Effect of Educational and Exercise Program on Blood Glucose Level Among Pre-diabetic Obese Children

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Abstract

The pre-diabetes stage is the period before the onset of type II diabetes, but not all children in the pre-diabetes stage suffering from type II diabetes. Childhood obesity has been linked with type ٢ diabetes. These diseases can decrease the life expectancy of the child. **Aim**: The aim of the study was to evaluate effect of educational and exercise program on blood glucose level among pre-diabetic obese children. **Research design:** Quasi-experimental design was used to complete this study. **Settings:** This study was conducted in the classrooms in governmental schools at Benha city, the schools were named; Ibn Khaldun, El-Emam Mohamed Abdou, Hoda Shaarawy and Benha modern school. **Sample:** Convenient sample of (١٠٠) students. **Tool:** Tool was used to collected the study data: **An interviewing questionnaire** was used to collected data which include five parts: Personal characteristics of studied children, children's knowledge about pre-diabetic stage, children's knowledge about obesity, children's knowledge about diabetes mellitus and children physical examination. **Results:** The mean age of studied children was١١.٣٧±٢.٤١ years and ٥٦٪ of children were females, same percentages were engaged in preparatory education and ٥٥٪ living in urban areas. More than half of children had poor knowledge in preprogram implementation. However, after the application of the programs, majority of children had good knowledge. There were statistically significant differences between children' knowledge in the preprogram and post program. **Conclusion**: This study concluded that, children in pre-diabetes period their knowledge was upgrading after implementation of the health education program were improved especially for diet, obesity and personal hygiene, exercise, laboratory examination and physical examination. Meanwhile, there were improvement in blood sugar level, blood pressure and decrease body weight as compared to preprogram. **Recommendation:** the study recommended that, further research to be carried out about causes of prediabetes in children because diabetes has become a major public health problem in Egypt.

Keywords: Pre-diabetes, obesity, diabetes, children

Introduction

Prediabetes, elevated of fasting blood glucose, abnormal glucose tolerance, or both, is associated with an enhanced risk for development of type ٢ diabetes in adults. Children with pre-diabetes have blood glucose levels that are higher than normal, but not high enough to be diagnosed as diabetes. Prediabetes can put children at increased risk of developing type ٢ diabetes, heart disease, and stroke. Prediabetes children may have some of the symptoms of diabetes or even problems from diabetes already present **(National Institute of Diabetes and Digestive and Kidney disease, ٢٠١٤).** Prediabetes in obese children and adolescents has been associated with several cardiovascular changes, increased arterial thickness and stiffness, increased intimae media thickness due to elevation in systolic blood pressure **(Haemer, et al., ٢٠١٤).**

The estimated number of obesity among adolescents (١٢–١٩ years) (٢٠.٦٪) and school-aged children (٦–١١ years) (١٨.٤٪) was higher than among preschool-aged children (٢–٥ years) (١٣.٩٪) **(Hales, et al., ٢٠١٧).**Childhood obesity is a serious problem in the United States putting children and adolescents at risk for poor health. Obesity prevalence among children and adolescents is still too high for children and adolescents aged ٢-١٩ years **(Centers for Disease Control and Prevention (CDC), ٢٠١٧).**

Diabetes is one of the most common chronic diseases of childhood. Estimated number of new diagnosed cases of type ١ and type ٢ diabetes are increasing among young children in the United States, about ٢٩.١ million people are living with diagnosed or undiagnosed diabetes, and about ٢٠٨,٠٠٠ people younger than ٢٠ years are living with diagnosed diabetes. The incidence of new diagnosed cases in type ١ diabetes in youth increased by about ١.٨ percent each year. During the same period, the rate of new diagnosed cases of type ٢ diabetes increased even more quickly, at ٤.٨ percent. Type ١ diabetes, the most common form of diabetes in young people, is a condition in which the body fails to make insulin. Causes of type ١ diabetes are still unknown. But, in type ٢

diabetes, the body does not make or use insulin well. In the past, type ٢ diabetes was extremely rare in youth, but it has become more common in recent years. Young children especially obese should be directly to examining, prevent, and treat diabetes **(National Institutes of Health (NIH), ٢٠١٧)**.

