6 years. This scale includes 35 pictures covered seven domains regarding heart, energy, musculoskeletal, immunity nutrients, snacks, oral and hand

hygiene. It took around 15-20 minutes to complete and was easily understood by the preschool children.

Scoring system:

Knowledge: For the knowledge items, a correct response was scored 1 and the incorrect zero. For each area of knowledge and for the total questionnaire the scores of the items were summed-up and the total divided by the number of the items, giving mean scores. These scores were converted into percentage score and means and standard deviations and medians were computed. Knowledge was considered satisfactory if the percent score was 60% or more and unsatisfactory if less than 60%.

II. Operational design

The operational design includes description of the preparatory phase, validity, reliability, pilot study, field work, and ethical consideration.

A. The preparatory phase:

A comprehensive review of the present and previous studies, national and international references linked to the study title were conducted using textbooks, articles, internet periodicals and magazines in order to get a clear picture of all aspects related to the study. This helped in the design of the data collection tools, and game-based learning.

B. Validity:

The tool was revised by a panel of three experts in the field of community health nursing, community medicine who conducted content validity of all the items of the tool for relevance, clarity, comprehensiveness and understandability.

C. Reliability:

Internal consistency of the tool was assessed and reliability proved to be satisfactory by calculating Cronbach Alpha Coefficient, (0,841).

D. Pilot study:

The pilot study was carried out on a sample of 7 children representing 10% of the calculated total sample size. The aim was to test clarity of the questions, the format of the questionnaire, comprehensiveness of the items and to estimate the exact time required for filling the questionnaire sheet. The children involved in the pilot study were excluded from the main study sample, since there was no modification in the tools of data collection.

E. Field work:

The researcher sought formal approval from the Under-Secretary of the Ministry of Education and the West and the East Zagazig administration director before starting field work. After that, the researcher received the final approval letter and met with the directors of nursery schools to schedule the data collection process.

Field work of this study was conducted over a three months span, beginning from the mid of February 2023 to the mid of May 2023. The study was carried out through successive phases of assessment, planning, implementation, and evaluation.

1. Assessment phase (Pre-intervention data collection):

After securing all official permissions, the researcher first introduced herself and explained the purpose of the study briefly to the directors and teachers of nursery schools to gain their cooperation and get the needed data from the preschool children files. The parents of the preschool children were met and verbal consent for participation were obtained from them and they were assured that the obtained information used only for the purpose of the study.

After that, the researcher spent some time with each child to fill out food choices questionnaire sheet at the nursery school class or play garden. The needed time for tool of data collection for each child was about 15-20 minutes. At the end of the day, at leaving time, the researcher met with the children's parents to fill out the demographic questionnaire. The

researcher stayed with the parents to answer any specific questions that arose during completing the data. It required 20 to 25 minutes. Three-four days of work per week (from 8.5 AM to 12 PM) persisted. This phase lasted for two weeks.

2. Planning phase:

Based on the results obtained from the data analysis of the assessment phase, and in view of the pertinent literature, the researcher designed the training program sessions contents according to the children's needs and preferences towards learning activities, and the study aim. Identified needs, requirements and deficiencies were translated into aim and objectives of the training program and set in the form of a booklet.

3. Implementation phase:

The intervention was implemented in the form of seven sessions for small groups (4-5) of children's in the three nursery schools and each session lasted for 60-90 minutes, the length of each session was variable according to children's responses and their active participation, as well as the time available, and the content of each session. The researcher met the children for 3-4 days per week. All children received the same content using the same teaching methods, media, games, and same activities.

4. Evaluation phase:

The evaluation of the effectiveness of the training program was done immediately after its implementation by comparing the change in children's food choices scores through applying the same tool of the pre-test. This phase lasted for two weeks.

F. Ethical consideration:

The study protocol was approved by the pertinent committees at the faculty of Nursing, Zagazig University. Then, the agreement of participants was taken from parents after full explanation of the aim and objectives of the study. Participants were given the opportunity to refuse participation and they were notified that they could withdraw at any time of the data collection interviews; also, they were assured that the information would be confidential and used for the research purpose only. The researcher assured maintaining anonymity and confidentiality of the subject's data.

