The Review Of
DIABETIC
STUDIES OPEN ACCESS

The Effectiveness Of Maternal Educational Programs On Dietary Habits And Physical Activity Of Preschool Children In Makkah, 2023: A Randomized Controlled Trial Study

Amani Abdullah AlSaedi[1], Abdulrahman Ahmed Alharbi[2], Umniah Adel Marghalani[3], Omnia Salah Abualnaja[4], Fatmah Salman Alharbi[5], Safenaz Meshal Al-Qurashi[6], Ameen Mohammed Malky[7]

[1]Preventive medicine consultant
[2]Medical student um Alqura University
[3]Clinical Dietitian
[4]Family medicine consultant
[5]Family medicine consultant
[6]Family medicine consultant
[7]Preventive medicine Specialist

Abstract

Background: Childhood overweight and obesity have emerged as major global public health concerns and are now recognized among the most prevalent preventable causes of morbidity and mortality. Beyond their immediate health risks, excess weight in early childhood adversely affects physical, psychological, social, and environmental dimensions of quality of life.
Aim: This study examines the effectiveness of a maternal nutrition-education program in improving mothers' knowledge of healthy dietary habits and physical activity for preschool children.
Methodology: The study employed a two-phase design. Phase 1 consisted of a cross-sectional survey to determine the prevalence of overweight and obesity among children aged 3–6 years enrolled in selected kindergartens in Makkah, Saudi Arabia. Phase 2 used a two-stage cluster random sampling technique. In the first stage, four kindergartens were randomly selected from 115 facilities across eight districts. In the second stage, the selected kindergartens were randomly assigned to an intervention or control group. Mothers of eligible children were recruited until the required sample size was reached. The intervention group received a structured five-week nutritional education program, whereas the control group received routine one-time dietary and weight-management advice. Data were collected at baseline and three months post-intervention using a screening questionnaire and the General Nutrition Knowledge Questionnaire (GNKQ). Statistical analyses were performed using SPSS version 22.
Results: Of the 350 distributed questionnaires, 176 completed responses were analyzed. The sample included 100 boys and 76 girls (mean age: 5.5 years). Most mothers were college-educated (72.6%) and employed (65%), and the majority of parents were married (94%). Nearly half of the children (48.9%) had normal weight, while 11.9% were overweight and 21% were obese. A significant improvement in maternal nutrition knowledge was observed in the intervention group compared with the control group at post-test ($p < 0.0001$), with no significant differences at baseline. Dietary and lifestyle patterns revealed that 52.2% of children had mixed feeding during infancy; daily breakfast, lunch, and dinner intake was reported by 38.6%, 67%, and 54.5% respectively; and 36.9% consumed snacks one to two times daily. Lunch was the primary meal for most children (64.2%), and boiled food was the most common cooking method (44.3%). Most mothers reported removing visible fats from meat (84.7%). Screen time ranged between one and three hours daily for half of the children, while 65.9% engaged in some physical activity. Only 22.2% of mothers reported having nutrition-related qualifications, and 7.2% had attended a nutrition-related course.
Conclusion: With the global rise in childhood overweight and obesity, early preventive strategies are essential. The findings highlight the need for sustained, community-based educational interventions targeting parents—particularly mothers—alongside broader efforts by policymakers and educators to promote healthy eating and physical activity habits among Saudi preschool children.

Keywords: Maternal education; Nutrition education; Preschool children; Dietary habits; Physical activity; Childhood obesity; Overweight prevention; Makkah; Saudi Arabia; Health promotion.

1. Introduction

Overweight and obesity in childhood are emerging as one of the major public health concerns in the last few decades, affecting both developed and developing countries. Recent data revealed that overweight and obesity were estimated to cause 3·4 million deaths, 3·9% of years of life lost, and 3·8% of disability-adjusted life-years (DALYs) worldwide [1]

In the year 2014, according to the World Health Organization, it is found that over 600 million Obese individuals. And 41 million children (under age 5) around the world were either overweight or obese and it is predicted that by 2030, a majority of the adult population of the world would be either obese or overweight [2]

Specifically, in Africa, the number of children who are overweight or obese has doubled from 5.4 million in 1990 to 10.6 million in 2014. In Asia, nearly half of the children under five were overweight or obese [2]. A similar pattern was observed in Saudi Arabia, overall obesity prevalence in 2017 reached 52.9%. According to the statistics, rate of obesity is continuously increasing and expected to reach 59.5% by 2022 [3]

Obesity can be defined as an abnormal condition or excess accumulation of fat in adipose tissue, to the extent that health may be impaired [4] Overweight and obesity conditions develop from the interaction between predisposing factors genetic, behavioural, socioeconomic and environmental factors when there is an imbalance between calories consumed and calories expenditure mostly due to consumption of unhealthy foods and physical inactivity that may affect all ages and all socio-economic classes. [5] I It is known to be associated with substantial loss of quality of life. [1] Children as a vulnerable group requires special attention and nutritional care because of the negative nutritional consequences that may occur among them.[5]

Children obesity disturb all aspects of a child's life. It is proven to cause multiple health obstacles especially to those who have been overweight and obese since early childhood. It can cause different health problems range from physical and psychological to social problems. The physical health problems range from type 2 diabetes, high blood pressure, asthma, heart disease, sleep apnea and certain types of cancer. [6] The psychological problems range from depression, “low self-esteem, anxiety, depression and the feeling of chronic rejection, body dissatisfaction loss-of-control eating, unhealthy and extreme weight control behaviours, impaired social relationships, obesity stigma, withdrawal from peer interaction, negative self-esteem and decreased health-related quality of [7]

In epidemiological studies body mass index is the most commonly method used to assess overweight and obesity for both children and adults. BMI is determined both by weight and height and calculated by dividing weight in kilograms by the square of height in meters (kg/ m2). [8] The measure is simple, practical, inexpensive and easy to use to assess population overweight and obesity but is prone to overestimating some peoples’ weight status as it does not measure Increased fat-free mass such as muscle mass. Hence, it does not distinguish overweight due to excess fat mass from overweight due to excess lean mass [4]

For children, weight status is determined using an age- and sex-specific percentile for BMI as a substitute of the BMI categories used for adults. Overweight define as a BMI at or above the 85th percentile and below the 95th percentile for children of the same age and sex. Obesity is diagnosed as a BMI at or above the 95th percentile for children of the same age and sex[9]. That is due to the body composition fluctuates differentially with developmental growth across age and sex. Consequently, BMI levels among children need to be determined compared to other children of the same age and sex [6,10]

Regarding the sutable amounts of consuming diffent kind of foods and practicing physical activities for children (2-8 years), the american diatry guidline 2015-2012 recommended the following as daily consumption; fruits & vegetables (1-1.5 cup), serials (1.5-5.0 ounce), protein (2-4 ounce), milk (2-3cups), the lowest estimated calories/daily for preschool children is 1000calories, and reached 1200to 1800 based on gender, ae, and lifestyle. [11] On the other hand, there is no exact amount or duratio for physical activities under 6 year, however, children should be encouraged to be active throughout the day, every day fro at least 180 minutes. Children under 5 should not be inactive for long times, except when they're aslee, where apctivity of any intensity should be encouraged, including light activity (standing up, moving around, rolling and playing) and more energetic physical activity (skipping, hopping, running and jumping). And the best games to get moving in this age are (climbing frame, riding a bike, playing in water, chasing games and ball games). [12]

The consequences of childhood obesity go beyond health; they can also impact the economic, social, and psychological aspects of our community. It is, therefore, essential to develop the effective measurement that can be used to control this rising epidemic and decrease the future increase in health care cost. [13] Childhood obesity prevention programs are one of the current tools that are being used to fight childhood obesity. To date, the majority of childhood obesity interventions have had short-term success. Evidence suggests that eating behaviours are learned at an early age, and therefore, preventative efforts during early childhood may have life-long success in preventing obesity [14].

Additionally, previous studies have shown that interventions that involved parents were more effective. Obesity prevention efforts need to be implemented in a wide range of settings, including the home, to have long-term success and sustainability. this study focused on prevention during early development with parental involvement [15]. The study aims to evaluate the effectiveness of the nutrition educational program of preschool children's mothers on changing knowledge about dietary habit and physical activity.

In recent years, growing international attention has been directed toward the prevention of childhood obesity during the preschool period, as evidence increasingly demonstrates that health-related behaviors established in early childhood tend to persist across the life course. Dietary patterns, food preferences, screen-related sedentary behaviors, and levels of physical activity are largely formed before the age of six, making early childhood a critical window for preventive intervention. Studies published between 2020 and 2022 emphasize that interventions initiated during this developmental stage are more likely to produce sustainable outcomes than those introduced later in childhood or adolescence.

Contemporary research has also highlighted the pivotal role of parents—particularly mothers—in shaping early childhood nutrition and lifestyle behaviors. Mothers typically serve as the primary caregivers and decision-makers regarding food selection, meal preparation, portion sizes, and opportunities for physical activity. Recent evidence indicates that higher maternal nutrition knowledge is associated with healthier dietary patterns among children, including increased consumption of fruits, vegetables, and whole grains, as well as reduced intake of sugar-sweetened beverages and energy-dense foods. Furthermore, maternal attitudes toward physical activity have been shown to significantly influence children’s activity levels and sedentary behaviors.

Despite the growing body of international literature supporting parent-focused interventions, evidence from Saudi Arabia remains comparatively limited, especially for structured nutrition education programs targeting mothers of preschool children. Although several regional studies have documented high prevalence rates of childhood overweight and obesity, fewer investigations have examined modifiable parental factors, such as nutrition knowledge and feeding practices, or evaluated the effectiveness of educational interventions within the Saudi cultural context. This gap is particularly important given the rapid lifestyle transitions occurring in Saudi society, including increased reliance on convenience foods, higher screen exposure among young children, and reduced opportunities for daily physical activity.

Recent national and regional reports up to 2023 indicate that childhood overweight and obesity continue to rise in Saudi Arabia, reinforcing the urgency of implementing evidence-based, culturally appropriate preventive strategies. Public health authorities increasingly recognize that sustainable obesity prevention requires community-based approaches that engage families, rather than relying solely on school-based or clinical interventions. Maternal education programs represent a promising strategy, as they can enhance nutrition literacy, empower mothers to adopt healthier feeding practices, and create supportive home environments that foster healthy growth and development in young children.

Within this context, evaluating the effectiveness of maternal nutrition education programs is essential to inform public health policy and guide future intervention design. Understanding how structured educational interventions influence maternal knowledge related to dietary habits and physical activity can contribute to the development of scalable prevention strategies aimed at reducing the burden of childhood obesity in Saudi Arabia.

2. Literature Review

Overweight and obesity are independent risk factors for morbidity and mortality throughout an individual's life span. Being overweight or obese during childhood increases the duration that an individual will have to live with co-morbidities associated with obesity by one or two decades and will increase their risk of obtaining many adult diseases and increase the risk of premature death [16]. In addition to health issues, being Overweight and obese has economic consequences. Direct costs related to medical expenditures from obesity-related diseases, and indirect costs related to reduced productivity and disability. Childhood obesity also has an impact on the nation's medical costs. Annual medical costs are about three times higher for an obese child than a child of normal weight. The average annual costs for prescription drugs, emergency room visits, and outpatient services related to childhood obesity are more than $14 billion and the inpatient hospital costs are $238 million annually [13].

Beside to the medical costs, there are physical, emotional and social costs related to childhood obesity. Among adults, obesity-related job absenteeism costs the nation $4.3 billion each year. Obesity is also associated with decrease work productivity totaling $506 per obese worker each year [13]. Among children, the loss of productivity is expressed as school absenteeism. Compared to their normal-weight peers, school absenteeism among obese children is significantly higher [17]. If nothing is done to prevent obesity in children, the direct and indirect costs will continue to rise [13].