The incidence of diabetes continues to increase with more cases of type ١ and type ٢ diabetes being diagnosed among children and adolescents each year. The incidence of type ١ diabetes worldwide is growing most rapidly in children under five years of age. Managing type ٢ diabetes includes making healthy food choices and participating in regular physical activity. Medical management may include insulin, other injectable medications or oral medications. Management can vary from nutrition only, to oral diabetic medication, to insulin or specific combinations **(Neill, et al., ٢٠١٥).** The methods of maintaining child's current weight or losing weight are needed to eat a healthy diet and increase physical activity. Success depends largely on child desire to helping the child to make these changes. One of the most important things for a child in pre-diabetes to do is make useful, concrete decisions on lifestyle changes and exercise. The child and his parents should be proactive and ask their healthcare professionals about healthy diet and exercise helps to maintain weight-loss and prevent regain **(Boyse and Clark, ٢٠١١).**

A primary role for nurses to provides necessary information for children with diabetes and their mothers in an effort to help children make informed about prevention and managing their condition. A diabetes nurse can be able helps in monitor and educate patients especially children about advanced practice, advanced diabetes management and education. A diabetes nurse has additional responsibilities such as adjusting the type and dosage of medication, providing nutritional therapy, exercise planning and providing behavioral and psychosocial counseling **(Graduate Nursing Education, ٢٠١٧).**

Aim of the Study

The study aimed to evaluate effect of educational and exercise program on blood glucose level among pre-diabetic obese children through:

١. Assess children knowledge regarding pre-diabetes among obese children.

٢. Developing and implementing educational and exercise program to reduce complications of pre-diabetes

٣. Evaluating effect of educational and exercise program on children knowledge in pre-diabetes stage.

Research Hypotheses

- The health educational and exercise program will improve the knowledge and exercise ability of studied children regarding pre-diabetes stage
- The health educational and exercise program will improve the blood glucose level among obese pre-diabetic children.

Subjects and Methods

Research Design

Quasi-experimental design was utilized in the current study.

Setting

The study was carried out in the class rooms in governmental schools at Benha city, the schools were named; Ibn Khaldun, El-Emam Mohamed Abdou, Hoda Shaarawy and Benha modern school, to collect the study data.

Sample

Convenient sample of all obese students (١٠٠) from the previous mentioned settings; ٢٥ child from Ibn Khaldun, ٢٠ child from El-Emam Mohamed Abdou,٤٠ child from Hoda Shaarawy and ١٥ child from Benha

modern in mentioned settings(selected sample after taking body mass index).

Inclusion criteria:

- Children aged from ٦ to ١٥ years.
- Children having overweight
- Measure blood pressure by using sphygmomanometer
- Body weight and body mass index.

Body mass index (BMI) is an important measurement used to determine child have overweight, underweight, or at an ideal weight.

Underweight and overweight ranges in children:

- Underweight: BMI-for-age < ٥th percentile
- At risk of overweight: BMI-for-age ٨٥th percentile to < ٩٥th percentile
- Overweight: BMI-for-age > ٩٥th percentile

The manual calculation is as follows:

BMI = weight in pounds / [height in inches x height in inches] x ٧٠٣

BMI = weight in kilograms / [height in meters x height in meters]

•Measure blood sugar level (fasting blood sugar, random blood sugar and urine analysis)

١. A fasting blood sugar level below ١٠٠ mg/dL is considered normal, blood sugar level from ١٠٠ to ١٢٥ mg/dL is considered prediabetes and blood sugar level of ١٢٦ mg/dL considered higher indicates type ٢ diabetes.

٢. Random blood sugar test: A blood sample is taken at a random time. A random blood sugar level of ٢٠٠ mg/dL considered higher suggests diabetes.
٣. Make urine analysis.

Tools of data collection

The following data were collected by using the following tools:

١. **An interviewing questionnaire** was used to collect data which include five parts: ١): A personal characteristics of the children as age, sex, educational stage and residence. ٢): Children's knowledge about pre-diabetic stage. ٣): Children, knowledge about diabetes mellitus which concerned with (diabetes, exercise, nutrition, body hygiene and laboratory investigation). ٤): Children knowledge about obesity (define, causes, complication and method of treatment). ٥): Children physical examination.

Scoring system for children knowledge

The studied children knowledge was calculated for each item as follows: knows and /or correct answer was scored (٢), knows and incorrect answer was scored (١), while don't know was scored (٠). According to the actual student's responses which consisted of ٢٠ questions, their total level of knowledge was categorized as poor level (less than ٢٠ degree), average level (from ٢٠ -< ٣٠ degree) or good level (from ٣٠- ٤٠ degree).