III. Administrative design:

The official permission was obtained from the Education Directorate at Zagazig city based on letters issued from the postgraduate's department at Faculty of Nursing, Zagazig University explaining the aim and procedures of the study. Then, the director of West and East administration referred the researcher to the directors of the selected nursery schools with approval letters. Then the researcher met with each of them and explained the aim of the study and the nature of tool used for data collection.

IV. Statistical analysis

Data entry and statistical analysis were done using SPSS 20.0 statistical software package. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations for quantitative variables. Quantitative continuous data were compared using Student t-test in case of comparisons between two independent groups and paired t-test for dependent groups. When normal distribution of the data could not be assumed, the non-parametric Kruskal-Wallis or Mann-Whitney tests were used. Qualitative categorical variables were compared using chi-square test. Whenever the expected values in one or more of the cells in a 2x2 tables was less than 5, Fisher exact test was used instead. In larger than 2x2 cross-tables, no test could be applied whenever the expected value in 10% or more of the cells was less than 5. Spearman rank correlation was used for the assessment of the inter-relationships among quantitative variables and ranked ones. In order to identify the independent predictors of the knowledge scores, multiple linear regression analysis was used. Statistical significance was considered at p-value <0.05.

Results

Table 1: Demographic characteristics of preschool children in the study sample (n=70)

Characteristics	Frequency	Percent
Age:		
5.0-<5.5	29	41.4
5.5-6.0	41	58.6
Range	5.0-6.0	
Mean±SD	5.6±0.5	
Median	5.59	
Gender:		
Male	34	48.6
Female	36	51.4
No. of siblings:		
0-1	32	45.7
2-5	38	54.3
Range	0-4	
Mean±SD	2.0±0.9	
Median	2.0	
Birth order:		
1	3	4.3
2-3	46	65.7
4+	21	30.0
Firstborn:		
No	3	4.3
Yes	67	95.7
Range	1-4	
Mean±SD	2.9±0.9	
Median	3.0	

Table 1 explains that 58.6 %of the study sample was at age group 5.5-6.0 years, with Mean±SD equal 5.6±0.5. As for gender, 51.4% of them were female. More than half of study sample (54.3%) had about 2-5 siblings, with Mean±SD equal 2.0±0.9. More than two thirds (65.7) of children were the second to third child, and 95.7% of children were firstborn, with Mean±SD equal 2.9±0.9.

Table 2: Demographic characteristics of parents of preschool children in the study sample (n=70)

Characteristics	Frequency	Percent
Father age:		
<35	35	50.0
35+	35	50.0
Range	27.0-48.0	
Mean±SD	34.4±5.6	
Median	34.50	
Father education:		
Illiterate	3	4.3
Read/write	4	5.7
Basic	5	7.1
Secondary	39	55.7
University	19	27.1
Father job:		
None	1	1.4
Manual	5	7.1
Professional	9	12.9
Employee	21	30.0
Freelancer	34	48.6
Mother age:		
<30	30	42.9
30+	40	57.1
Range	21.0-39.0	
Mean±SD	29.6±4.2	
Median	29.00	
Mother education:		
Illiterate	2	2.9
Read/write		
Basic	11	15.7
Secondary	40	57.1
University	17	24.3
Mother job:		
Housewife	64	91.4
Working	6	8.6

Table 2 demonstrates that 50% of fathers of the study sample were at age group less than 35 years, with Mean±SD equal 34.4±5.6. More than half (55.7%) of fathers had secondary educational level, and 48.6% of them were freelancer. Whereas, 57.1% of mothers of the study sample were at age group more than 30 years, with Mean±SD equal 29.6±4.2. Also 57.1% of mothers had secondary educational level, and 91.4% of them were housewives.