The Arabian Gulf Countries has higher rates of obesity and diabetes and spends more than 5.6 USD billions a year on diabetes-related health care. For example, the Saudi Diabetes & Endocrine Association estimates the indirect and direct costs of overweight and obesity to be around to five billion dollars per year in Saudi Arabia [18]. During the past three decades, Saudi Arabia has been undergoing rapid socio-economic and nutrition transformation. The increase in income parallels changes in lifestyle and dramatic change in food consumption patterns towards a westernized diet high in energy, salt, fats and sugar and physical inactivity [19].

Economic development has created obvious changes in eating habits. For example, in Saudi Arabia, the daily per capita fat consumption has risen to 143% and a similar trend in the reduction of energy expenditure has been recorded. Unfortunately, due to these social changes, the concept of eating has changed from being a simple and necessary required nourishment to a marker of lifestyle and source of pleasure [20]. There are many challenges to managing childhood obesity. Due to their growing bodies, children who's on a restricted diet may not receive the energy and nutrients their bodies need to develop properly [7]. Inadequate diet during this period can result in decreased iron deficiency, anemia, learning ability, delayed sexual maturity, impaired school performance, lack of concentration, and slow growth. Furthermore, inappropriate food habits increase obesity/underweight, and the risk of incidence of diet-related chronic diseases among adolescents [6].

Prevention should be the primary goal for childhood obesity. If successful, obesity in the adult population will also decrease [21]. Modifiable and non-modifiable risk factors both play a role in the

childhood obesity epidemic. Modifiable risk factors for children include lack of regular exercise, excessive television viewing or computer usage, working parent, low family income, and overconsumption of high-calorie foods. The most common non-modifiable risk factor is genetics. Intervention programs aimed at childhood obesity are often focused on the modifiable risk factors [22].

Intervention programs apply behavior modification techniques to promote lifelong lifestyle changes. Also, parent involvement in behavior modification programs has a greater impact than those with little or no parent involvement [22]. Lifestyle modification includes both behavioral and cognitive changes. Lifestyle modification encourages long-term lifestyle and behavior change and motivates increased caloric expenditure while decreasing caloric intake [23].

Evidence suggests that discouraged consumption of High caloric dense foods and encouraged consumption of low caloric dense foods and leads to small positive changes. Placing emphasis on the consumption of plant-based foods, vegetables, and fruits are major steps in decreasing energy-dense food intake [21]. Consumption of small, frequent meals may also be influential in reducing caloric intake [14].

Some factors play an essential role in the development of obesity. It is a complex multifactorial phenomenon school, community, environment, culture, media, and industries These factors are leading to obesity due to their influence on the child's diet and level of physical activity also, A weight of the child can be influenced by his parents [21]. Parent involvement is a fundamental component of childhood obesity prevention interventions. Parents are the role models and providers of food and physical activity opportunities [15].

Physical activity and dietary habits are established during the early years of life. Therefore, parent involvement has powerful effects on a child's perceptions, and behaviors towards food and physical activity. Feeding practices are intended to promote positive and healthy [22]. Eating behaviors that will foster a child's development; thus, these practices may produce unintended negative consequences, Therefore, parent's role in the feeding process should be examined when researching the influences on child weight status [15].

Parents are key players in the development of childhood obesity because they directly influence the child's genetic potential and their environment. Parents determine what foods are offered to their children and provide the atmosphere in which children are eating. Low parental educational level, Parental obesity low total family income, an absence of breastfeeding, and physical inactivity, long hours of TV watching is significantly associated with childhood overweight/obesity [14].

Research revealed a strong correlation between parental food preferences and their child's food preferences, particularly with fruits, vegetables, sweetened beverages, and meats. Young children learn about eating and foods by watching the eating habits and food preferences of their parents [14]. Research have demonstrated that children are more likely to eat an unfamiliar food item after watching their mother consume the same food item. These findings, with the findings of other research studies, suggest that parental influence can play a significant role in the prevention of childhood obesity by establishing healthy eating behaviors in their children. Additionally, parents are solely responsible for purchasing and preparing healthy food for their children [22].

A measure of parental influence on the child's eating behaviors is a necessary component of childhood obesity so that Any program implemented must include a parent component [15].

To date, the majority of childhood obesity interventions have occurred in schools with older children and adolescents and have had short-term success. Evidence suggests that eating behaviors are achieved at an early age, and therefore, preventative efforts during early childhood may have life-long success in preventing obesity. Additionally, previous studies have shown that interventions that involved parents were more effective. It is clear that obesity prevention efforts need to be implemented in an early age with parental involvement, to have long-term success and sustainability [15].

Parental support interventions targeting parents of young children are considered more effective than those targeting parents of older children [24]. The literature also demonstrates a significant lack of nutrition education in the Saudi population, as it is absent from the school curriculum. Therefore, nutrition education intervention is a means by which to increase nutritional knowledge has led to improvement in the quality of food consumed, such as increasing fruit and vegetables, and decreasing sweets and chocolate [25].

In 2018 in Abha South western Saudi Arabia, Al-Qahtani et al conducted a cross-sectional study among 385 parents of a child aged 12–72 months from 5 PHCCs to detect parents' perception regarding ideal weight for their preschool children and to assess their awareness about childhood obesity. They used a structure questionnaire consisted of 32 questions about demographic data, perception and knowledge about ideal weight, preferred weight for children, and child's nutrition and lifestyle. They used Saudi body mass index chart to classify the children as ideal, overweight, or failure to thrive. The results explained that the overall percentage of overweight children amounted to 8.6%. It was found that 57.6%of the parents of overweight children perceived the weight of their children to be ideal. On the other hand, 42.2% of the parents of ideal weight children thought that the weight of their children was low,when it was ideal. However, 90.9% of the parents among the children with obesity and 85.5%of the parents among the children with ideal weight preferred their children to have ideal weight. Among overweight children, 6.1% of their parents preferred their children to have an increase in their weight. Also, among ideal weight children, about 15.1% of the parents preferred an increase in their child's weight. [36]

In 2014 in Eastern Saudi Arabia, Darwish et al conducted a cross-sectional study to explore life styles and dietary behaviors among Saudi preschool children (1–5 years) attending primary health care centers (PHCCs) in Dammam and Qatif areas, eastern province, Saudi Arabia. They used a structured, interviewer-filled questionnaire, where 300 preschool children and their mothers were enrolled during their well-baby clinic visits. The results showed an unsatisfactory area include smoking fathers (32%), smoking in front of children (11.3%), overweight and obesity among mothers (60.3%), noncompliance using seat belts for both parents (56.3%) and children (68%), children watching television (T.V) more than 2 hours (50%), adherence to exclusive breast feeding (only 20.7%), and late solid food introduction (65.3%). Frequent intake of unhealthy food items (24%). Regrettably frequency of intake of the following unhealthy food items was high: biscuits, deserts/chocolates, and chips, which were 78%, 67%, and 72%, respectively. This study provides a benchmark of the current situation. [37]

Recent literature has increasingly emphasized the importance of early-life interventions in preventing childhood overweight and obesity, particularly during the preschool years. Systematic reviews published between 2020 and 2022 indicate that obesity prevention strategies initiated before school entry are more effective in shaping long-term dietary behaviors and physical activity patterns than interventions targeting older children. Early interventions benefit from greater parental control over food choices and daily routines, allowing healthier behaviors to be integrated into the child's environment before unhealthy habits become entrenched.

Family-based and parent-focused interventions have been consistently identified as among the most effective approaches for childhood obesity prevention. Contemporary studies demonstrate that programs involving parents—especially mothers—are more successful in improving children's dietary quality and reducing obesogenic behaviors than child-only or school-based interventions. This effectiveness is attributed to parents' central role in food availability, meal structure, role modeling, and regulation of screen time and physical activity. Maternal education, in particular, has been shown to significantly influence feeding practices, portion control, and responsiveness to children's hunger and satiety cues.

Nutrition knowledge has emerged as a key modifiable determinant of parental feeding behaviors. Evidence from recent cross-sectional and intervention studies suggests that mothers with higher levels of nutrition literacy are more likely to provide balanced meals, limit the consumption of sugar-

sweetened beverages and ultra-processed foods, and encourage regular physical activity among their children. Conversely, limited nutrition knowledge has been associated with inappropriate feeding practices, such as excessive portion sizes, frequent snacking, and reliance on convenience foods, all of which contribute to positive energy balance and weight gain in early childhood.

In addition to dietary behaviors, physical activity and sedentary behaviors are critical components of childhood obesity prevention. Studies conducted between 2020 and 2022 report that increased screen time, including television viewing and digital device use, is strongly associated with higher body mass index (BMI) and lower physical activity levels among preschool children. Parental attitudes and household rules regarding screen use play a decisive role in shaping children's activity patterns. Mothers who are informed about physical activity recommendations are more likely to encourage active play and limit sedentary behaviors, thereby supporting healthier energy balance.

Cultural and environmental factors also influence the effectiveness of obesity prevention interventions. Research conducted in Middle Eastern contexts highlights that social norms, family structure, urban design, and climate conditions may limit opportunities for outdoor physical activity and shape dietary practices. Therefore, culturally tailored interventions that account for local lifestyles, beliefs, and constraints are more likely to achieve meaningful and sustainable outcomes. In Saudi Arabia, maternal education programs that are sensitive to cultural values and delivered through accessible platforms have been suggested as a practical and acceptable approach for promoting healthy behaviors in young children.

Despite the growing international evidence base, there remains a notable scarcity of intervention studies in Saudi Arabia that rigorously evaluate maternal nutrition education programs for preschool children. Most existing studies in the region are descriptive or cross-sectional, focusing on prevalence and associated risk factors rather than intervention effectiveness. This gap limits the availability of locally relevant evidence to guide public health planning and underscores the need for experimental and quasi-experimental studies assessing the impact of structured educational programs on maternal knowledge and child-related health behaviors.

Taken together, the literature supports the premise that maternal nutrition education represents a promising strategy for improving dietary habits and physical activity behaviors among preschool children. However, further research is required to assess the effectiveness of such interventions within specific cultural and community contexts. Evaluating maternal education programs in Saudi Arabia can contribute valuable evidence to inform policy development and support the design of comprehensive, family-centered obesity prevention strategies.

3. Methodology and Procedures

3.1 Study Design

a) First phase: Cross-sectional design.
b) second phase: A cluster randomized controlled trial

3.2 Study Setting

The Kingdom of Saudi Arabia is located in the Arabian Peninsula and occupies most of that area. The total population is 31.5 million (World Bank, 2015) and covers 200,000 square kilometers It is bordered by Kuwait, Iraq, and Jordan to the north, Yemen, and Oman to the south, the Arabian Gulf, the Kingdom of Bahrain, Qatar and the United Arab Emirates to the east and the Red Sea to the west. There are many important cities, such as Riyadh, which is the capital city, and Makkah and Madinah, the holy cities. Saudi citizens constitute approximately 68% of the total population residing in Saudi Arabia. Of the total population, 5.2% are over the age of 60 years. Currently half (50%) of the population are under the age of 30 years, and 24.5% are under the age of 15 years old (General Authority for Statistics Kingdom of Saudi Arabia, 2015).