Validity: Content validity was done through three experts from Faculty Members of pediatric Health Nursing and pediatrician in university hospital.

Reliability: Reliability coefficients were calculated for the questionnaire items. The coefficient alpha was ٠.٨٦.

Ethical consideration: All relevant ethical aspects were considered for ensuring the confidentiality of the collected data through; gaining oral consent for participation in the study, explaining the purpose of the study, and all participants have the right to refuse or continue in the study any time without giving any reasons.

Pilot study: was carried out on ١٠ child to assess the tool clarity, applicability, and time needed to fill in each sheet those who participated in the pilot study were included from the main study sample.

Field Work

A permission from faculty of nursing, to the central agency of statistics and mobilization were prepared and delivered to the administration of education in Qualyobia was taken in order to conduct the study. Permission from administration of education in Qualyobia was obtained, to enter the schools and conducting the study.

The actual field work was carried out from the beginning of January ٢٠١٧ to the end of February and data collection from beginning of March to the end of April ٢٠١٧. The researchers were available two days/week (Sunday and Monday,) from ٩am-١pm. The children's were interviewed individually by the researchers to implement the program in the schools. The children who fulfilled the criteria were invited to participate after providing them with a simple and full explanation of the aim and process of the study to obtain their verbal informed consent. Handout about the health education and exercise program for studied children's about control of pre-diabetes stage was provided.

- **Theoretical part:** consists of ٥ sessions, each researcher take (٣٢-٣٣) children for knowledge, every session contain (٦-٧) children.

- **Practical part:** Was carried out in ٢ session to be (٢٠) children in each session and divided on the three researchers to be (١١) child's with each one. Each session started by setting objectives and preparation of the content which covered the reason behind the application of the sessions, Random blood sugar test and urine analysis test. Each child takes about ١٠-١٥minutes for random blood sugar test and urine analysis test. Each child was allowed to perform the steps of each procedure in school class room under the supervision of researchers. The researchers were repeated procedures until the student mastered these skills. Demonstration and redemonstration were conducted in ٢ sessions for each group.

The Educational Intervention:

-First Phase:

A pretest was carried out by using the previously mentioned tools to assess knowledge, reported practice, quality of life and self-efficacy of mothers′ and their children.

-Second Phase:

This phase included analysis of the pre-test findings and identification of the actual needs of the children knowledge regarding to prediabetes and diabetes stage. Accordingly, the educational program was designed by the researchers using simple Arabic language and different illustrated pictures in order to facilitate subjects' understanding.

-Third Phase (Planning and Implementation):

General and specific objectives of educational program were stated and implemented to satisfy the actual needs of the study subjects; evaluation was carried out immediately after the implementation of the educational program by using the same pretest format as a post test.

- Fourth Phase:

Follow up of the educational program was carried out in ٢ weeks by using the same pre and post test tools.

Statistical analysis

The collected data were organized, tabulated and analyzed using electronic computer and statistical package for social sciences (SPSS) version ٢٠. Descriptive statistics were calculated for the data in the form of: Mean and standard deviation for quantitative data, and frequency and distribution for qualitative data. Also in analytical statistics, inter-group comparison of categorical data was performed by using chi square test ($\mathbf{X^2}$ value). Also, Pearson correlation coefficient test was used. P value <٠.٠٥ was considered statistically significant (*) while >٠.٠٥ statistically insignificant and P value <٠.٠٠١ was considered highly significant (**) in all analyses.

Results

Table (١): Frequency distribution of studied children regarding personal characteristics (n=١٠٠)

Items	No(=١٠٠)	%
Age in years		
٦<٩	٢٠	٢٠
٩<١٢	٢٠	٢٠
١٢≤١٥	٦٠	٦٠
Mean ± SD	١١.٣٧±٢.٤١	
Gender		
-Male	٤٤	٤٤
-Female	٥٦	٥٦
Educational stage		
-Primary	٤٤	٤٤
-Preparatory	٥٦	٥٦
Child ranking		
-First	٢٥	٢٥
-Second	٤٥	٤٥
-Third	٣٠	٣٠
-Last child	٠	٠
Residence		
-Urban	٥٥	٥٥
-Rural	٤٥	٤٥

Table (١): Shows that, mean age of studied children ١١.٣٧±٢.٤١ years' and ٥٦٪ were female, same percentages were engaged in preparatory school and ٥٥٪ living in urban areas.