Table 3: Family characteristics of preschool children in the study sample (n=70)

Characteristics	Frequency	Percent
Residence: Rural	70	100.0
Family size: 2-4 5+	34 36	48.6 51.4
Range Mean±SD Median	3-6 5.0	4.6±0.8
Family income: Sufficient Insufficient	48 22	68.6 31.4
Living with: Both parents One parent Others	61 8 1	87.1 11.4 1.4
Reason for living with others: Travel	1	100.0

Table 3 shows that 100.0% of the study sample were residing in rural area, and family size was more than 5 members among 51.4% of them, with Mean±SD equal 4.6±0.8. More than two thirds of study sample (68.6%) had sufficient income. Most of children (87.1%) were living with both parents.

Table 4: Dietary habits of preschool children in the study sample (n=70)

Dietary habits	Frequency	Percent
Eat breakfast: No Yes Reason for not eating (n=29): [@] No time Not used to No appetite Prefer eating with friends	29 41 3 4 14 14	41.4 58.6 10.3 13.8 48.3 48.3
Eat 3 meals/day: No Yes	46 24	65.7 34.3
Eat fast food: Never Sometimes Often	15 51 4	21.4 72.9 5.7
Eat while watching TV: No	17	24.3

Yes	53	75.7
Appetite compared to peers:		
More	4	5.7
Same	27	38.6
Less	39	55.7
Good mastication:		
No	10	14.3
Yes	60	85.7
Forced to eat:		
No	28	40.0
Yes	42	60.0
No. of meals/day:		
1	1	1.4
2	44	62.9
3	25	35.7

Table 4 clarifies that 41.4% of the study sample didn't take breakfast, and 65.7% of them didn't take 3 meals/day. While, 72.9% of the study sample were take fast food, and 75.7% took while watching TV. More than half (55.7%) of children had less appetite compared to their peers, and most of children (85.7%) were good mastication. About two thirds (60.0%) of the study sample were forced to eat. Whereas, majority of the children (80.0%) had normal dietary habits.

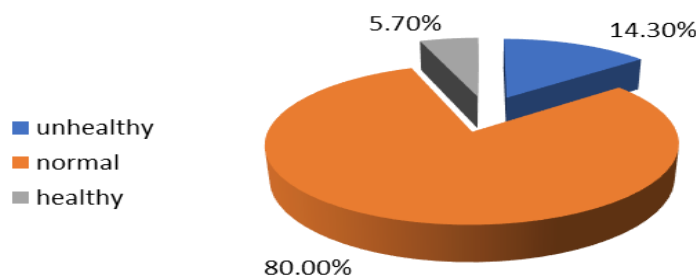


Figure 1: Overall view of dietary habits of the preschool children: The figure demonstrated that the majority of the preschool children (80.0%) had normal dietary habits.

Table 5: Preschool children's knowledge scores of healthy food choices before and after the intervention

Knowledge of healthy food	Time				X ² test	p-value
	Pre (n=70)		Post (n=70)			
	No.	%	No.	%		
Heart nutrients:						
Satisfactory	33	47.1	70	100.0	50.29	<0.001*
Unsatisfactory	37	52.9	0	0.0		
Energy nutrients:						
Satisfactory	24	34.3	62	88.6	43.53	<0.001*
Unsatisfactory	46	65.7	8	11.4		
Musculoskeletal nutrients:					57.98	<0.001*
Satisfactory	29	41.4	70	100.0		
Unsatisfactory	41	58.6	0	0.0		

Immunity nutrients:						
Satisfactory	53	75.7	70	100.0		
Unsatisfactory	17	24.3	0	0.0	19.35	<0.001*
Snacks:						
Satisfactory	3	4.3	69	98.6		
Unsatisfactory	67	95.7	1	1.4	124.56	<0.001*
Oral hygiene:						
Satisfactory	0	0.0	70	100.0		
Unsatisfactory	70	100.0	0	0.0	140.00	<0.001*
Hand hygiene:						
Satisfactory	15	21.4	70	100.0		
Unsatisfactory	55	78.6	0	0.0	90.59	<0.001*
Total knowledge:						
Satisfactory	4	5.7	70	100.0		
Unsatisfactory	66	94.3	0	0.0	124.87	<0.001*

(*) Statistically significant at $p < 0.05$

Table 5 shows highly statistically significant improvements in preschool children's knowledge scores of healthy food choices regarding heart nutrients (100.0%), energy food (88.6%), musculoskeletal nutrients(100.0%), immunity nutrients (100.0%),snacks(98.6%), oral hygiene(100.0%), and hand hygiene(100.0%) post the implementation of the program ($p < 0.001$).

