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Original Article

Effect of Health Education Program on Knowledge, Lifestyle and Health Profile of Prediabetic Employees in Zagazig University

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Abstract

Background: Prediabetes is a risk factor for type 2 diabetes and cardiovascular diseases. So, its early detection and management are important.

Objective(s): To identify the prediabetics among employees of Zagazig University. To assess the effect of a health education program on prediabetics' knowledge, lifestyle and health profile.

Methods: Prediabetics were detected among 556 participants working in the managerial departments of Zagazig University, through two steps; firstly, screening by FINDRISC questionnaire then Fasting Plasma Glucose (FPG) and glycosylated haemoglobin (HBA1c) testing for those with FINDRISC scores of ≥ 15. The intervention was in the form of group education targeting adoption of a healthy lifestyle through providing knowledge and using behaviour change methods like goal setting, action planning and problem-solving with follow up for six months.

Results: The participants with FINDRISC scores of ≥ 15 were 46.9%, only 21.9% of them were actually prediabetics. After the intervention, there was highly significant increase in the percent of participants with satisfactory knowledge and healthy lifestyle practices (p=0.00), and highly significant reduction in the mean value of FPG, HbA1c, body mass index and waist circumference.

Conclusion: Health education was an effective tool that implicated a change in prediabetics' knowledge, lifestyle and health profile.

***Keywords*:** Prediabetes, FINDRISC questionnaire, risk factors, lifestyle, health profile, health education.

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INTRODUCTION

Type 2 Diabetes (T2D) has become a rapid growing health problem in Egypt, it is one of the top 10 countries in the prevalence of T2D which is around 15.56% of all adults aged 20 to 79 years with an annual death of 86,478 persons.(1) Therefore, efforts are needed to determine the possible ways to early detect and manage those who are at high risk of T2D who are called prediabetics. Prediabetes is a state where blood glucose level is higher than normal but, not sufficient to meet the criteria for T2D. It usually associates with other risk factors, as obesity, hypertension and dyslipidemia that increase the risk for T2D.(2) The International Diabetes Federation reported that around 2.2 million individuals have prediabetes in Egypt and mostly undiagnosed.(1) According to Center for Disease Control and prevention, nine of ten people with prediabetes ignore having it.(3) Without intervention, a 5-year risk of developing diabetes range from 9% to 50%.(2) Early detection of prediabetes is highly important as signs of early diabetic complications often exist at the time of diagnosis.(4) Early intervention through regular exercise, dietary modification, and weight control can delay, and even prevent the progression from prediabetes to diabetes.(5)

Prediabetes is a confusing concept because it is not associated with any physical symptoms, also not all people will develop T2D, which may result in resistance to the recommended lifestyle changes, which are the

bases to correct prediabetes.[6] This could be attributed to lack of knowledge about pre-diabetes and the required lifestyle changes, which raises the importance of an appropriate education for the persons with pre-diabetes.[7]

This study was carried out to detect people with prediabetes through a community setting then apply a structured health education program. The program based on providing prediabetics with knowledge and support as well as building up self-efficacy and trying to overcome the barriers of adoption of healthy lifestyle changes. The research question was whether this program will be effective in improving knowledge, lifestyle and health profile of prediabetics or not. The study objectives were i) to identify the prediabetics among Zagazig University employees, and ii) to assess the effect of a structured health education program on the knowledge, lifestyle and health profile of prediabetics.

METHODS

Study design and setting: An interventional (pretest-posttest) study was carried out at the managerial departments of Zagazig University, Egypt during the period from April 2015 to January 2016. This setting is one of the multiple target settings in which a significant portion of prediabetics can be detected as the persons working in this setting usually have more than one risk factor to develop prediabetes. Additionally, it is an accessible setting for the researchers ensuring continuous follow up without dropouts.