Figure (١): Frequency distribution of studied children regarding eating habits in pre and post program

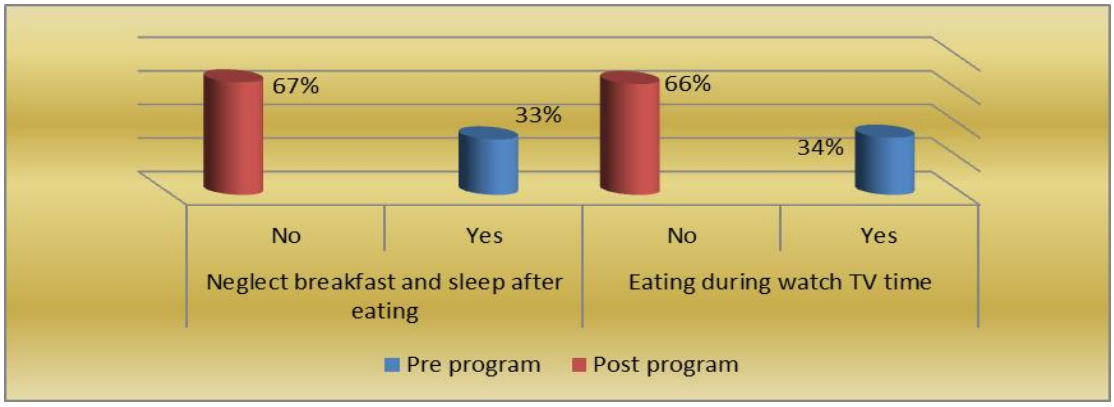

Figure (١): Illustrates that, more than one third (٣٣٪ and ٣٤%) of the studied children were eating during watching TV and neglect breakfast and sleeping after eating in preprogram. While less than three quarter (٦٦٪ and ٦٧٪) of the studied children don't eating during watch TV and don't neglect breakfast and not sleeping after eating.

Table (٢): Frequency distribution of studied children knowledge regarding prediabetes (n=١٠٠)

Items	Pre-program (n=١٠٠)	Post program (n=١٠٠)	X^2	p-value
	%	%		
Define of the pre diabetes				
- Knows and correct answer	١٥	٨٣	٩٥.٢٤	٠.٠٠
- knows and incorrect answer	٤٠	١٣		
- Don't knows	٤٥	٤		
Causes of pre diabetes				
- Knows and correct answer	١٨	٨٧	٩٨.٩٧	٠.٠٠
- knows and incorrect answer	٢٠	٨		
- Don't knows	٦٢	٥		
Complications of pre diabetes				
- Knows and correct answer	٢٠	٧٠	٥٦.٤٤	٠.٠٠
- knows and incorrect answer	٣٠	٢٠		
- Don't knows	٥٠	١٠		
Prevention of pre diabetes				
- Knows and correct answer	٢٠	٧٧	٧٠.٦٩	٠.٠٠
- knows and incorrect answer	٢٠	١٣		
- Don't knows	٦٠	١٠		

Table (٢): Evident that the highest percentages of children who participated in the current study had no knowledge as regards the definition, causes, complications and prevention of pre-diabetes before the program implementation. However, after the application of the programs, the majority of children had knowledge about the previously mentioned issues. There were statistically significant differences between children' knowledge in the pre- and post- program.

Table (٣): Frequency distribution of studied children knowledge regarding nutrition (n=١٠٠)

Items	Preprogram (n=١٠٠)	Post program (n=١٠٠)	X ²	p-value
	%	%		
Foods can lead to diabetes				
-Yes	٣٠	٩٠	٧٥.٠٠	٠.٠٠
-No	٧٠	١٠		
Foods should be taken				
- Knows and correct answer	٩	٨٠	١١٣.٠٤	٠.٠٠
- knows and incorrect answer	٩	١٠		
- Don't knows	٨٢	١٠		
Foods should be avoided				
- Knows and correct answer	٩	٧٩	١٠٩.٩٣	٠.٠٠
- knows and incorrect answer	٩	١٠		
- Don't knows	٨٢	١١		
Content of balanced meals t for child				
- Knows and correct answer	١٥	٧٩	٨٣.٠١	٠.٠٠
- knows and incorrect answer	١٥	١٠		
- Don't knows	٧٠	١١		
Number of meals the child should be taken per day				
-Know	٢٠	٨٥	٨٤.٧١	٠.٠٠
-Unknown	٨٠	١٥		

Table (٣): Clarified that the highest percentages of children who participated in the current study had no knowledge as regards the food should be avoided, food should be taken, content of balanced meals and number of meals before the program. However, after the application of the programs, the majority of children had knowledge about the previously mentioned issues. There were statistically significant differences between children' knowledge in the pre- and post-program.