Table 6: Correlation between preschool children's pre- and post-intervention knowledge scores and their characteristics

Characteristics	Spearman's rank correlation coefficient	
	Pre-intervention score (n=70)	Post-intervention score (n=70)
Post score	.359**	1.000
Characteristics:		
Age	.309**	.254*
No. of siblings	-.166	.037
Birth order	-.392**	.001
Father age	-.080	-.027
Father education	-.151	-.048
Mother age	-.028	.021
Mother education	-.122	-.011
Family size	-.080	.031
Income	.069	-.049
No. of meals	.002	-.039
Mean healthy food intake	-.014	-.156
Mean unhealthy food intake	-.297*	-.253*
Overall view of dietary habits	-.168	.017

(*) Statistically significant at $p < 0.05$

Table 6 represents correlation between preschool children's pre- and post-intervention knowledge scores and their characteristics. The table clarifies a statistically significant positive correlation between pre-intervention score and post score ($r = .359$), and age ($r = .309$). While, there were a statistically significant negative correlation between pre-intervention score and birth order ($r = -.392$), and mean unhealthy food intake ($r = -.297$). As regard post-intervention score, the same table points to a statistically significant positive correlation between post-intervention score and age($r = .254$). As well, there was a statistically significant

negative correlation between post-intervention score and mean unhealthy food intake.

Table 7: Best fitting multiple linear regression model for the post-intervention knowledge score

Predictors	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value	95% Confidence Interval for B	
	B	Std. Error				Lower	Upper
Constant	-1.92	2.46		-0.781	0.436	-6.78	2.94
Intervention	13.69	0.39	0.94	35.099	0.000	12.91	14.46
Age	0.89	0.40	0.06	2.220	0.028	0.10	1.69
Birth order	-0.46	0.21	-0.06	-2.224	0.028	-0.86	-0.05
Live with both parents	0.99	0.59	0.05	1.670	0.097	-0.18	2.17

r-square=0.90

Model ANOVA: F=312.00,p<0.001

Variables entered and excluded: gender, parents' education, job, income, overall opinion of dietary habits

Table 7 displays best fitting multiple linear regression model for the post-intervention knowledge score. It indicates that intervention, age, and live with both parents were a statistically significant positive predictors of children's post-intervention knowledge score. Conversely, birth order was a statistically significant negative predictor of children's post-intervention knowledge score. The model explains 90% of the variation in this score as the value of r- square indicates.

Discussion

Early exposure of nutrition education to preschoolers can influence their eating habits. The first 5 years of life are a crucial window of development where the children are forming food preferences and eating habits, and this is the perfect time to teach them about healthy eating habits and choices (**Kostecka et al., 2021**). It's important to begin promoting healthy eating habits as early as possible. Attending preschool is a big milestone in a child's life and a significant portion of their day and meal times are often spent in school. For many children, kindergarten is the first place where children are exposed to foods and eating habits that may differ to the ones in their homes which makes it the ideal place to begin to introduce healthy food choices such as fruits and vegetables (**Manriquez, 2020**).

The aim of the present study was to evaluate the effect of game-based learning approach on improving healthy food choices among preschool children.

Concerning dietary habits of preschool children, the current study results demonstrated that less than half of children did not take breakfast. These results might be attributed to that children had no enough time in the morning to take their breakfast, do not feel hungry in the morning, and always a hurry to go to nursery school, and prefer took breakfast with friends. This finding was on the same way with **Abd-El Aziz (2019)** in Egypt revealed that less than half of children didn't take breakfast. Similar findings have been found by **Youn Kim and Mi Cha (2021)** in Korea found that less than half of study sample refuse to take breakfast every day.