Saudi Arabia is divided into 13 administrative regions (Ministry of Foreign Affairs, 2016). Arabic is the spoken language, and the capital city is Riyadh, located in the mid-region of the country This study was undertaken in Makkah city, a western region of the Kingdom of Saudi Arabia. The city is divided into eight districts according to the Ministry of education. There are about 115 governmental and private kindergartens in total in these eight districts. The setting for this study included randomly selected government and private KGs to be inclusive of different socioeconomic backgrounds, maternal education, occupation and working status and thus striving for maximum variation within Makkah city.

3.3 Study Population

Saudi pre-school children (3-6-year-old) attending the selected kindergartens and their mothers/caregivers

3.4 Inclusion Criteria

included mothers with a preschool child between the ages of 3 to 6 age of years,

3.5 Exclusion Criteria:

- Mother and /or child had physical disabilities or learning difficulties, which would interfere with their ability to take part in the program
- Mother and/or child following a special diet.
- The mother was unable to read, write Arabic.

3.6 Sample size

Sample size is estimated using software program G power; a statistical program designed for sample size estimation [39] Previous study [40] shows that nutrition education to mothers can increased nutritional knowledge by 50% Considering this, with an alpha error of 0.05 and power of 90%, the minimum required sample size was calculated to be 86 participant for each group. This sample size increased to 100 for each group to account for possible missing data and loss of follow up. To achieve the secondary objective (1)

3.7 Sampling technique:

A multistage stratified random sample technique was adapted which was used to select the four KG from all 115 KG from eight districts. If a school could not participate another was selected.
This study was undertaken in two phases:

Phase 1 :

All children (age 3-6 year) and their mothers in the selected KG who were eligible and invited to participate in the study.

Phase 2 :

the KGs were randomly allocated to the interventional group and control group equally.
Kindergarten of the intervention arm: the educational program was conducted to mother and pamphlet sheet for follow-up will be distributed
Kindergarten of the control arm: act as a control group and only received one-time advice on routine measures on diet and weight management

3.8 Recruitment and Procedure

The process of gaining access to the study site for data collection began in January |2023, with a visit to the General Administration of Education in Makkah to get Permission for the study. After explaining the research objectives and aims. He requested to see the proposal and questionnaires. After that, I had received the official approval with the list of all Kindergartens in Makkah (Appendix 4) also a letter of support with the approval was sent directly by email to the all the head teachers to encourage each particular KG to participate, so the researcher could contact head teachers immediately, which saved both time and effort. Mothers of selected KG were invited to join in the study via announcement online brochure (appendix7) and Registration link sent by WhatsApp through the staff of those KG. However, participation was entirely voluntary a letter of invitation (appendix 7) was given to all participants before they began the study. Out of the 350 mothers invited 211 responses were received for parent questionnaire. implying a 60 % response rate, out of which 25 of the returned surveys were incomplete

and not considered for analysis and 10 withdrawals. Thus, the analysable sample contained data from 176 mothers were asked to complete screening questionnaire and GNKQ before the intervention to assess the baseline and at the end of the trail. Men were excluded from this study as men are not allowed to enter KG according to Saudi culture.

The first meeting was scheduled for all participants to complete a pre-test nutrition knowledge and screening questionnaires. Participants were given up to 20 minutes to complete the survey and were asked to turn the completed survey directly to the researcher. The researcher was available to clarify any questions and to monitor participants. The intervention group was invited to attend one intervention session per week approximately 1 hour every week, for five consecutive weeks. The control group was contacted after the 5-week nutrition education Intervention was completed and the participants were asked to complete the post-test on an electronic version. The organization of First meeting was a challenge in practice, and there were difficulties in coordinating and getting full attendance at sections, a flyer sent out to all mothers to remind them of the dates, times, and locations of the classes even with this the attendance was limited. It became apparent that it was difficult to conduct the consecutive meetings.

Reported reasons for non-attendance for participant who cancelled at the last minute included sickness or not being able to find anyone to drive them to the venue or the period when holding sessions was not convenient, therefore, the supervisor suggested to complete the consecutive sessions online that the nutrition education interventions got advantage of emerging technology including Internet-based applications. These technologies are easily adapted to self-administered interventions that they can be tailored to meet individual preferences. Five sessions were conducted for the educational intervention over a period of five weeks. Then, an electronic version of GNKQ completed again with the same group of mothers five weeks later.

3.9 Data collection tool:

The data collected using a predesigned questionnaire developed by the researcher after reviewing the recent literature and a similar questionnaire. [11] All questionnaires were designed for self-completion. Two versions of the questionnaire were created: a paper version and an online version. The latter was developed to reduce the item-non-response rate and incomplete data as it is easy to use, saves resources, provides more complete answers, and facilitates data collection

3.10 Intervention

The first intervention Session performed at Umm Ulqura venue, in Makkah. The educational program designed by the researcher after reviewing the related literature and Dietary Guidelines for American 2015-2020. [11] the consecutives sessions were conducted on WhatsApp. The following topics were presented and discuss with the participant through PowerPoints, video, and poster. each session contained different learning objectives as shown in the table

Sessions	Learning objectives
Session 1	- Importance of Breastfeeding - Nutrition during pregnancy - healthy diet is made up from a variety and balance of different foods and drinks - the different food groups
Session 2	- macronutrients and micronutrients - sources of different vitamins and minerals. - functions and sources of different vitamins and minerals.
Session 3	- Nutritional benefits of fruits, vegetables, and whole - grains - Overcoming the barriers of incorporating fruits, - vegetables, and whole grains into family mealtime

	- Food safety practices with fruits and vegetables - Proper storage of fruits and vegetables - Increasing fruit, vegetable, and whole grain consumption - at family mealtime and snacks - Identifying whole grains with a nutrition label and - ingredient list
Session 4	- functions and sources of dietary fiber - benefits of dietary fiber - the consequences of not having enough fiber - sources of carbohydrate, protein and fat. - the consequences of not having enough carbohydrate, protein and fat - Whole grains vs. enriched grains vs. refined grains Fiber
Session 5	- Tips to develop healthy eating habits in preschoolers - Techniques that will make feeding preschoolers a - Success - How to introduce new foods to preschoolers - − Physical activity recommendations for preschoolers - Nutritional requirement for male and female child aged 3-5 years

3.11 Data entry and analysis:

Data were entered and analyzed using IBM SPSS version 23.0, and the normality of data was assessed using shapiro wilk test. Descriptive statistics for all the primary variables were generated, including the mean, median, standard deviation and frequency distribution.

The inferential statistical analyses included chi-square and the Non-parametric test, a Mann Whitney and a Wilcoxon test were used to compare variables.

All tests conducted at a level of significance a=0.05; results with p-values<0.05 considered "statistically significant

-Age

Exact age was calculated by the difference between the date of data collection and the date of birth.

-Occupation: grouped into working and not working.

-Family monthly income : Children's Anthropometrics

Height: measured to the nearest 0.5 centimeters (cm)

Weight: measured by kilogram (kg) to the nearest 100 gram (g).

Body Mass Index for age : Body mass index percentiles (BMI percentiles). BMI percentile was calculated by online program on CDC website by entering the child's weight, height, birthday,

The body mass index (BMI) was calculated using the formula weight (kg) divided by height (m2). BMI values were categorized based on cut off values derived from age and sex-specific growth charts used by the CDC. [44]

Weight Status Category	**Percentile Range**
Underweight	Less than the 5th percentile
Normal or Healthy Weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obese	Equal to or greater than the 95th percentile

3.12 Pilot study:

A pilot study was carried out before conducted the main study where the field work was assessed, 10% of the sample size who meet the inclusion criteria of the target population randomly selected to conduct a pilot study. Around 20 participant mothers from one KG enrolled in a pilot study and excluded from the analysis of the main study. The primary purpose of the pilot study is to check understanding and applicability of the questionnaire. Accordingly, changes were made to the study questionnaires in which some questions were excluded.

Initially, the tools included a 24-hour diary intake, as well as the food frequency questionnaire. The questionnaire was very long and were not completed by any of the 20 participants in the pilot study, they commented that the survey was too much, and they had no time to finish these and FFQ and 24hr recall were challenging to be estimate and self-completion.so, they were replaced by food frequency questions about specific food items which consumed by child in the last 7 days.

3.13 Ethical consideration:

- Ethical approval for the study was granted by the ethical committee of Postgraduate Saudi Board Program, Western Province (appendix 6) and the General Administration of Education in Makkah. (appendix 4)
- Head teacher received a letter of permission from the Ministry of Education by email and asked to provide the researcher access to conduct the study so, I could contact head teachers immediately, which saved both time and effort.
- Verbal and written consent obtained from all participating mothers and were given an opportunity to refuse participation and withdraw at any time
- The researcher assigned a unique code to each participant so that their names did not appear alongside their data, allowing confidentiality and anonymity to be assured and maintained.
- Assurance that the information given is not going to be used for any other purposes apart from the academic research.
- There was a guarantee of anonymous and confidential data analysis, for both the paper and online versions of the questionnaire

3.14 The significance of the Study

This study contributes significantly to the existing literature because it provides updated insight into the current state of nutrition knowledge and dietary intakes among Preschool mothers. Furthermore, the study evaluates the impact of a 5-week intervention study on nutrition knowledge participant mothers, and thus it helps identify effective educational methods that may improve nutrition knowledge and dietary Intakes among this unique population. The results of the study demonstrate that nutrition education interventions may serve as effective tools for increasing nutrition knowledge among mothers. While development of additional strategies and teaching approaches are warranted in order to positively influence actual dietary behaviours of children, the results of this study suggest that maternal programs should invest more time and finances into nutrition education programs and nutrition professionals to improve basic childhood nutrition knowledge of parents.

3.15 Limitation:

There are a few limitations of the present study that should be mentioned.

- The organization of meeting was a challenge in practice, and there were difficulties in coordinating and attendance of mothers was limited
- The data were self-reported and may be subject to bias.
- Comparison across studies was challenging, due to the variety of growth charts and standards found in the studies reviewed. Another well-documented review of studies completed in the Middle East also reported that using a variety of growth charts makes it difficult to compare across studies
- Moreover, non-matching age groups of children made comparisons between studies challenging.
- The children's curriculum designed for children, ages three-to-six and is not applicable for all age groups

- Inconsistencies between what children actually consumed versus what their mothers recorded on food frequency questionnaires may affect the accuracy of data analysis.
- The study focused mainly on the Makkah region. So, the results of this study may not be accurate for the other areas.
- The study only looked at children who attend kindergartens. It will not include children who may not be attending.