Table (٤): Frequency distribution of studied children knowledge regarding obesity (n=١٠٠)

Items	Pre program			Post program			X^2	p-value
	Knows and correct answer	knows and incorrect answer	Don't knows	Knows and correct answer	Knows and incorrect answer	Don't knows		
	%	%	%	%	%	%		
Definition of obesity	١٠	١٠	٨٠	٨٦	١١	٣	١٣١.٦٤	٠.٠٠
Causes of obesity	٢٠	١٠	٧٠	٧٦	١٤	١٠	٧٨.٣٣	٠.٠٠
Complications of obesity	٢٠	٢٠	٦٠	٧٠	١٦	١٤	٥٦.٨١	٠.٠٠
Treatment of obesity	١٥	١٥	٧٠	٨٠	١٠	١٠	٩٠.٤٧	٠.٠٠

Table (٤): Showed that the highest percentages of children who participated in the current study had no knowledge as regards the definition, causes, complications and treatment of obesity before the program implementation. However, after the application of the programs, the majority of children had knowledge about the previously mentioned issues. There were statistically significant differences between children' knowledge in the pre- and post-program.

Table (٥): Frequency distribution of studied children knowledge regarding exercise (n=١٠٠)

Items	Preprogram(n=١٠٠)			Post program(n=١٠٠)			X^2	p-value
	Knows and correct answer	knows and incorrect answer	Don't knows	Knows and correct answer	Knows and incorrect answer	Don't knows		
	%	%	%	%	%	%		
Importance of exercise for a diabetic	١٥	٢٠	٦٥	٧٥	١٥	١٠	٨١.٠٤	٠.٠٠
Effort and hyperactivity should be avoided during exercise	٢٥	٢٥	٥٠	٨٠	١٠	١٠	٤٢.٦٦	٠.٠٠
Type of exercise for children	٢٠	٢٥	٥٥	٨٠	١٠	١٠	٧٣.٥٨	٠.٠٠
Normal range of exercise per day	٠	١٨	٨٢	٨٠	١٠	١٠	١٣٨.٦٣	٠.٠٠

Table (٥): Illustrate that the highest percentages of children who participated in the current study had no knowledge as regards the importance of exercise, effort and hyperactivity should be avoided and type of exercise and normal range exercise per day before the program implementation. However, after the application of the programs, the majority of children had knowledge about the previously mentioned issues. There were statistically significant differences between children' knowledge in the pre- and post-program.

Table (٦): Total mean score of studied children regarding laboratory examination

Items	Pre- program (n=١٠٠)	Post Program (n=١٠٠)	t test	P –value
	Mean ±SD	Mean ±SD		
Fasting blood sugar test	٢.٨١±.٣٩٤	١.٤٧±.٧٤٤	٦.٨٨٣	.٠٠٠
Random blood sugar test	٢.٨٣±٣٧٧	١.٣٩±.٦٩٤	٦.٤١٨	.٠٠٠
Urine analysis test	٢.٩٢±.٢٧٢	١.٢٢±.٥٢٣	٥.٦٩٣	.٠٠٠

Table (٦): Revealed that mean and standard deviation of the studied children knowledge score regarding to laboratory examination at pre and post program of educational intervention implementation (p=٠.٠٠١).

Table (٧): Total mean score of children knowledge at pre and post educational program implementation (n=١٠٠).