The existing study results clarified that less than three quarters consumed fast food. This might be attributed to that these foods are readily available for consumption and relatively inexpensive. In addition to, fast food has high sodium salt, which is often used as a preservative to make the food more flavorful and satisfying. So, such food attracts children. Furthermore, the fact that most of the preschool children today do not like spending more time on eating and are always in a hurry. In agreement with this finding, **Athavale et al. (2020)** in India revealed that over half of preschool children consumed fast food. As well, similar findings were found in a study carried out in Egypt by **Ali and Ahmed (2022)**

demonstrated that less than three quarters of preschool children took fast food.

The results of the present study revealed that around three quarters of study sample consumed meals while watching TV. This result might be attributed to some parents used TV to distract children to eat more food. In the same vein, a study conducted in China by **Hu et al. (2019)** indicated that more than half of study sample watching TV at meals. Furthermore, **Fikry et al. (2019)** in Alexandria, Egypt found that about two thirds of study sample watching TV at meals.

The present study results showed that two thirds of studied children had forced to eat. This might be due to the fact that the children in the kindergarten stage prefer playing and running more than eating meals. In the same context, a study conducted by **Wu et al. (2019)** in China revealed that majority of children had forced to eat.

Regarding pre-intervention knowledge about healthy food choices in the study sample, the existing study results clarified that about two thirds of children in study sample had unsatisfactory knowledge about healthy food choices in domains of heart nutrients, energy food, musculoskeletal nutrients, snacks, oral and hand hygiene. This might be attributed to young children do not have a clear understanding about healthy food choices at this young age. In addition, lack of nutritional knowledge among parents promotes unhealthy food choices in preschool children. In agreement with the aforementioned study results, a study conducted in Sri Lankan, by **Sahideen et al. (2020)** indicated that children had decreased healthy food choices knowledge due to lack nutritional knowledge among parents.

The current study findings illustrated that a statistically significant positive correlation between pre-intervention score of healthy food choices and age. This result might be due to the increasing age among children play an important role in promoting awareness and understanding regarding healthy food choices. This finding was in agreement with **DeJesus et al. (2020)** in Southeastern Michigan illustrated that children's food choices healthfulness accuracy scores were positively associated with age. Furthermore, similar result found by **Kerkez and Sakalli (2021)** in Turkey noted that nutritional recognition levels were generally high in 4 to 5-years old children and the nutritional recognition score increased with age.

The current study results illustrated that a statistically significant negative correlation between pre-intervention knowledge score of healthy food choices and birth order i.e. children have younger age had less awareness concerning healthy food choices. Similar result was found in a study carried out in Ethiopia by **Bras and Mandemakers (2022)** demonstrated that earlier born children had a better nutritional knowledge than later born children.

Regarding knowledge of **heart and energy nutrients domains**, the study results revealed that the mean score improved post-intervention. This result might be due to the positive effect of session explained the food choices of heart and energy that increase the children awareness. This finding is in agreement with **Chang et al. (2022)** in Taiwan reported that the level of nutritional knowledge for children was significantly higher after intervention. Furthermore, the frequency of consumption of chocolate, candies, and ice cream were reduced.

Concerning **musculoskeletal nutrients domain**, the study results indicated that the score increased after implementation of the program. This might be attributed to adequate healthy nutrient could influence bone health and help to maximize peak bone mass. In agreement with the forgoing present study findings, **Yoong et al. (2023)** in Australia suggested that healthy eating interventions likely increased children's consumption of healthy food.

Regarding **immunity nutrients domain**, mean score was highest one's post-intervention. This might be due to nutrition plays a critical role in the regulation of optimal immunological response. In such a manner, the immune system can initiate effective

responses against pathogens. In the same line, **Piziak (2021)** in South Texas mentioned that a significantly improved consumption of healthy immunity nutrition after using the game. In the light of the current study finding, **oral hygiene** scores of the children was increased post-intervention of the program. This might be attributed to the positive influence of game-based oral health education and practice of teeth brushing by easy manner. Additionally, oral hygiene plays an important role in the prevention of caries. So, proper oral hygiene should be emphasized from early childhood. Similarly, this finding was in the same way with **Shi et al. (2023)** in China clarified that oral health knowledge scores increased significantly among preschool children post intervention.