4. Results and Discussion

Phase 1: preliminary assessment

A. sociodemographic characteristics of participants, mothers and their children
B. Prevalence of obesity and overweight among preschool children

Phase 2: Effect of intervention program A. Knowledge B. Dietary Habits C. Dietary Intake D. Physical Activity

Phase 1: A) Socio-demographic distribution of preschool children and their mothers: This resulted in a sample of 176 children, 100 boys and 76 girls, aged 3-6 years old. Each family had only one child within the specified age group. The mean age of the children in the study was 5.5 years. The children were subdivided into four groups: 3 years (N = 2), 4 years (N = 13), 5 years (N = 51) and 6 years (N = 100). Almost two-thirds (72.6%) of the sample had a college/university education, while (39.8%) of mothers and (92.5%) of fathers had a job. The majority of parents were married (93.8%). Less than fifth (13.1%) of mothers and (18.4%) of fathers had chronic illness. The half had a monthly income between 6000-11999 (50.3%). Most of the child (790%) hadn't any chronic diseases, (73.9%) don't have obese member in the family, and (94.3%) don't have food allergy. In intervention group (65.9%) of the mothers had university degree, and (35.2%) had a job, while in control group (79.3%) of the mothers had university degree, and (44.3%) had a job. More than half of child were female (52.3%) in intervention group, and male (66.7%) in control group. (Table 1)

Table (1) Comparison between intervention and control groups regarding socio-demographic distribution of the study population

Variable	**Intervention group**		**Control group**		**Total**		**Test of Significance**
	N	%	N	%	N	%	
Marital status (mother)							
Married	80	90.9	85	96.6	165	93.8	X^2=3.7 p = 0.155
Divorced	6	6.8	1	1.1	7	4.0	
Widow	2	2.3	2	2.3	4	2.3	
Educational level (mother)							
Primary	4	4.5	5	5.7	9	5.1	X^2=7.77 p = 0.100
Intermediate	5	5.7	5	5.7	10	5.7	
high school	21	23.9	8	9.3	29	16.6	
University &postgraduate	58	65.9	69	79.3	127	72.6	
Occupation (mother)							
Yes	31	35.2	39	44.3	70	39.8	X^2=1.52 p = 0.218
No	57	64.8	49	55.7	106	60.2	

Chronic illness (mother)							
Yes	12	13.6	11	12.6	23	13.1	X^2=.038 p = 0.846
No	76	86.4	76	87.4	152	86.9	
Marital status (father)							
Married	82	93.2	84	97.7	166	95.4	X^2=2.66 p = 0.263
Divorced	4	4.5	2	2.3	6	3.4	
Widow	2	2.3	0	0	2	1.1	
Occupation (father)							
Yes	79	89.8	81	95.3	160	92.5	X^2= 1.89 p = 0.168
No	9	10.2	4	4.7	13	7.5	
Chronic illness (father)							
Yes	15	17.0	17	19.8	32	18.4	X^2=215 p = 0.643
No	73	83.0	69	80.2	142	81.6	
Monthly income							
Less than 3000	4	4.5	3	3.4	7	4	X^2=5.77 p = 328
3000-5999	16	18.2	11	12.6	27	15.4	
6000-11999	47	53.4	41	47.1	88	50.3	
12000-24999	17	19.3	24	27.6	41	23.4	
25000 and more	2	2.3	7	8.0	9	5.1	
Non	2	2.3	1	1.1	3	1.7	
Child gender							
male	42	47.7	58	66.7	100	57.1	X^2=6.4 p = 0.011
female	46	52.3	30	33.3	76	42.9	
Child order in the family							
1	41	46.6	27	33.3	68	40.2	X^2=4.93 p = 0.424
2	23	26.1	21	25.9	44	26.0	
3	11	12.5	19	23.5	30	17.8	
4	7	8.0	7	8.6	14	8.3	
5	4	4.5	5	6.2	9	5.3	
6	2	2.3	2	2.5	4	2.4	
Chronic illness (child)							
Heart disease	1	1.1	0	0	1	.6	X^2=10.7 p = 0.69
Diabetes	1	1.1	1	1.1	2	1.1	
Renal disease	0	0	1	1.1	1	.6	
Thoracic "Asthma"	12	13.6	13	14.8	25	14.2	
Other	0	0	8	9.1	8	4.5	

None	74	84.1	65	73.9	139	79.0	
Receiving medication (child)							
Yes	8	9.1	3	3.4	11	6.3	X^2=2.42 p = 0.119
No	80	90.9	85	96.6	165	93.8	
Food Allergy or inability to digestion							
Yes	6	6.8	4	4.5	10	5.7	X^2=.424 p =.515
No	82	93.2	84	95.5	166	94.3	
Obese member in the family							
father	10	11.4	3	3.4	13	7.4	X^2=7.83 p = 0.251
mother	8	9.1	5	5.7	13	7.4	
both farther and mother	3	3.4	1	1.1	4	2.3	
grandfather	3	3.4	2	2.3	5	2.8	
grandmother	4	4.5	6	6.8	10	5.7	
No body	60	68.2	71	80.6	131	73.9	

Prevalence of obesity

Prevalence of obesity and overweight among preschool children:

In the whole sample of 176 preschool children aged 3-6 years, 48.9 % of children were of normal weight,11.9% were overweight and 21% obese. (Table 2 and Figure 1).

Table (2): Prevalence of obesity and overweight among preschool children

BMI categories	N	%
Underweight	32	18.2
Normal	86	48.9
Overweight	21	11.9
obese	37	21.0

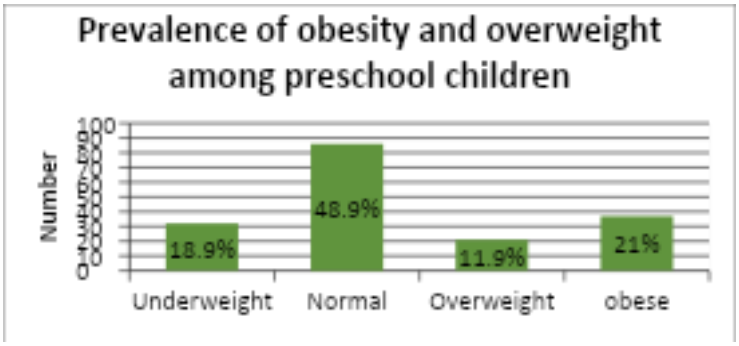

Figure 1 Prevalence of obesity (%) by category of the preschool children's weight

Prevalence of obesity and overweight among preschool children by gender:

The results revealed that boys tend to be more underweight and normal, while girls tend to be overweight and obese. (Table3 and Figure2)

Table (3) Prevalence of obesity and overweight (%) in Saudi preschool children in the population sample grouped by gender.

Variable	Underweight	Normal	Overweight	Obesity
Boy	20 (20%)	55 (55%)	10 (10%)	15 (15%)
Girl	12 (16%)	30(40%)	11(14.7%)	22 (29.3%)
Total	32 (18.3%)	85 (48.6%)	21 (12%)	37 (21.1%)

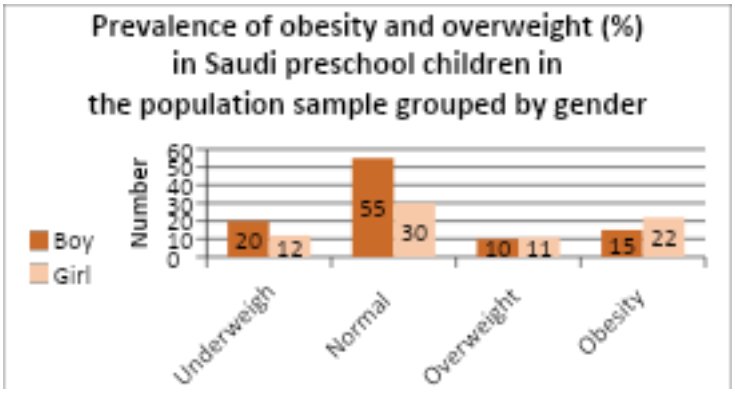

Figure 2 Prevalence of obesity and overweight (%) in Saudi preschool children in the population sample grouped by gender.

Table 4 showed the pattern of BMI category, where almost the half (47.2%) of intervention group and (50.6%) of control group were normal. (Table 4)

Table (4): Number (%) of children in each BMI category based on CDC

	Intervention group	Control group	Chi square and p value		
	N	%	N	%	
Underweight	18	20.2	14	16.1	X^2=1.96 p=0.890
Normal	42	47.2	44	50.6	
Overweight	9	10.1	12	13.8	
obese	20	22.5	17	19.5	

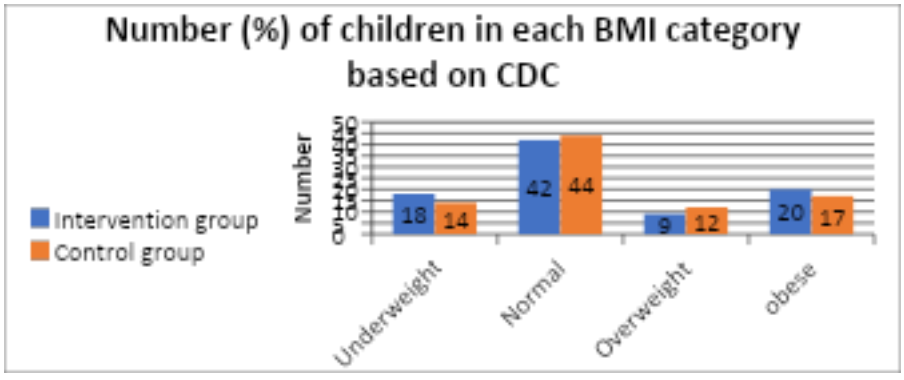

Figure (3): Number (%) of children in each BMI category based on CDC

Phase 2 : effect of intervention program

Mothers' nutritional knowledge

Table 5 showed no significant difference between the intervention and control groups regarding per-test (M=-1.17; P=0.240). While there was a significant difference between the intervention and control groups regarding post-test (M=-7.63; P<0.0001).

Also, the results revealed significant difference inside the two group regarding pre-test and post-test , in intervention group (W= -7.13; p< 0.0001), and in control group (W= -7.01; p< 0.0001), where the improvement was higher in intervention group than control group.

The results revealed a significant difference between the two group in knowledge category rate regarding post-tests (p<0.0001). On the other hand, there was no a significant difference between the two group in knowledge category rate regarding pre-test (p=0.06). (Table 5)

Table (5) Comparing the score between the two groups pre and post

Variable	Intervention group	Control group	P value
Pre-test			
POOR	30	34.1	p = 0.06
FAIR	46	52.3	
GOOD	11	12.5	
VERY GOOD	1	1.1	
Mean	28.3	29.7	M=-1.17 P=0.240
SD	7.7	8.7	
Median	26.5	27	
Minimum	16	14	
Maximum	51	51	
Less than 25	23	24.0	
25	23	24.0	
50	26.5	27.0	
75	29.8	35.0	
Post-test			
POOR	3	3.4	p = 0.0001
FAIR	11	12.5	
GOOD	52	59.1	
VERY GOOD	22	25.0	
Mean	43.7	32.9	M=-7.63 P<0.0001
SD	8.0	7.4	
Median	46	31.5	
Minimum	18	18	
Maximum	56	52	
Less than 25	39.4	28.4	
25	40.0	29.0	
50	46.0	31.5	
75	48.8	36.8	
W	-7.13	-7.01	

P value	p< 0.0001	p< 0.0001	
Mean rank	45.1	33.5	

M: Mann Whitney W: Wilcoxon

Effect of intervention on dietary habits:

Table 6 showed no significant difference between the intervention and control groups regarding per intervention (taking breakfast) (p=0.97). Also, there no significant difference between the intervention and control groups regarding post intervention (taking breakfast) (p=0.05), however, there was improvement in intervention group (from 38.6% to 613%) than control group (from 38% to 39.7%) in taking breakfast everyday.

Table (6) Comparison between intervention and control groups regarding taking breakfast (pre and post)

Variable	**Group**	**Chi square (X^2)**	**P value**		
	Intervention	**Control**			
is the child taking breakfast?	Never	9	7	0.441	0.97
		10%	7.9%		
Pre-intervention	1-2 times per week	15	14		
		17%	15.9 %		
	3-4 times per week	15	16		
		17%	18%		
	5-6 times per week	15	17		
		17%	19%		
	Yes, every day	34	34		
		38.6 %	38.6 %		
	Never	5	8	9.50	.050
Post-intervention		5.6%	9 %		
	1-2 times per week	9	14		
		10.2 %	15.9 %		
	3-4 times per week	13	15		
		14.7 %	17%		
	5-6 times per week	7	16		
		7.9%	18%		
	Yes, every day	54	35		
		61.3 %	39.7 %		

Table 7 showed no significant difference between the intervention and control groups regarding per intervention (taking lunch) (p=0.306). While there was a significant difference between the intervention

and control groups regarding post-intervention (taking lunch) (p=0.001), where, there was improvement in the intervention group (from 63.6% to 75.0%) than control group (kept on 72.7%) in taking lunch everyday .