Items	Preprogram (n=١٠٠)	Post-program (n=١٠٠)	Paired t test	P
	Mean ±SD	Mean ±SD		
Pre diabetes stage	٦.٥٦±٢.٩٧٢	١٠.٨٨±٢.١٨٩	٣٣.٠٤	٠.٠٠
Nutrition	١٢.٩١±٤.٨٦	٢١.٩٦±٤.٩٢	٣٥.٥٧٣	٠.٠٠
Obesity	٧.٥١±٣.١٣١	١٤.٤٧±٢.٦٢	٣٢.٣٢٧	٠.٠٠
Exercise	٨.١٠٠±٣.١٦٣	١٣.٣٠±٣.٢٤	٣٤.٠٠٠	٠.٠٠
Laboratory examination	٨.٢٨٠±٣.١٥٢	١٣.٢٧±٣.٠٤٧	٣٥.٦١١	٠.٠٠

Table (٧): Shows that there was a highly statistically significant difference in children total mean score of children knowledge regarding to prediabetes, nutrition, obesity, exercise and laboratory examination at post program implementation as compared to preprogram implementation (P=<٠.٠٠١).

Table (٨): Total mean score of studied children regarding physical examination in preprogram and post program (n=١٠٠)

Items	Pre- program	Post Program	t test	P –value
	Mean ±SD	Mean ±SD		
Systolic pressure	١٢٠.١٨ ±١٣.٢٨	١١٤.٩٣±١٢.٤٠	١٢٤.٣٣٤	٠.٠٠
Diastolic pressure	٧٤.٢٠±١٥.٤٣	٦٩.٧٨±١٤.٧٧	٦٥.٠٨١	٠.٠٠
Weight	٥٦.٣٦±١١.١٩	٤٣.٨٦±٨.٧٠	٥٦.٩١٦	٠.٠٠
Body mass index	٢٦.٣٦±١.٤١	٢٣.٧٣±١.٥١	١٤٢.٥٦٣	٠.٠٠
Fasting blood sugar	١٢٨.٢٤±٥.٥٣	١١٦.٩٣±١٠.٨٩	١٧١.٨٠٤	٠.٠٠
Random blood sugar	١٤٦.٧٣±٣.٢٤	١٤٠.٢٦±٢.٧١	٤٩٩.٤٠٦	٠.٠٠

Table (٨): Described that there was a highly statistically significant difference observed between the studied children blood pressure, weight and body mass index and blood sugar test at pre and post program implementation P= (<٠.٠٠١).

Table (٩): Total knowledge scores of studied children regarding prediabetes in preprogram and post program (n=١٠٠)

Items	Study group(n = ١٠٠)				X^2 test	p
	Pre program		Post training			
	No	%	No	%		
Good	١١	١١٪	٨٣	٨٣٪	١٥٧.٠٦١	٠.٠٠
Average	٣٩	٣٩٪	٩	٩٪		
Poor	٥٠	٥٠٪	٨	٨٪		
Total	١٠٠	١٠٠.٠	١٠٠	١٠٠.٠		

Table (٩): Evident that, more than half of children who participated in the current study had poor knowledge in preprogram implementation. However, after the application of the programs, the majority of children had good knowledge. There were statistically significant differences between children' knowledge in the pre- and post-program.

Discussion

Diabetes mellitus is one of the leading chronic diseases of childhood and adolescence. Although type ١diabetes is the most common form in children, type ٢ diabetes mellitus (T٢DM) poses a major health problem globally, especially in many developing countries. Type ٢ diabetes mellitus in children is probably under-diagnosed because it can exist without symptoms. Early identification of children with prediabetes aids in appropriate management thereby reducing the incidence of diabetes **(Dnarayanappa, et al., ٢٠١١).**The prevalence of obesity, particularly severe obesity, in all pediatric age groups has been accompanied by prediabetes, and insulin resistance (IR) and increase risk of type ٢ diabetes mellitus (T٢DM). Along with other comorbidities of obesity, including hypertension, dyslipidemia, fatty liver disease, musculoskeletal disorders, and cardiovascular disease, T٢DM and its complications represent a significant cause of long-term disability (**Colberg et al., ٢٠١٠).**

According to children age, this study illustrated that mean age of studied children ١١.٣٧±٢.٤١ years and more than half of studied children were female, same percentage were engaged in preparatory school and more than half were living in urban areas. This result accordance with finding of **Weinbery, (٢٠١٥),** which study entitled "sports and fats, blood", who reported that the incidences of diabetes on world are the rise, the most of children are affected by type ١ diabetes in childhood. The number of children and young adults affected by type ٢ diabetes is beginning to rise. This result accordance with **Eklioğlu et al., (٢٠١٦),** which study entitled "prediabetes and cardiovascular parameters in obese children and adolescents", the prevalence of prediabetes was ٤٠.٩٪ in the obese children. The mean age was ١١.٨٤±٢.٩٥ years in prediabetes children.