Considering, **hand hygiene** scores was improved post-intervention. This might be attributed to personal hygiene is essential at all stages of life, but good hygiene habits should be established in early childhood. As well, a study conducted by **Dangis et al. (2023)** in Finland found that games have shown to improve handwashing behavior, and hygiene knowledge among young children.

According to the present study results, **live with both parents** was a statistically significant independent positive predictor of children's post-intervention knowledge score. This result might be attributed to that parents are considered influential forces in the development of children's health and the best position for the provision of children's healthy food choices. Similar finding was reported by **Sirasa et al. (2021)** in Sri Lanka found that live with both parents had significantly increased children's food knowledge and healthy food preferences scores. Additionally, a study conducted by **Brecic et al. (2022)** in Zagreb, Croatia stated that live with both parents was positive attitudes toward healthy food.

The current study findings illustrated that a statistically significant negative correlation was found between post-intervention score and mean unhealthy food intake. This result might be attributed to effect of games in promoting and improving healthy eating choices knowledge in children. In the same context, a study carried out by **Pontes et al. (2022)** in Portugal concluded that children had significantly higher consumption of healthy food and lower unhealthy food. Also, in agreement with the present study finding, **Lamas et al. (2023)** in Portugal found that increased healthy food intake and decrease consumption of sugar-sweetened beverages packaged snacks, and non-healthy foods.

Ultimately, the existing study results revealed that the game-based learning intervention was a statistically significant independent positive predictor of children knowledge scores. This result might be due to that the intervention equipped the children with the sound knowledge related to healthy food choices which in turn enhanced their favorable attitude towards healthy food. This finding is in agreement with **Chang (2022)** in Taiwan found that game-based learning had positive effects on nutrition knowledge of food choice and was able to facilitate nutrition education. In the same vein, a study conducted by **Sönmez et al. (2023)** in İzmir, Turkey reported that nutrition education is affected children knowledge of healthy nutrition.

Conclusion

According to the findings of the present study, the following concluded:

The majority of the study sample characterized by normal dietary habits. Additionally, it was proved that healthy food choices scores among preschool children improved after the application of the game-based learning approach. Concerning predictors for healthy food choices indicated that, intervention, age, mother education, and live with both parents were a statistically significant positive predictors of children's post-intervention knowledge score. Conversely, birth order was a statistically significant negative predictor of children's post-intervention knowledge score.

Recommendations

On the basis of the current study findings, the following recommendations are

suggested:

- Further studies based on active training methods regarding healthy food choices among preschool children to confirm study findings.
- Further researches based on the predictors affecting of healthy food choices to assist in building more effective and more tailored intervention for preschool children.
- The game-based learning approach should be implemented on a wider scale in similar ones to confirm its positive effects and to generalize the findings