Table (7) Comparison between intervention and control groups regarding taking lunch (pre and post)

Variable	**Group**	**Chi square ($X^{2)}$**	**P value**		
	Intervention	**Control**			
Is the child taking lunch? **Pre-intervention**	Never	2	2	**4.82**	**0.306**
		2.2%	2.2%		
	1-2 times per a week	4	1		
		4.5%	1.13 %		
	3-4 times per a week	12	14		
		13.6 %	15.9 %		
	5-6 times per a week	14	7		
		15.9 %	7.9%		
	every day	56	64		
		63.6 %	72.7 %		
Post-intervention	Never	0	2	**17.71**	**.001**
		0.0%	2.2%		
	1-2 times per a week	1	2		
		1.13 %	2.2%		
	3-4 times per a week	3	15		
		3.4%	17%		
	5-6 times per a week	18	5		
		20.4 %	5.6%		
	Yes, every day	66	64		
		75%	72.7 %		

Table 8 showed no significant difference between the intervention and control groups regarding per intervention (taking dinner) (p=0.482). While, there was a significant difference between the intervention and control groups regarding post intervention (taking dinner) (p=0.039), where, there was improvement in intervention group (from 51.1% to 75.0%) than control group (kept on 58.0%) in taking dinner everyday .

Table (8) Comparison between intervention and control groups regarding taking dinner (pre and post)

Variable	Group	Chi square ($X^{2)}$	P value		
	Intervention	Control			
Is the child taking dinner **Pre-intervention**	Never	3	5	**3.47**	**.482**
		3.4%	5.7%		
	1-2 times per a week	11	5		
		12.5 %	5.7%		
	3-4 times per a week	16	13		
		18.2 %	14.8 %		
	5-6 times per a week	13	14		
		14.8 %	15.9 %		
	Yes, every day	45	51		
		51.1 %	58.0 %		
Post-intervention	Never	0	3	**10.09**	**.039**
		0.0%	3.4%		
	1-2 times per a week	1	3		
		1.1%	3.4%		
	3-4 times per a week	7	17		
		8.0%	19.3 %		
	5-6 times per a week	14	14		
		15.9 %	15.9 %		
	Yes, every day	66	51		
		75.0 %	58.0 %		

Table 9 showed no significant difference between the intervention and control groups regarding per intervention (taking snacks) (p=0.172). While, there was a significant difference between the intervention and control groups regarding post intervention (taking snacks) (p=0.009), where, there was increasing in the intervention group (from 21.6% to 35.2%) than control group (decreasing from 15.9% to 11.5%) in taking snacks everyday.

Table (9) Comparison between intervention and control groups regarding taking snacks (pre and post)

Variable	Group	Chi square ($X^{2)}$	P value		
	Intervention	Control			
Is the child taking snacks? **Pre-intervention**	Never	7	1	**7.73**	**.172**
		8.0%	1.1%		
	1-2 times per a week	5	10		
		5.7%	11.4 %		
	3-4 times per a week	18	18		

		20.5 %	20.5 %		
	5-6 times per a week	10	9		
		11.4 %	10.2 %		
	1or 2 times per day	29	36		
		33.0 %	40.9 %		
	more than two times per day	19	14		
		21.6 %	15.9 %		
Post-intervention	Never	2	1	**15.3**	**.009**
		2.3%	1.1%		
	1-2 times per a week	5	10		
		5.7%	11.5 %		
	3-4 times per a week	13	17		
		14.8 %	19.5 %		
	5-6 times per a week	8	8		
		9.1%	9.2%		
	1or 2 times per day	29	41		
	Never	33.0 %	47.1 %		
	more than two times per day	31	10		
		35.2 %	11.5 %		

Table 10 showed no significant difference between the intervention and control groups regarding per intervention (number of meals) (p=0.119). While, there was a significant difference between the intervention and control groups regarding post intervention (number of meals) (p=0.025), where, there was improvement in intervention group (from 3.4% to 13.6%) than control group (kept on 8.5%) in 5meals/day .

Table (10) Comparison between intervention and control groups regarding taking number of child meals (pre and post)

Variable	**Group**	**Chi square ($X^{2)}$**	**P value**		
	Intervention	**Control**			
How many meals does the child have every day?	1	1	1	**7.33**	**.119**
		1.1%	1.2%		
	2	22	11		
Pre-intervention		25.0 %	13.4 %		
	3	49	56		
		55.7 %	68.3 %		
	4	13	7		
		14.8 %	8.5%		
	5	3	7		

		3.4%	8.5%		
Post-intervention	1	1	1	**11.140**	**.025**
		1.1%	1.2%		
	2	22	11		
		25.0 %	13.4 %		
	3	38	56		
		43.2 %	68.3 %		
	4	15	7		
		17.0 %	8.5%		
	5	12	7		
		13.6 %	8.5%		

Table 11 showed no significant difference between the intervention and control groups regarding per intervention (way of cooking) (p=0.55). While, there was a significant difference between the intervention and control groups regarding post intervention (way of cooking) (p=0.023), where, there was increasing in intervention group (from 39.8% to 48.9%) than control group (from 38.4% to 39.5%) in using boiled way .

Table (11) Comparison between intervention and control groups regarding way of cooking (pre and post)

Variable	**Group**	**Chi square ($X^{2)}$**	**P value**		
	Intervention	**Control**			
what's the most used way of cooking **Pre-intervention**	fried	18	13	**1.17**	**0.55**
		20.5 %	15.1 %		
	grilled	35	40		
		39.8 %	46.5 %		
	boiled	35	33		
		39.8 %	38.4 %		
Post-intervention	fried	24	15	**7.52**	**0.023**
		27.3 %	17.4 %		
	grilled	21	37		
		23.9 %	43.0 %		
	boiled	43	34		
		48.9 %	39.5 %		

Table 12 showed no significant difference between the intervention and control groups regarding per intervention (removing external fats of meat or chicken skin in the child meals) (p=0.239). Also, there was no significant difference between the intervention and control groups regarding post intervention (removing external fats of meat or chicken skin in the child meals) (p=0.256), however, there was

improvement in intervention group (from 76.1% to 81.1%) than control group (from 68.2% to 72.7%) in removing external fats of meat or chicken skin in the child meals.

Table (12) Comparison between intervention and control groups regarding removing external fats of meat or chicken skin in the child meals (pre and post)

Variable	Group	Chi square ($X^{2)}$	P value		
	Intervention	Control			
Are the external fats of meat or chicken skin removed when feeding a child? **Pre-intervention**	Yes	67	60	**1.38**	**.239**
		76.1 %	68.2 %		
	No	21	28		
		23.9 %	31.8 %		
Post-intervention	Yes	72	64	**2.72**	**.256**
		81.8 %	72.7 %		
	No	16	23		
		18.2 %	26.1 %		

Effect of intervention on dietary intake:

Table 13 showed no significant difference between the intervention and control groups regarding per intervention (consumption of soft drinks and juices) (p=0.323). While, there was a significant difference between the intervention and control groups regarding post intervention (consumption of soft drinks and juices) (p<0.0001), where, there was improvement in intervention group (from 23.9% to 37.5%) than control group (kept on 22.7%)) regarding no consumption of soft drinks and juices .

Table (13) Comparison between intervention and control groups regarding consumption of soft drinks and juices (pre and post)

Variable	Group	Chi square ($X^{2)}$	P value		
	Intervention	Control			
How often does your child take soft drinks or juices? **Pre-intervention**	Never	21	20	5.83	.323
		23.9 %	22.7 %		
	1-2 times a week	22	24		
		25.0 %	27.3 %		
	3-4 times a week	14	21		
		15.9 %	23.9 %		
	5-6 times a week	8	5		

		9.1%	5.7%		
	once or twice a day	15	16		
		17.0 %	18.2 %		
	more than 2 times a day	8	2		
		9.1%	2.3%		
Post-intervention	Never	33	20	23.5	.000
		37.5 %	22.7 %		
	1-2 times a week	23	24		
		26.1 %	27.3 %		
	3-4 times a week	17	21		
		19.3 %	23.9 %		
	5-6 times a week	7	5		
		8.0%	5.7%		
	once or twice a day	0	16		
		0.0%	18.2 %		
	more than 2 times a day	8	2		
		9.1%	2.3%		

Table 14 showed no significant difference between the intervention and control groups regarding per intervention (consumption of processed meats) (p=0.178). Also, there was no significant difference between the intervention and control groups regarding post intervention (consumption of processed meats) (p=0.066), however, there was improvement in intervention group (from 52.3% to 55.7%) than control group (from 40.9% to 38.6%) regarding no consumption of processed meats.

Table (14) Comparison between intervention and control groups regarding consumption of processed meats (marmalade, burger, sausage) (pre and post)

Variable	**Group**	**Chi square ($X^{2)}$**	**P value**		
	Intervention	**Control**			
How often does your child take processed meats (marmalade, burger, sausage)? **Pre-intervention**	Never	46	36	6.29	.178
		52.3 %	40.9 %		
	1-2 times a week	33	39		
		37.5 %	44.3 %		
	3-4 times a week	7	7		
		8.0%	8.0%		
	5-6 times a week	1	6		
		1.1%	6.8%		
	once or twice a day	1	0		

		1.1%	0.0%		
Post-intervention	Never	49	34	8.82	.066
		55.7%	38.6%		
	1-2 times a week	32	41		
		36.4%	46.6%		
	3-4 times a week	6	10		
		6.8%	11.4%		
	5-6 times a week	0	3		
		0.0%	3.4%		
	once or twice a day	1	0		
		1.1%	0.0%		

Table 15 showed no significant difference between the intervention and control groups regarding per intervention (consumption of milk and dairy) (p=0.220). While, there was a significant difference between the intervention and control groups regarding post intervention (consumption of milk and dairy) (p<0.0001), where, there was improvement in intervention group (from 10.2% to 50.0%) than control group (kept on 12.5%)) regarding consumption of milk and dairy more than two times/ day.

Table (15) Comparison between intervention and control groups regarding consumption of milk and dairy (pre and post)

Variable	**Group**	**Chi square ($X^{2)}$**	**P value**		
	Intervention	**Control**			
How often does your child take milk and dairy? **Pre-intervention**	Never	0	2	7.00	.220
		0.0%	2.3%		
	1-2 times a week	9	3		
		10.2%	3.4%		
	3-4 times a week	29	23		
		33.0%	26.1%		
	5-6 times a week	22	23		
		25.0%	26.1%		
	once or twice a day	19	26		
		21.6%	29.5%		
	more than 2 times a day	9	11		
		10.2%	12.5%		
Post-	Never	1	0	52.8	.000
		1.1%	0.0%		

intervention	1-2 times a week	8	2		
		9.1%	2.3%		
	3-4 times a week	12	22		
		13.6 %	25.0 %		
	5-6 times a week	21	22		
		23.9 %	25.0 %		
	once or twice a day	2	31		
		2.3%	35.2 %		
	more than 2 times a day	44	11		
		50.0 %	12.5 %		

Table 16 showed no significant difference between the intervention and control groups regarding per intervention (consumption of vegetables) (p=0.094). While, there was a significant difference between the intervention and control groups regarding post intervention (consumption of vegetables) (p=0.042), where, there was improvement in intervention group (from 5.7% to 15.9%) than control group (from 10.2% to 8.0%) regarding daily consumption of vegetables.