As regards children knowledge regarding pre-diabetes, this study showed that the highest percentages of children who participated in the current study had no knowledge as regards the definition, causes, complications and prevention of pre-diabetes before the program implementation. However, after the application of the programs, the

majority of children had knowledge about the previously mentioned issues. There were statistically significant differences between children' knowledge in the pre- and post-program. This results in accordance with **Hagman, (٢٠١٦),** which study entitled "elevated fasting glucose levels in obese children and adolescents", who reported that the pre-diabetes stage is the period before the onset of type II diabetes, but not all children in the pre-diabetes stage suffering from type II diabetes. In the pre-diabetes stage the blood sugar levels high than normal, not considered children suffering from diabetes but at risk to incidence of diabetes.

According to studied children knowledge toward nutrition, this study clarified that the highest percentages of children who participated in the current study had no knowledge as regards the food should be avoided, food should be taken, content of balanced meals and number of meals before the program. However, after the application of the programs, majority of children had knowledge about the previously mentioned issues. There were statistically significant differences between children' knowledge in the pre- and post-program. These study accordance with **Simon, (٢٠١٣),** which study entitled "diabetes", who revealed that most children have an increased weight resulting from poor dietary habits and lack of exercise can contribute to insulin resistance. This study a accordance with **Stefanaki et al., (٢٠١٦),** which study entitled "prediabetes and adolescents trends causes, effects and screening", who founded that an indisputable association between unhealthy diet behaviors, such as increased junk food consumption, sweetened beverages, reduced consumption of fiber, lower energy intake from snack episodes, breakfast skipping, and energy density of foods have been accompanied by a rise in the prevalence of obesity and prediabetes. This result accordance with **Tsenkova, (٢٠١٤),** which study entitled "childhood socioeconomic disadvantage and prediabetes and diabetes in later life", who reported that a healthy eating plan for losing weight and reducing the risk of type ٢ diabetes should include a reduction in total energy, fat intake, particularly foods containing saturated fat such as butter, full fat dairy products, fatty meats, take away foods, biscuits, cakes and pastries. Instead choose a wide range of high fiber, moderate carbohydrate foods such as wholegrain breads and cereals, and fruit.

According to studied children knowledge toward obesity, this study revealed that the highest percentages of children who participated in the current study had no knowledge as regards the definition, causes, complications and treatment of obesity before the program implementation. However, after the application of the programs, the majority of children had knowledge about the previously mentioned issues. There were statistically significant differences between children' knowledge in the pre- and post-program. This result accordance with finding of **Hagman, (٢٠١٦),** who reported that the prevalence of childhood obesity in recent decades within a relatively genetic factors are not the primary cause. The important factors for childhood obesity prevalence include: societal factors, such as the marketing of energy-dense foods on television, socioeconomic factors, such as income inequality, physical inactivity, and dietary habits, such as more widespread food purchasing opportunities, larger portion size, junk food consumption and sugar-sweetened beverages. However, other factors, such as viral infections may also contribute to the development. In addition, this study agreement with **Eklioğlu et al., (٢٠١٦),** which study entitled "prediabetes and cardiovascular parameters in obese children and adolescents", Who reported that when insulin secretion cannot maintain the degree of hyperinsulinemia required to overcome the resistance, prediabetes impaired glucose tolerance (IGT), impaired fasting glucose and subsequently T٢DM develop.

Also, this study accordance with **Dnarayanappa, et al., (٢٠١١),** which study entitled "prevalence of prediabetes in school-going children", who reported that positive association between obesity (overweight) and risk of type ٢ diabetes has been established repeatedly in many cross-sectional and prospective studies and increasing prevalence of type ٢ diabetes among children in India and other countries has been attributed to epidemic of obesity and overweight among children.