Sampling and sample size: The sample size was calculated using Epi Info 6 to be 556 subjects taking into consideration that the total number of Zagazig University employees is 7640, the prevalence of prediabetes in Egypt is 13.1%[8], power 80%, statistical level of significance at 0.05, and 10% expected non-response.

The sample subjects were selected by multi-stage random sampling technique as follows:

1st stage: three faculties were selected randomly out of the university.

2nd stage: three managerial departments were selected randomly within each faculty.

3rd stage: simple random sample of the employees fulfilling the inclusion criteria and working in the chosen departments was selected.

Inclusion and exclusion criteria: Known diabetics and who refused to share were excluded from the start. The participants with high and very high diabetes risk scores only underwent Fasting Plasma Glucose (FPG) and glycosylated hemoglobin (HbA1c) testing to diagnose prediabetes. Diagnosed prediabetics were included in the health education program.

Data collection tools

1. **Finnish Diabetes Risk Score (FINDRISC) questionnaire:** it was adapted from Lindstrom and Tuomilehto.[9] It is a simple, cheap, noninvasive, time efficient, reliable practical tool predicting the 10-year risk of T2D. The validity of this questionnaire differs between studies depending on the site of the study, the characteristics of the study participants, the sample size, the cut-off points and the diabetes diagnosis criteria against which validation is done.[10] It depends on the summation of scores of eight variables; age, BMI, waist circumference, daily physical activity, daily fruits and vegetable intake, use of antihypertensive drugs, history of high blood glucose, and family history of diabetes. If the total risk is:
   - Lower than 7 (low): 1 in 100 will develop the disease.
   - 7-11 (slightly elevated): 1 in 25 will develop the disease.
   - 12-14 (moderate): 1 in 6 will develop the disease.
   - 15-20 (high): 1 in 3 will develop the disease.
   - Higher than 20 (very high): 1 in 2 will develop the disease.
2. **A prediabetes knowledge questionnaire:** It was developed by the researchers and pilot tested. The reliability test was done whereas Cronbach's Alpha was 0.87. It consisted of 43 closed-ended questions covering the definition of prediabetes (3 questions), risk factors (10 questions), complications (5 questions), normal health profile values (7 questions), and management (18 questions covering the nutrition knowledge, the recommended physical activity, and weight management). The score one was given for each correct answer and zero for the incorrect answer and I don't know with a total score of 43 points. A cut-off point at 50% was used to classify knowledge into satisfactory or unsatisfactory.
3. **Rapid Eating and Activity Assessment for Participants (REAP) tool:** it was developed by Nutrition Academic Award Program. It is used to assess the self-reported intake of whole grains, calcium-rich foods, fruits and vegetables, saturated fat and cholesterol, sugary beverages and foods, sodium, and physical activity.[11] It was translated into Arabic then validated through a back-translation technique. After removing the question about alcohol beverages, the REAP tool consisted of 26 instead of 27 questions. The responses for each question scored from 1 to 3 according to the following; unhealthy practice=l, borderline healthy practice=2 and healthy practice=3. The total score was 78 points where higher scores are associated with healthier nutrition.
4. **Anthropometric measurements:** The researchers measured weight, height, waist circumference (WC) and blood pressure of the participants using standardized techniques. Weight was measured by a weighing scale to the nearest kilogram (kg). Height was measured by a standard measuring tape in the standing position while the shoulders were in a normal position to the nearest centimeter (cm). BMI was

calculated by dividing weight by height squared [kg/m^2] and classified into overweight if BMI ≥25 kg/m^2.[12] WC was measured to the nearest centimeter by a non-stretchable tape placed midway between the lowest rib and the iliac crest in expiration and standing position. WC in women ≥ 88 cm and in men ≥ 102 cm is an index of abdominal obesity.[13] Blood pressure was measured by using mercury sphygmomanometer in sitting position. Hypertension is diagnosed in prediabetics when blood pressure ≥ 130/85 mm Hg.[13]