Table (16) Comparison between intervention and control groups regarding consumption of vegetables (pre and post)

Variable	**Group**	**Chi square (X^2)**	**P value**		
	Intervention	**Control**			
How often does your child take vegetables? **Pre-intervention**	Never	17	12	9.39	.094
		19.3 %	13.6 %		
	1-2 times a week	24	18		
		27.3 %	20.5 %		
	3-4 times a week	17	29		
		19.3 %	33.0 %		
	5-6 times a week	14	16		
		15.9 %	18.2 %		
	once or twice a day	5	9		
		5.7%	10.2 %		
	more than 2 times a day	11	4		
		12.5 %	4.5%		
Post-intervention	Never	14	7	11.52	.042
		15.9 %	8.0%		
	1-2 times a week	17	22		

		19.3 %	25.0 %		
	3-4 times a week	16	29		
		18.2 %	33.0 %		
	5-6 times a week	12	15		
		13.6 %	17.0 %		
	once or twice a day	14	7		
		15.9 %	8.0%		
	more than 2 times a day	15	8		
		17.0 %	9.1%		

Table 17 showed no significant difference between the intervention and control groups regarding per intervention (consumption of fruits) (p=0.693). Also, there was no significant difference between the intervention and control groups regarding post intervention (consumption of fruits) (p=0.170), however, there was improvement in intervention group (from 10.2% to 12.5%) than control group (kept on 13.6%) regarding daily consumption of fruits.

Table (17) Comparison between intervention and control groups regarding consumption of fruit (pre and post)

Variable	**Group**	**Chi square ($X^{2)}$**	**P value**		
	Intervention	**Control**			
How often does your child take fruits? **Pre-intervention**	Never	10	5	3.04	.693
		11.4 %	5.7 %		
	1-2 times a week	26	25		
		29.5 %	28.4 %		
	3-4 times a week	24	30		
		27.3 %	34.1 %		
	5-6 times a week	14	12		
		15.9 %	13.6 %		
	once or twice a day	9	12		
		10.2 %	13.6 %		
	more than 2 times a day	5	4		
		5.7 %	4.5 %		
Post-intervention	Never	7	5	7.75	.170
		8.0 %	5.7 %		
	1-2 times a week	22	25		

		25.0 %	28.4 %		
	3-4 times a week	21	30		
		23.9 %	34.1 %		
	5-6 times a week	13	12		
		14.8 %	13.6 %		
	once or twice a day	11	12		
		12.5 %	13.6 %		
	more than 2 times a day	14	4		
		15.9 %	4.5 %		

Table 18 showed no significant difference between the intervention and control groups regarding per intervention (consumption of meat) (p=0.362). While, there was a significant difference between the intervention and control groups regarding post intervention (consumption of meat) (p<0.0001), where, there was increasing in intervention group (from 4.5% to 25.0%) than control group (kept on 21.6%) regarding daily consumption of meat .

Table (18) Comparison between intervention and control groups regarding consumption of take meat (beef, chicken, fish, and eggs (pre and post)

Variable	**Group**	**Chi square ($X^{2)}$**	**P value**		
	Intervention	**Control**			
How often does your child take meat (beef, chicken, fish, and eggs? **Pre-intervention**	Never	3	2	5.45	.362
		3.4%	2.3%		
	1-2 times a week	18	11		
		20.5 %	12.5 %		
	3-4 times a week	26	27		
		29.5 %	30.7 %		
	5-6 times a week	25	28		
		28.4 %	31.8 %		
	once or twice a day	12	19		
		13.6 %	21.6 %		
	more than 2 times a day	4	1		
		4.5%	1.1%		
Post-intervention	Never	1	2	24.9	.000
		1.1%	2.3%		
	1-2 times a week	9	11		
		10.2 %	12.5 %		
	3-4 times a week	21	27		
		23.9 %	30.7 %		

	5-6 times a week	27	28		
		30.7 %	31.8 %		
	once or twice a day	8	19		
		9.1%	21.6 %		
	more than 2 times a day	22	1		
		25.0 %	1.1%		

Table 19 showed no significant difference between the intervention and control groups regarding per intervention (consumption of serials) (p=0.698). Also, there was no significant difference between the intervention and control groups regarding post intervention (consumption of serials) (p=0.119), however, there was increasing in intervention group (from 13.6% to 23.9%) than control group (kept on 12.5%) regarding daily consumption of serials.

Table (19) Comparison between intervention and control groups regarding consumption of serials (rice, pasta, oatmeal, bread, and corn) (pre and post)

Variable	**Group**	**Chi square ($X^{2)}$**	**P value**		
	Intervention	**Control**			
How often does your child take serials (rice, pasta, otmeal, bread, and corn)? **Pre-intervention**	Never	6	3	3.01	.698
		6.8%	3.4%		
	1-2 times a week	10	6		
		11.4 %	6.8%		
	3-4 times a week	19	25		
		21.6 %	28.4 %		
	5-6 times a week	29	29		
		33.0 %	33.0 %		
	once or twice a day	12	14		
		13.6 %	15.9 %		
	more than 2 times a day	12	11		
		13.6 %	12.5 %		
Post-intervention	Never	3	3	8.75	.119
		3.4%	3.4%		
	1-2 times a week	7	6		
		8.0%	6.8%		
	3-4 times a week	11	25		
		12.5 %	28.4 %		
	5-6 times a week	22	21		
		25.0 %	23.9 %		
	once or twice a day	24	22		

		27.3 %	25.0 %		
	more than 2 times a day	21	11		
		23.9 %	12.5 %		

Table 20 showed no significant difference between the intervention and control groups regarding per intervention (consumption of chocolate, chips, Ice-cream, and desserts) (p=0.605). While, there was a significant difference between the intervention and control groups regarding post intervention (consumption of chocolate, chips, Ice-cream, and desserts) (p=0.029), where, there was decreasing in intervention group (from 28.4% to 22.7%) than control group (kept on 12.5%) regarding daily consumption of chocolate, chips, Ice-cream, and desserts.

Variable	**Group**	**Chi square ($X^{2)}$**	**P value**		
	Intervention	**Control**			
How often does your child take fast food (Al-Baick, Pizza, and others)? **Pre-intervention**	Never	13	6	6.62	.250
		14.8 %	6.8%		
	1-2 times a week	55	59		
		62.5 %	67.0 %		
	3-4 times a week	4	11		
		4.5%	12.5 %		
	5-6 times a week	4	3		
		4.5%	3.4%		
	once or twice a day	6	4		
		6.8%	4.5%		
	more than 2 times a day	6	5		
		6.8%	5.7%		
Post-intervention	Never	17	6	12.3	.030
		19.3 %	6.8%		
	1-2 times a week	60	59		
		68.2 %	67.0 %		
	3-4 times a week	5	10		
		5.7%	11.4 %		
	5-6 times a week	3	3		
		3.4%	3.4%		
	once or twice a day	0	5		
		0.0%	5.7%		
		3	5		

	more than 2 times a day	3.4%	5.7%		

Table (20) Comparison between intervention and control groups regarding consumption of chocolate, chips, Ice-cream, and desserts (pre and post)

Table 21 showed no significant difference between the intervention and control groups regarding per intervention (consumption of fast-food) (p=0.250). While, there was a significant difference between the intervention and control groups regarding post intervention (consumption of fast-food) (p=0.030), where, there was improvement in intervention group (from 14.8% to 19.3%) than control group (kept on 6.8%)) regarding no consumption of fast-food.

Table (21) Comparison between intervention and control groups regarding consumption of fast-food (Al-Baick, Pizza, and others) (pre and post)

Variable	**Group**	**Chi square ($X^{2)}$**	**P value**		
	Intervention	**Control**			
How often does your child take chocolate, chips, Ice-cream, and desserts? **Pre-intervention**	Never	5	1	3.62	.605
		5.7%	1.1%		
	1-2 times a week	11	13		
		12.5 %	14.8 %		
	3-4 times a week	18	22		
		20.5 %	25.0 %		
	5-6 times a week	20	18		
		22.7 %	20.5 %		
	once or twice a day	25	23		
		28.4 %	26.1 %		
	more than 2 times a day	9	11		
		10.2 %	12.5 %		
Post-intervention	Never	9	1	12.4	.029
		10.2 %	1.1%		
	1-2 times a week	18	14		
		20.5 %	15.9 %		
	3-4 times a week	17	22		
		19.3 %	25.0 %		
	5-6 times a week	21	18		
		23.9 %	20.5 %		
	once or twice a day	20	22		
		22.7 %	25.0 %		
		3	11		

	more than 2 times a day	3.4%	12.5 %		

Effect of intervention on physical activity :

Table 21 showed no significant difference between the intervention and control groups regarding per intervention (watching TV) (p=0.234). Also, there was no significant difference between the intervention and control groups regarding post intervention (watching TV) (p=0.420), however, there was increasing in intervention group (from 37.5% to 43.2%) than control group (from 33.0% to 39.8%) regarding watching TV for less than one hour / day.

Table (22) Comparison between intervention and control groups regarding time spend watching TV

Variable	**Group**	**Chi square ($X^{2)}$**	**P value**		
	Intervention	**Control**			
How many hours a day does your child spend watching TV **Pre-intervention**	less than one hour	33	29	2.90	.234
		37.5 %	33.0 %		
	1-3 hours a day	46	42		
		52.3 %	47.7 %		
	more than 3 hours	9	17		
		10.2 %	19.3 %		
Post-intervention	less than one hour	38	35	1.73	.420
		43.2 %	39.8 %		
	1-3 hours a day	47	46		
		53.4 %	52.3 %		
	more than 3 hours	3	7		
		3.4%	8.0%		

Table 22 showed no significant difference between the intervention and control groups regarding per intervention (playing computer and video games) (p=0.397). While, there was a significant difference between the intervention and control groups regarding post intervention (playing computer and video games) (p=0.020), where, there was improvement in intervention group (from 61.4% to 72.7%) than control group (kept on 52.4%) regarding playing computer and video games for less than one hour/ day.

Table (23) Comparison between intervention and control groups regarding time spend playing computer and video games

Variable	**Group**	**Chi square ($X^{2)}$**	**P value**		
	Intervention	**Control**			
How many hours a day does your child play	less than one hour	54	44	1.847	.397

computer and video games **Pre-intervention**		61.4 %	52.4 %		
	1-3 hours a day	25	32		
		28.4 %	38.1 %		
	more than 3 hours	9	8		
		10.2 %	9.5%		
Post-intervention	less than one hour	64	44	7.821	.020
		72.7 %	52.4 %		
	1-3 hours a day	18	32		
		20.5 %	38.1 %		
	more than 3 hours	6	8		
		6.8%	9.5%		

Table 23 showed no significant difference between the intervention and control groups regarding per intervention (sleeping) (p=0.248). While, there was a significant difference between the intervention and control groups regarding post intervention (sleeping) (p=0.019), where, there was improvement in intervention group (from 46.6% to 62.5%) than control group (kept on 43.2%) regarding sleeping more than 8 hours/ day.

Table (24) Comparison between intervention and control groups regarding time spend sleeping

Variable	**Group**	**Chi square ($X^{2)}$**	**P value**		
	Intervention	**Control**			
How many hours a day does your child spend sleeping? **Pre-intervention**	less than 7 hour	1	5	2.79	.248
		1.1%	5.7%		
	7-8 hours a day	46	45		
		52.3 %	51.1 %		
	more than 8 hours	41	38		
		46.6 %	43.2 %		
Post-intervention	less than 7 hour	1	5	7.96	.019
		1.1%	5.7%		
	7-8 hours a day	32	45		
		36.4 %	51.1 %		
	more than 8 hours	55	38		
		62.5 %	43.2 %		

Table 24 showed no significant difference between the intervention and control groups regarding per intervention (physical activities) (p=0.589). While, there was a significant difference between the

intervention and control groups regarding post intervention (physical activities) (p=0.013), where, there was improvement in intervention group (from 70.5% to 83.0%) than control group (kept on 66.7%) regarding physical activities.