References

- Abd-El Aziz, E. M. (2019). Body mass index and cognitive abilities of preschool children in Zagazig city. Master thesis, Faculty of nursing, Zagazig University.
- Adipat, S., Laksana, K., Busayanon, K., Asawasowan, A., & Adipat, B. (2021). Engaging students in the learning process with game-based learning: The fundamental concepts. *International Journal of Technology in Education (IJTE)*, 4(3), 542-552.
- Ali, A. A. E., & Ahmed, F. M. (2022). Determinants of Picky Eating Behavior Among Preschoolers in Zagazig City, Egypt. *Egyptian Journal of Nursing & Health Sciences [EJNHS]*, 3(2).
- Aslan, S., Agrawal, A., Alyuz, N., Chierichetti, R., Durham, L. M., Manuvinakurike, R., Okur, E., Sahay, S., Sharma, S., Sherry, J., Raffa, G., & Nachman, L. (2022). Exploring Kid Space in the wild: A preliminary study of multimodal and immersive collaborative play-based learning experiences. *Educational Technology Research and Development*, 70(1), 205–230.
- Athavale, P., Khadka, N., Roy, S., Mukherjee, P., Mohan, D. C., Turton, B., & Sokal-Gutierrez, K. (2020). Early Childhood Junk Food Consumption, Severe Dental Caries, and Undernutrition: A Mixed-Methods Study from Mumbai, India. *Int. J. Environ. Res. Public Health*, 17.
- Baker, S., Morawska, A., & Mitchell, A. (2019). Promoting Children's Healthy Habits Through Self-Regulation Via Parenting. *Clinical Child and Family Psychology Review*, 22, 52–62.
- Bras, H., & Mandemakers, J. (2022). Maternal education and sibling inequalities in child nutritional status in Ethiopia. *SSM - Population Health*, 17.
- Brecic, R., Gorton, M., & Cvencek, D. (2022). Development of children's implicit and explicit attitudes toward healthy food: Personal and environmental factors. *Appetite*, 176.
- Chang, C. "Meta-Analysis for Comparing Effect Between Game-Based Learning Versus Gamification Utilized in Nutrition Education". Theses and Dissertations. University of North Dakota. [Online]. 2022 [Cited 2023 October]; Retrieved from <https://commons.und.edu/theses/4330>
- Clay, C. B. (2019). Establishing healthy habits in early childhood: Lessons learned from early care professionals. Doctorate theses, Institution: Mississippi State University. [Cited 2022, September 8], Retrieved from <https://scholarsjunction.msstate.edu>
- Dangis, G., Terho, K., Graichen, J., Gunther, S. A., Rosio, R., & Salantera, S. (2023). Hand hygiene of kindergarten children—Understanding the effect of live feedback on handwashing behaviour, self-efficacy, and motivation of young children: Protocol for a multi-arm cluster randomized controlled trial. *PLoS ONE*, 18(1).
- DeJesus, J. M., Gelman, S. A., & Lumeng, J. C. (2020). Children's implicit food cognition: Developing a food Implicit Association Test. *Cogn Dev*, 54.
- El-hasry, R. T., Abd-El Hameed, H. S., ElSayed, D. M. S. (2023). Perception of Mothers regarding Effect of Fast Food on Preschool Children Health Status. *Journal of Nursing Science - Benha University ISSN*, 4(2).

- Fikry, F. E. E., Mohamed, A. A., Mohamed, A. M., &El-said, S. M. (2019). Assessment of Overweight and Obesity among preschool children in day care centers in Alexandria -Egypt. *International Journal of Novel Research in Healthcare and Nursing*, 6(3), 577-595.
- Hu, H.,Yang, C., Tan, F.,Zhao, X., Du, X.,Liang, J.,Wu, T.,Wang, H.,Qiu, Z., Zhang, H.,Zhang, J.,&Liu, W. (2019). Parental Influence in Forming Preschool Children's Eating Behaviors—A Cross-Sectional Survey in Chongqing, China. *Healthcare*, 7(4), 140.
- Kerkez, F. I., &Sakalli, D. (2021). physical Activity and Healthy Food Preference in Turkish Preschool Children. *International Journal of Sport Culture and Science*, 9(2).
- Kostecka, M.,Kostecka-Jarecka, J.,Kowal, M., &Jackowska, I. (2021). Dietary Habits and Choices of 4-to-6-Year-Olds: Do Children Have a Preference for Sweet Taste?.*Children (Basel)*, 8(9), 774.
- Lamas, S.,Rebelo, S.,Costa, S. D., Sousa, H.,Zagalo, N.,& Pinto, E. (2023). The Influence of Serious Games in the Promotion of Healthy Diet and Physical Activity Health: A Systematic Review. *Nutrients*, 15(6).
- Manriquez, M. Introducing Nutrition Education to Preschoolers. capstone projects and master's theses, California State Univ California State University, Monter, Monterey Bay. [Online]. 2020 [Cited 2023 October]; Retrieved from <https://digitalcommons.csumb.edu>. *Nutrients*, 7.
- Mi Cha, S., Youn Kim, S. (2023). Analysis of the factors that influence preschool children eating behavior by applying the health belief model: Seoul and Gyeonggi Province. *Nutr Res Pract*, 17(7).
- Oktavia D., Bali, M., Rahman, H., Umar, U., Syakroni, A., & Widat, F. (2019). Exploration of Fine Motor Skills through the Application of Paint. European Union Digital Library,1–6.
- Orkusz, A. (2022). An Assessment of the Nutritional Value of the Preschool Food Rations for Children from the Wroclaw District, Poland—The Case of a Big City. *Nutrients*, 14, 460.
- Piziak, V. (2021). Developing Educational Games for Preschool Children to Improve Dietary Choices and Exercise Capacity. *Sustainability*, 13(6).
- Pontes, C. B.,Dias, S. S.,Lages, M.,Guarino, M. P.,& Graça, P. (2022). Nutrition education strategies to promote vegetable consumption in preschool children: The Veggies4myHeart project.*Public Health Nutrition*, 25(4), 1061-1070.
- Sahideen, F. S. M.,Mitchell, L. J.,Silva, R.,&Harris, N. (2020). Factors influencing the food choices of urban Sri Lankan preschool children: Focus groups with parents and caregivers.*Appetite*, 150.
- Said, F. A., Khamis, A. G., Salmin, A. H., Msellem, S. N., Mdachi, K., Noor, R., Leyna, G., Mchau, G. J. (2023). Influence of diet quality on nutritional status of school-aged children and adolescents in Zanzibar, Tanzania. *PLoS One*, 18(10).
- Shi, Y.,Wu, W.,Huo, A., Wang, H.,Lu, W.,&Jin, X. (2023). Effect of Conventional and “Dental Truth or Dare” Board Game on Oral Hygiene Knowledge and Oral Hygiene Status of Preschool Children. *Games for Health Journal*, 12(2).
- Sirasa, F., Mitchell, L., & Harris, N. (2023). Healthy eating in preschool children: Perceptions of parents and caregivers in Sri Lanka. *Health Education Journal*, 82(8), 864-877.
- Sirasa, F., Mitchell, L., Azhar, A., Chandrasekara, A., & Harris, N. (2021). A 6-week healthy eating intervention with family engagement improves food knowledge