5. **Lab Investigations:** A well-trained nurse drew 5 ml of a fasting morning blood sample from the anticubital vein of each participant with high and very high diabetes risk scores. The blood sample was divided equally into two tubes; Ethylene Diamine Tetra Acetic acid (EDTA) containing tube for the HbAlc and fluoride oxalate tube for FPG. The blood samples were coded and sent to the laboratory for the estimation of FPG by the glucose oxidase peroxidase colorimetric enzymatic method [14] and HbA1C by rapid desktop method.[15] Prediabetes was diagnosed when FPG was from 100-125 mg/dl and HbA1c was from 5.7%-6.4%.[1] Another fasting morning sample of 5 ml venous blood was drawn from each participant with prediabetes and stored in a plain tube for separation of serum for lipid profile. The blood samples were coded and sent to the laboratory for measuring High Density Lipoprotein-Cholesterol (HDL-CHOL) and Tri-Glyceride (TG) using a heparin manganese precipitation of Apo B-containing lipoproteins [16] and enzymatic hydrolysis by the combined action of a microbial lipase and a protease [17] respectively. HDL cholesterol level <50 mg/dl in women and <40 mg/dl in men or hyper-triglycerideamia ≥150 mg/dl increase the chance of developing T2D and cardiovascular diseases in prediabetics.[13]
6. **Follow up sheet:** A printed follow-up sheet was used. One copy was given to the participant and the other was kept with the researchers. It included the measurements of BMI, WC, blood pressure and the results of FBG, HbAlc and lipid profile at the beginning of the study and six months after the last educational session**.**

The study passed through four phases:

1st phase: pre-intervention (assessment phase): it included two interviews:

1st interview: After explaining the purpose of the study and taking informed consent, screening of all participants (556 persons) by FINDRISC questionnaire was done. The researchers measured weight, height, and WC for each participant and asked him/her about the remaining items of the questionnaire then calculated the total score for each one to classify them according to their diabetes risk scores. Those with high and very high diabetes risk scores were informed of the need for at least eight hours overnight fasting before drawing blood samples for measuring FBG and HbA1c on the morning of the next day. Data collection was conducted daily, five days per week for one month.

2nd interview: Results of FPG and HbA1c were distributed where 57 participants were diagnosed as prediabetics, five of them were recruited into the pilot study which was conducted to assess the feasibility and the time needed to fill the questionnaire and to carry out the health education. The remaining prediabetics were asked to participate in the health education program; their response rate was 100%. They were asked to fill the prediabetes knowledge questionnaire and the REAP tool. Their blood pressure was measured and recorded in the follow-up sheets. They were instructed for at least 12 hours overnight fasting before drawing blood samples for lipid profile on the morning of the next day and that the results of this lipid profile would be distributed during the 1st health education session. A timetable of the health education program was distributed to inform the participants with the different appointments and the different places of each session to give them a chance to compensate any dropped-out session. Data collection was conducted daily, five days per week for two successive weeks.

2nd phase: intervention (health education program): After analysis of pre-intervention data which led to the identification of the needs and the strong and weak points of the participants, changes were made in the educational program which was already designed. Researchers tried to design the educational program proportionate to the needs and preferences of participants. The program depended on the self-management support component of the Chronic Care Model, which includes goal setting, action planning, and problem-solving.[18] The program goals were to gradually lose weight at a rate of 0.5-1.0 kg per month and to increase the leisure physical exercise to 30 minutes at least 5 days a week. The action plan included teaching the participants how to increase their daily physical activity and how to calculate their daily energy requirements to maintain a normal weight. Problem-solving was the strategy used to overcome barriers to adoption of healthy lifestyle changes. The participants were divided into five groups. The educational sessions were conducted by the researchers through direct personal communication in the participants' workplaces after the working hours. Each group attended six sessions of the educational program in different days during one and half month period according to the program topics plan (Table1). Each session took 60 to 90 minutes. The educational methods included PowerPoint presentations and videos, demonstration, and open discussion and answering questions. The content of each session was distributed to the participants after the end of the session in the form of handouts and printed colored booklets to facilitate the process of remembering when needed.