Table (25) Comparison between intervention and control groups regarding time spend in physical activities such as sports, cycling, or swimming

Variable	Group	Chi square (X^2)	P value		
	Intervention	Control			
Has your child done physical activities such as sports, cycling, or swimming? **Pre-intervention**	Yes	62	58	.291	.589
		70.5 %	66.7 %		
	No	26	29		
		29.5 %	33.3 %		
Post-intervention	Yes	73	58	6.167	.013
		83.0 %	66.7 %		
	No	15	29		
		17.0 %	33.3 %		

Discussion

The growth and mental developments are signs of good health and nutrition. [46] The precise evaluation of the physical growth and development of children is an essential topic that gains the attention of pediatricians and public health providers. [47] Globally, there is a different in size and shape between children from different communities. These variances are multi-factorial "genetic interaction, environment and nutrition". [48] Knowledge of what acceptable growth is? How it can be correctly noticed? How abnormalities can be determined in right time is very useful in childhood. Anthropometry has been commonly and effectively applied for the evaluation of health and nutritional risk, particularly in children. [48]

The current study aimed to evaluate the effectiveness of nutrition educational program of preschool children's mothers on changing knowledge about dietary habit, and physical activity. Preschool age is the period where particular behaviors for example healthy eating, regular sleeping pattern and sedentary habits are developed and stabilized through adulthood [49]. Which mean that, early childhood is the suitable period for a concentrate intervention in order to prevent obesity and establish a healthy lifestyle. Preschool children can have a steady healthy dietary behavior, which includes participating in physical activities as well as having nutrition knowledge and parents should choose closely what they give to their children to eat in order to have a balanced diet and prevent obesity [50]. During this period of life, children start to find the basis of their dietary patterns and physical activity habits which will decide their adulthood behavior. [27]

Results of this study showed that about one-third of children were overweight and obese. In Al-Qahtani et al study, the rate of overweight /obesity was 8.6%[36]. While in Al-Enazy et al study the rate was 37.3% [51]. This result showed that children obesity is a common problem and have been reported by several studies. And the variance rate could be due to the variety of socio-economic factors and geographic areas. During the early years, a child will promote a positive approach towards healthy food

and new flavors, if the child has the opportunity to get familiar with frequently exposed [52],without any pressure to eat these foods, or the results will be bad and the child will develop negative attitude towards the food [53].On the other hand, when a child is exposed to unhealthy food at any time during the early years, before the kindergarten or while he/she is a toddler, the consequences could be bad towards eating healthy foods (25). The family food patterns and priorities depend also by the socioeconomic level and the cultural background [54].

In the current study less than third consumed wheat, vegetables, fruits, and meat. While more than half consumed fast food. Musaiger et al, in Bahrain , reported that less than third (27.8%) consumed fast food more than 4 times/week. [55]. Similar results were reported in Darwish et al study, that consumption of the following healthy items was noticeably rare among study participants , less than half and sometimes less than fifth, While the consumption of unhealthy items was common as a daily habits among study participants. [37]. The reports of the association between rate of food intake and obesity were not steady. Several studies showed that a high intake of fruit and vegetables decreased the risk of obesity. [55-56].

Despite the world health organization (WHO) recommendations regarding exclusive breast feeding up to 6 months duration [37], the current study showed that only 23.9% of the mothers exclusively breastfed their babies, 52.2% were on mixed feeding, 23.9% of the mothers used bottles. Prevalence of exclusive breastfeeding was very low in the population while partial breastfeeding was the trend for feeding in the first 6 months of life; similar results were reported from many studies done in Saudi Arabia which was go with rapid decrease in lactation duration [57]. Participating in physical activity enhance healthy mental, social and physical development [46]. Physical education has been winning in several societies. This could be explained by the fact that there are numerous benefits of physical activity for young people's health, particularly when physical activity becomes a daily habit with clear pattern at the beginning of preschool age , where affects the whole adult population's health [47].Physical activity, shares significantly in the stabilization of a healthy active lifestyle through improving the physical development and strengthening psychomotor skills of children. However, even with the scientific recommendations for the need to raise physical activity level, globally more and more children have reduced levels of engagement in everyday physical activity which causes several health problems [48].and an increased level of obesity [58].Several researchers reported that the child achieve up to 50% of the daily-recommended physical activity hours during their times in kindergarten or nursery [59].

One of the main factor related to obesity and physical inactivity is sedentary activities , this factors become in the first line of youth importance such as television viewing, computer use, video gaming and other small screen recreation and other low strength/low energy-expenditure activities, where the amount the time spent in this activities was associated with obesity, and these behaviors increased with aging[60].The time spent in watching video, TV, and playing electronic games is enough to raise calories consumption and to decrease metabolic rate, eating while watching TV is also a common practice among Arabic families[51]. In the current study less than half reported watching TV "1-3 hours a day" (50%), while for playing video games "less than one hours a day"(55.7%),and for sleeping "7-8 hours a day" (51.7%),. On the other hand, (65.9%) were physically active. The parents perception of a child's weight status is important for following to dietary and physical activity recommendations early in life. [51]

In the current study the results showed a significant higher rate of obesity among female than male. While in Al-Enaizy study, the overall rate of obesity among boys was significantly higher than girls (26.4% versus 19.3%respectively) ($P < 0.05$)[51]. his differences in the percentage could be due to several factors such as socio-economic factors, sample size, and studies nature. The preschool years have been recognized as a critical period in childhood for the progress of childhood obesity due to the fact that eating and physical activity habits that participate to later obesity become established during these early years [35]. Aiming preschool aged children is essential to preventing obesity, where development at this life period is more flexible than it is in later childhood and adolescence, and risk factors of overweight can be more easily changed [35]. In the current study the intervention

process showed significant improvement in the knowledge level, where mothers' knowledge in intervention group became good, while mothers' knowledge in control group keep fair.

Overall, the increasing in the rate of obesity at the age of preschool could be explained by the fact that children start going to school at that age, where there is a less control on their eating habits and nutrition. Also, children in Saudi Arabia became less active; few or none walk to school, spending more time in sedentary entertainment activities, such as watching TV, computer and video games. These findings indicate the importance of focusing on the relation between obesity and dietary and social habits, to design effective preventing programs.

5. CONCLUSION

Based on the findings, Overweight and obesity is a worldwide problem in both developing and developed countries. Without geographical limits. The prevalence in Arab countries, particularly Saudi Arabia reached catastrophe level. About one-third of children in the current study were overweight and obese. Girls were significantly more overweight and obese than boys. The majority had fair knowledge prior the intervention. The intervention process showed significant improvement in the knowledge level, where mothers' knowledge in intervention group became good, while mothers' knowledge in control group keep fair. Also, it improve dietary habits and physical activity. Mothers with fair and good knowledge about nutrition thought more that their children had a normal weight.

Based on the findings of the researcher, the administrators in MOH should organize and conduct more intervention health education programs about nutrition-related health problems in easy and familiar language among the community through mass media to raise public awareness. Designing different interventional programs to develop an effective preventive strategy for these comparatively common and epidemic problems, these programs should include the following issues: "dealing with balancing calorie intake with physical activity; choosing healthy food at home, school and in eating out; nutritional density of foods to calories; depending on the traditional foods and lifestyle compared with the western lifestyle". The Ministry of Education should take an active role in developing this school-based intervention program.

References

1- Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, Mullany EC, Biryukov S, Abbafati C, Abera SF, Abraham JP. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. The Lancet. 2014 Sep 5;384(9945):766-81.
2- World Health Organization. Obesity and overweight [Fact sheet]; updated June 2016. Trouvé le. 2016;13.
3- Alqarni SS. A Review of Prevalence of Obesity in Saudi Arabia. Journal of Obesity & Eating Disorders. 2016.
4- Chan RS, Woo J. Prevention of overweight and obesity: how effective is the current public health approach. International Journal of Environmental Research and Public Health. 2010 Feb 26;7(3):765-83.
5- Onyiriuka AN, Umoru DD, Ibeawuchi AN. Weight status and eating habits of adolescent Nigerian urban secondary school girls. South African Journal of Child Health. 2013 Jan;7(3):108-12
6- Ogden C, Carroll MD, Curtin LR, Lamb MM, Flegal KM. About childhood obesity. JAMA. 2010;303(3):242-9.
7- Kelly AS, Barlow SE, Rao G, Inge TH, Hayman LL, Steinberger J, Urbina EM, Ewing LJ, Daniels SR. Severe obesity in children and adolescents: identification, associated health risks, and treatment approaches. Circulation. 2013 Oct 8;128(15):1689-712.
8- World Health Organization. Physical status: The use of and interpretation of anthropometry, Report of a WHO Expert Committee.
9- Cole TJ, Flegal KM, Nicholls D, Jackson AA. Body mass index cut offs to define thinness in children and adolescents: international survey. Bmj. 2007 Jul 26;335(7612):194.
10- Cawley J. The economics of childhood obesity. Health Affairs. 2010 Mar 1;29(3):364-71

11- Olstad DL, McCargar L. Prevention of overweight and obesity in children under the age of 6 years A report commissioned by the Canadian Council of Food and Nutrition. Applied Physiology, Nutrition, and Metabolism. 2009 Jun 12;34(4):551-70.
12- Golley R, Hendrie GA, Slater A, Corsini N. Interventions that involve parents to improve children's weight-related nutrition intake and activity patterns–what nutrition and activity targets and behaviour change techniques are associated with intervention effectiveness?. Obesity reviews. 2011 Feb 1;12(2):114-30.
13- McGuire S. US Department of Agriculture and US Department of Health and Human Services, Dietary Guidelines for Americans, 2010. Washington, DC: US Government Printing Office, January 2011. Advances in Nutrition: An International Review Journal. 2011 May 1;2(3):293-4
14- Geier AB, Foster GD, Womble LG, McLaughlin J, Borradaile KE, Nachmani J, Sherman S, Kumanyika S, Shults J. The relationship between relative weight and school attendance among elementary schoolchildren. Obesity. 2007 Aug 1;15(8):2157-61.
15- Atlas ID. International Diabetes Federation: Brussels
16- Amin TT, Al-Sultan AI, Ali A. Overweight and obesity and their relation to dietary habits and socio-demographic characteristics among male primary school children in Al-Hassa, Kingdom of Saudi Arabia. European journal of nutrition. 2008 Sep 1;47(6):310.
17- Al Dhaifallah A, Mwanri L, Aljoudi A. Childhood obesity in Saudi Arabia: opportunities and challenges. Saudi Journal of Obesity. 2015 Jan 1;3(1):2.
18- Deckelbaum RJ, Williams CL. Childhood obesity: the health issue. Obesity research. 2001 Nov 1;9(S11):239S-43S.
19- Stang J, Loth KA. Parenting style and child feeding practices: potential mitigating factors in the etiology of childhood obesity. Journal of the American Dietetic Association. 2011 Sep 30;111(9):1301-5.
20- Lok KY, Chan RS, Sea MM, Woo J. Nutritionist's variation in counseling style and the effect on weight change of patients attending a community based lifestyle modification program. International journal of environmental research and public health. 2010 Feb 2;7(2):413-26.
21- Kader M, Sundblom E, Elinder LS. Effectiveness of universal parental support interventions addressing children's dietary habits, physical activity and bodyweight: A systematic review. Preventive medicine. 2015 Aug 31;77:52-67.
22- Bailey K. The Effectiveness of a Multi-Component Community Program for the Prevention of Childhood Obesity.
23- Oli N, Vaidya A, Pahkala K, Eiben G, Krettek A. Knowledge, attitude and practice on diet and physical activity among mothers with young children in the Jhaukhel-Duwakot Health Demographic Surveillance Site, Nepal. PLoS ONE.2018; 13(7): e0200329. https://doi.org/10.1371/journal. pone.0200329
24- Kokolaki S, Kouli O, Bebetsos E, Goudas M. Mothers' Self-Efficacy Regarding Dietary Behaviour and Physical Activity of Preschool Children. Int J Pediatr. 2018; 6(1): 6843-50. DOI: 10.22038/ijp.2017.28512.2479
25- Chen JL, Guo J, Esquivel JH, Chesla CA.Like Mother, Like Child: The Influences of Maternal Attitudes and Behaviors on Weight-Related Health Behaviors in Their Children. J Transcult Nurs. 2017 Oct 1:1043659617736883. doi: 10.1177/1043659617736883.
26- Park S, Li R, Birch L. Mothers Child-Feeding Practices Are Associated with Children s Sugar-Sweetened Beverage Intake. J Nutr. 2015 Apr;145(4):806-12. doi: 10.3945/jn.114.207233.
27- Nyberg G, Sundblom E, Norman Å, Bohman B, Hagberg J, Elinder LS, et al. Effectiveness of a Universal Parental Support Programme to Promote Healthy Dietary Habits and Physical Activity and to Prevent Overweight and Obesity in 6-Year-Old Children: The Healthy School Start Study, a Cluster-Randomised Controlled Trial. PLoS ONE.2015; 10(2): e0116876. doi:10.1371/journal. pone.0116876
28- Ozgena L, Demiriz S. Determining Mothers' Attitude in Developing Preschool Children' Eating Behaviors. Procedia - Social and Behavioral Sciences. 2015; 191: 662 – 667
29- van Ansem WJ, Schrijvers CT, Rodenburg G, van de Mheen D. Maternal educational level and children's healthy eating behavior: role of the home food environment (cross-sectional results from the INPACT study). Int J Behav Nutr Phys Act. 2014 Sep 12;11:113. doi: 10.1186/s12966-014-0113-0.