and preferences but not dietary diversity among urban preschool children in Sri Lanka. *Public Health Nutrition*, 24(13).

- Sönmez, S., Kolaşınlı, I. B., Topcan, Y., & Paylaş, M. (2023). Investigation of the Effectiveness of Nutrition Education Applied to Preschool Children. *Humanities Today: Proceedings*, 2(1).
- Tahir, R., & Wang, A. I. (2020). Codifying Game-Based Learning: Development and Application of leaguê Framework for Learning Games, *Electron. J. e-Learning*, 17 (4), 69–87.
- Wu, Z., Yang, H., Tan, H., & Zhao, S. (2019). Parental Influence in Forming Preschool Children's Eating Behaviors—A Cross-Sectional Survey in Chongqing, China. *Healthcare*, 7(4), 140.
- Yoong, S. L, Lum, M., Wolfenden, L., Jackson, J., Barnes, C., Hall, A. E, McCrabb, S., Pearson, N., Lane, C., Jones, J. Z., Nolan, E., Dinour, L., McDonnell, T., Booth, D., & Grady, A. (2023). Healthy eating interventions delivered in early childhood education and care settings for improving the diet of children aged six months to six years. *Cochrane Database of Systematic Reviews*, 8.
- Youn Kim, S., & Mi Cha, S. (2021). Evaluation of dietary behaviors of preschool children in Seoul and Gyeonggi-do associated with the level of parents' health consciousness: using nutrition quotient for preschoolers (NQ-P). *Nutr Res Pract*, 15(2), 248–265.
- Zolkipli, N. Z., Rahmatullah, B., Mohamad Samuri, S., Árva, V., & Sugiyono Pranoto, Y. K. (2023). Leave no one behind: A systematic literature review on game-based learning courseware for preschool children with learning disabilities. *Southeast Asia Early Childhood Journal*, 12(1), 79–97.

المراجع العربية

- إبراهيم؛ إيمان يونس (2023). بناء مقياس إختيار الأطعمة الصحية المصور لدى طفل الروضة. المؤتمر العلمي السادس والعشرين للعلوم الانسانية والتربوية- كلية التربية الأساسية- الجامعة المستنصرية- بغداد. مجلة المستنصرية للعلوم الإنسانية. العدد 1