As regards studied children knowledge regarding exercise, this study illustrate that the highest percentages of children who participated in the current study had no knowledge as regards the importance of exercise, effort and hyperactivity should be avoided and type of exercise and

normal range of exercise per day before the program implementation. However, after the application of the programs, the majority of children had knowledge about the previously mentioned issues. There were statistically significant differences between children' knowledge in the pre- and post-program. This result accordance with **Health Care and Education Committee of Diabetes Australia, (٢٠١٢),** which study entitled " prediabetes (IFG &IGT)", who reported that exercises can help insulin enter in to membranes of muscle cells, facilitates the entry of glucose in to muscles, and prove that the insulin is responsible for glucose transport during physical exercise and these exercises increase the influence of insulin and should be take into account reduce calories intake in the meal. Regular physical activity such as brisk, walking or swimming) every day or three, ٢٠ minute sessions of exercise per week (such as aerobics class, strenuous gardening) helps body to use insulin better and to feel fit and healthy. Starting a regular physical activity program and sticking to it can often be made a lot easier by joining up with a group or motivated friend to encourage keeping continuously performance.

According to children physical examinations, this study described that there was a highly statistically significant difference observed between the studied children blood pressure, children weight and body mass index and blood sugar test at pre and post program implementation This result accordance with finding of **Simon, (٢٠١٣),** who reported that diabetes is a chronic illness that requires continuing medical care and support to prevent acute complications and to reduce the risk of long-term complications. Also, this result accordance with **Preneet et al., (٢٠١٤)**, which study entitled "screening obese children and adolescents for prediabetes/type٢diabetes in pediatric practices", who reported that, the childhood obesity epidemic has led to an increase in type ٢ diabetes in children and youth. The children have shown that rates of prediabetes should be early detection in particular is key to restoring normal glucose tolerance (NGT) because use of lifestyle modification and/or medications such as metformin or both, have proven to be effective in reversing prediabetes. Therefore, defining effective screening tools for pediatricians is an important task and validating these measures against a diagnostic

standard such as OGTT and recommends screening at-risk children using fasting plasma glucose (FPG) or oral glucose tolerance test (OGTT) every ٢ years starting at ١٠ years of age or at the onset of puberty.

According to children total knowledge regarding prediabetes, this study illustrated that, more than half of children who participated in the current study had poor knowledge in preprogram implementation. However, after the application of the programs, majority of children had good knowledge. There were statistically significant differences between children' knowledge in the pre- and post-program. This study agreement with finding of **Blasingame, (٢٠١٧),** which study entitled" Addressing Childhood Obesity with Education, " who noted that there was an increase in knowledge of children in ١١ out of ١٦ questions. The questionnaire contained multiple choice questions pertaining to harm of obesity, benefits of physical activity, and the recommendations related to diet and exercise. With a significance level <٠.٠٥, question number ٨ had a significance level of (p=٠.٠١٦) and question ١١ had a significance level of (p=٠.٠٠٢). The majority (n=٨) failed ٤ out of the ١٦ questions on the pretest. Surprisingly, using ٨٠٪ as passing score for the posttest, all of the participants scored a passing rate. It was noted participants posttest answered question ١١ with an increase of ٦٦.٧٪ in the post-test. Question number ٨ (pre-test) was the second most missed question with only ٤٦.٧٪ answering it correctly. Question number ٨ asked, the American Heart Association recommends that children and teenagers get at least-minutes of exercise per day. Post-test there was an increase of students answering question ٨ correctly scoring ٩٣٪.

In my opinion obesity among children become most common problems, obesity can lead to type ٢ diabetes mellitus and parents not having any knowledge about periodic laboratory test should be done for children to detect elevation of blood glucose and methods to prevent complication.

Conclusion

Studied children in pre-diabetes period their knowledge was upgrading after implementation of the health education program were improved especially for diet, obesity and personal hygiene, exercise, laboratory

examination and physical examination. Meanwhile, there were improvement in blood sugar level, blood pressure and decrease body weight as compared to preprogram. This improvement result from educational program offered. Education may be a tool used to empower and challenge youth to take a stand to live healthier while preventing chronic diseases.

Recommendations

- Continuous health education program should be provided for obese children to prevent occurrence of diabetes mellitus
- Further research to be carried out regarding prediabetes in children because diabetes has become a major public health problem in Egypt.
- School nurse should be monitoring blood glucose level for obese children to prevent occurrences of type two diabetes mellitus (T٢D).
- The guidelines also recommend the compulsory analyzed blood sugar test for obese or overweight children every year.
- Further research is needed to guide which therapies might best prevent progression of prediabetes to T٢DM among children
- Mass media should play a vital role in increasing awareness about prediabetes, methods of its prevention and its treatment.

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