30- Yabancı N, Kısaç I, Karakuş SS. The effects of mother's nutritional knowledge on attitudes and behaviors of children about nutrition. Procedia - Social and Behavioral Sciences . 2014;116: 4477 – 4481
31- Østbye T, Malhotra R, Stroo M, Lovelady C, Brouwer R, Zucker N, Fuemmeler B. The Effect of the Home Environment on Physical Activity and Dietary Intake in Preschool Children. Int J Obes (Lond). 2013 Oct;37(10):1314-21. doi: 10.1038/ijo.2013.76.
32- Skouteris H, McCabe M, Swinburn B, and Hill B. Healthy eating and obesity prevention for preschoolers: a randomised controlled trial. BMC Public Health. 2010; 10: 220.
33- Al-Qahtani SM, Alsultan BS, Awdah NA, Alshehri MA, Alqahtani AS, Al Assiri KM, Bosily MJ, Jalfan AM, Mahfouz AA. Parental perception and knowledge about ideal weight among preschool-aged children in Abha city, southwestern Saudi Arabia. Saudi J Obesity 2017;5:85-90.
34- Darwish MA, Al-Saif G, Albahrani S, and Sabra AA. Lifestyle and Dietary Behaviors among Saudi Preschool Children Attending Primary Health Care Centers, Eastern Saudi Arabia. International Journal of Family Medicine. 2014, Article ID 432732. http://dx.doi.org/10.1155/2014/432732
35- https://www.cdc.gov/healthyweight/assessing/index.html
36- Faul F, Erdfelder E, Lang AG, Buchner A. G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior research methods. 2007 May 1;39(2):175-91.
37- Fatima SB, Alshammary NN. A Study on the Impact of Nutrition Educational Program on "My Plate". International Journal of Innovative Research in Science & Engineering 2 (9): 621–627. 2013.
38- Amal Essa Ahmad Thani AL-Muraikhi. Preventing obesity in school children in the state of Qatar Al-Muraikhi, Ph.D. thesis, University of Birmingham.2012.
39- http://www.ucl.ac.uk/iehc/research/behavioural-science-health/resources/questionnaires/eating-behaviour-questionnaires
40- N Kliemann,1 J Wardle,1 F Johnson,1 and H Croker. Reliability and validity of a revised version of the General Nutrition Knowledge Questionnaire. Eur J Clin Nutr. 2016 Oct; 70(10): 1174–1180.
41- Cdc.gov. (2015). About Child & Teen BMI | Healthy Weight | CDC. [online] Available at: https://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html
42- Asakura K, Todoriki H, Sasaki S. Relationship between nutrition knowledge and dietary intake among primary school children in Japan: Combined effect of children's and their guardians' knowledge. J Epidemiol. 2017 Oct;27(10):483-491. doi: 10.1016/j.je.2016.09.014.
43- Kyhälä AL, Reunamo J, Ruismäki H. Physical activity and learning environment qualities in Finnish day care. Procedia Soc Behav Sci. 2012; 45: 247-56.
44- 2. Tammelin R, Yang X, Leskinen E, Kankaanpää A, Hirvensalo M, Tammelin T. Tracking of physical activity from early childhood through youth into adulthood. Med Sci. Sports Exerc 2014; 46(5): 955-62.
45- 3. Kim SYS, Prestopnik N, Biocca FA. Body in the interactive game: How interface embodiment affects physical activity and health behavior change. Comput Human Behav 2014; 36: 376-84.
46- Koh GA, Scott JA, Woodman RJ, Kim SW, Daniels LA, Magarey AM. Maternal feeding self-efficacy and fruit and vegetable intakes in infants. Results from the SAIDI study. Appetite 2014; 81: 44-51.
47- Petrauskiene A, Dregval L, Petkute S. Health behavior of families having preschool-age children. Medicina (Kaunas, Lithuania) 2006; 43(10): 816-23.
48- Al-EnazyWH, Al Dahi SK, Al Hariri IM. Prevalence of overweight and obesity among Saudi primary school students in Tabuk, Saudi Arabia. Saudi Journal of Obesity.2014;2(1):13-18
49- Anzman SL, Rollins BY, Birch LL. Parental influence on children's early eating environments and obesity risk: implications for prevention. Int J Obes 2010; 34(7): 1116-24.
50- Jarman M, Ogden J, Inskip H, Lawrence W, Baird J, Cooper C, et al. How do mothers manage their preschool children's eating habits and does this change as children grow older? A longitudinal analysis. Appetite 2015; 95: 466-74.
51- Nepper MJ, Chai W. Parents' barriers and strategies to promote healthy eating among school-age children. Appetite 2016; 103: 157-64.
52- Musaiger AO, Al-Roomi K, Bader Z. Social, dietary and lifestyle factors associated with obesity among Bahraini adolescents. Appetite. 2014 Feb;73:197-204. doi: 10.1016/j.appet.2013.11.002.

53- Ledoux, T. A., Hingle, M. D., & Baranowski, T. Relationship of fruit and vegetable intake with adiposity. A systematic review. Obesity Reviews,2011; 12(5): c143-50.
54- M. I. El Mouzan, A. A. Al Omar, A. A. Al Salloum, A. S. Al Herbish, and M. M. Qurachi, "Trends in infant nutrition in Saudi Arabia: compliance with WHO recommendations," Annals of Saudi Medicine, vol. 29, no. 1, pp. 20–23, 2009.
55- Sun H. Impact of exergames on physical activity and motivation in elementary school students: A follow-up study. J Sport Health Sci. 2013; 2(3): 138-45.
56- Tucker P, Irwin JD. Physical activity behaviors during the preschool years. Child Health Educ 2010; 1(3): 134-45.
57- Helen N. Measurement and definition of obesity in childhood and adolescence: A field guide for the uninitiated. Nutrition Journal 2007;6:53.
58- Jackson J, Strauss CC, Lee AA, Hunter K. Parents' accuracy in estimating child weight status. Addict Behav 1990;15:65-8.
59- Baughcum AE, Chamberlin LA, Deeks CM, Powers SW, Robert C, Whitaker RC. Maternal perceptions of overweight preschool children. Pediatrics 2000;106:1380-6.
60- Carnell S, Edwards C, Croker H, Boniface D, Wardle J. Parentalperceptions of overweight in 3–5 y olds. Int J Obes 2005;29:353-5.
61- Brown CL, Skinner AC, Yin HS, Rothman RL, Sanders LM, Delamater AM, et al. Parental perceptions of weight during the first year of life. Acad Pediatr 2016;16:558-64.
62- World Health Organization (WHO). (2022). Obesity and overweight: Fact sheet. Geneva: World Health Organization.

63- UNICEF, World Health Organization, & World Bank. (2023). Levels and trends in child malnutrition: Joint child malnutrition estimates. Geneva: WHO.

64- Simmonds, M., Llewellyn, A., Owen, C. G., & Woolacott, N. (2020). Predicting adult obesity from childhood obesity: A systematic review and meta-analysis. The Lancet, 395(10223), 130–138. https://doi.org/10.1016/S0140-6736(19)31622-0

65- Brown, T., Moore, T. H. M., Hooper, L., Gao, Y., Zayegh, A., Ijaz, S., … Summerbell, C. D. (2021). Interventions for preventing obesity in children. Cochrane Database of Systematic Reviews, 7, CD001871.
https://doi.org/10.1002/14651858.CD001871.pub4

66- Hamilton, D., Dee, A., & Perry, I. J. (2022). The lifetime costs of overweight and obesity in childhood and adolescence: A systematic review. Obesity Reviews, 23(3), e13366. https://doi.org/10.1111/obr.13366

67- Lindsay, A. C., Wallington, S. F., Muñoz, M. A., & Greaney, M. L. (2021). A review of early influences on physical activity and sedentary behaviors of preschool-aged children. Nutrients, 13(3), 844.
https://doi.org/10.3390/nu13030844

68- Vaughn, A. E., Ward, D. S., Fisher, J. O., Faith, M. S., Hughes, S. O., Kremers, S. P. J., … Power, T. G. (2020). Fundamental constructs in food parenting practices: A content map to guide future research. Nutrition Reviews, 78(6), 415–435.
https://doi.org/10.1093/nutrit/nuz068

69- Hammersley, M. L., Okely, A. D., Batterham, M. J., & Jones, R. A. (2022). Parent-focused interventions to improve child dietary intake and physical activity: A systematic review. Public Health Nutrition, 25(6), 1635–1646.
https://doi.org/10.1017/S1368980021004457

70- Al-Hazzaa, H. M., AlMarzooqi, M. A., & Al-Rasheedi, A. A. (2021). Physical activity, sedentary behaviors, and dietary habits among Saudi preschool children. International Journal of Environmental Research and Public Health, 18(12), 6326.
https://doi.org/10.3390/ijerph18126326

71- Althumiri, N. A., Basyouni, M. H., AlMousa, N., et al. (2021). Obesity in Saudi Arabia in 2020: Prevalence, distribution, and determinants. Saudi Journal of Health Systems Research, 1(1), 1–10. https://doi.org/10.1159/000516742

72- Alqahtani, M. M., Aljuraiban, G. S., & AlMarzooqi, M. A. (2022). Economic burden of obesity and related non-communicable diseases in Saudi Arabia. BMC Public Health, 22, 1987. https://doi.org/10.1186/s12889-022-14309-7

73- Ministry of Health, Saudi Arabia. (2023). National health statistics and obesity indicators. Riyadh: MOH.