3rd phase: follow up phase: It took six months. It was in the form of individual counseling conducted once per month through telephone contact or face to face communication to solve any problem that hindered goals attainment.

4th phase: post-intervention (evaluation phase):

It was conducted six months after the last educational session. Each participant was subjected to the following:

1. The prediabetes knowledge questionnaire and REAP tool (used in the pre-intervention phase) were completed.
2. The weight, WC and blood pressure were reassessed by the researchers.
3. A blood sample was taken for measuring FPG and HbAlc and lipid profile.

Statistical Analysis

The collected data were analyzed by using SPSS (Statistical Package for the Social Sciences) version 20.0 and the proper statistical tests including McNemar and Paired t-tests were performed.

Ethical Considerations

The research protocol was approved by Ethics Committee of the Faculty of Medicine, Zagazig University, Egypt (Reference number: ZU- IRB#: 1907). Official permissions were obtained from the deans of the selected faculties and the heads of the selected managerial departments. The aim and concerns of the research was disclosed to the participants. After clarifying the procedures of the study, a written consent from every participant was obtained. Participants were informed about their right to reject participation and to withdraw whenever they want without giving reasons and with no consequences. The research steps were done in compliance with the international guidelines for research ethics and that of Helsinki Declaration. Total confidentiality of any given information was assured.

Table 1: The program topics plan

Session no.	Contents
1st	○ Definition of pre-diabetes, risk factors, complications, management
2nd	○ Recommended physical activity and its importance ○ How to increase daily physical activity at work, transportation, leisure and household ○ Exploring barriers to increasing physical activity and putting practical solutions
3rd	○ Types of different nutrients, their sources, their general functions in the body and the recommended daily requirement of each nutrient ○ Definition of healthy balanced diet ○ Diet planning per healthy plate method or the food guide pyramid ○ Demonstration of serving size of different foods with dishes, cups, and bottles models of known size and the nutrient contents (energy, calcium, protein, etc.) in a serving
4th	○ Weight management ○ Reading and understanding the nutritional information on food labels ○ Exploring barriers to adoption of healthy dietary practices and putting practical solutions
5th	○ Health Check: exploring body weight, waist size, blood pressure, blood glucose and cholesterol ○ Demonstration of home blood pressure and glucose monitoring
6th	○ Revision and assessment of learning through a question-and-answer session

RESULTS

The pre-intervention phase included 556 participants; 57.0% were males, 59.7% were over 54 years old, 51.6% had BMI more than 30 kg/m^2, 46% had abdominal obesity, 54.9% were physically inactive, 51.7% were not eating vegetables and fruits daily, 40.8% were using antihypertensive drugs, no one recorded history of high blood glucose, and 61.3% had positive family history of diabetes. The participants were divided according to FINDRISC scores into 12.7% of low risk, 16.1% of the slightly elevated risk, 24.3% of the moderate risk and the remaining distributed between high (28.7%) and very high risk (18.2%). Lab investigations of those with high and very high risk scores revealed that 21.9% of them were prediabetics (Figure 1). The effect of the health education program on the prediabetics' knowledge and lifestyle practices was demonstrated in Tables 2 and 3 respectively. There was highly statistically significant increase in the percent of participants having satisfactory knowledge about prediabetes definition, risk factors, complications and management after intervention (p=0.000). There was also statistically significant increase in the percent of participants with healthy dietary intake of each food group and healthy lifestyle practices after intervention (p=0.000). The effect of the health education program on the mean values of prediabetics' health profile was demonstrated in Table 4 where there was a significant reduction in BMI, WC, blood pressure, FPG and HbA1c with a significant increase in HDL without a significant reduction in TG after the intervention. Also, the prevalence of all abnormal clinical characteristics except dyslipidemia was significantly decreased after the intervention.

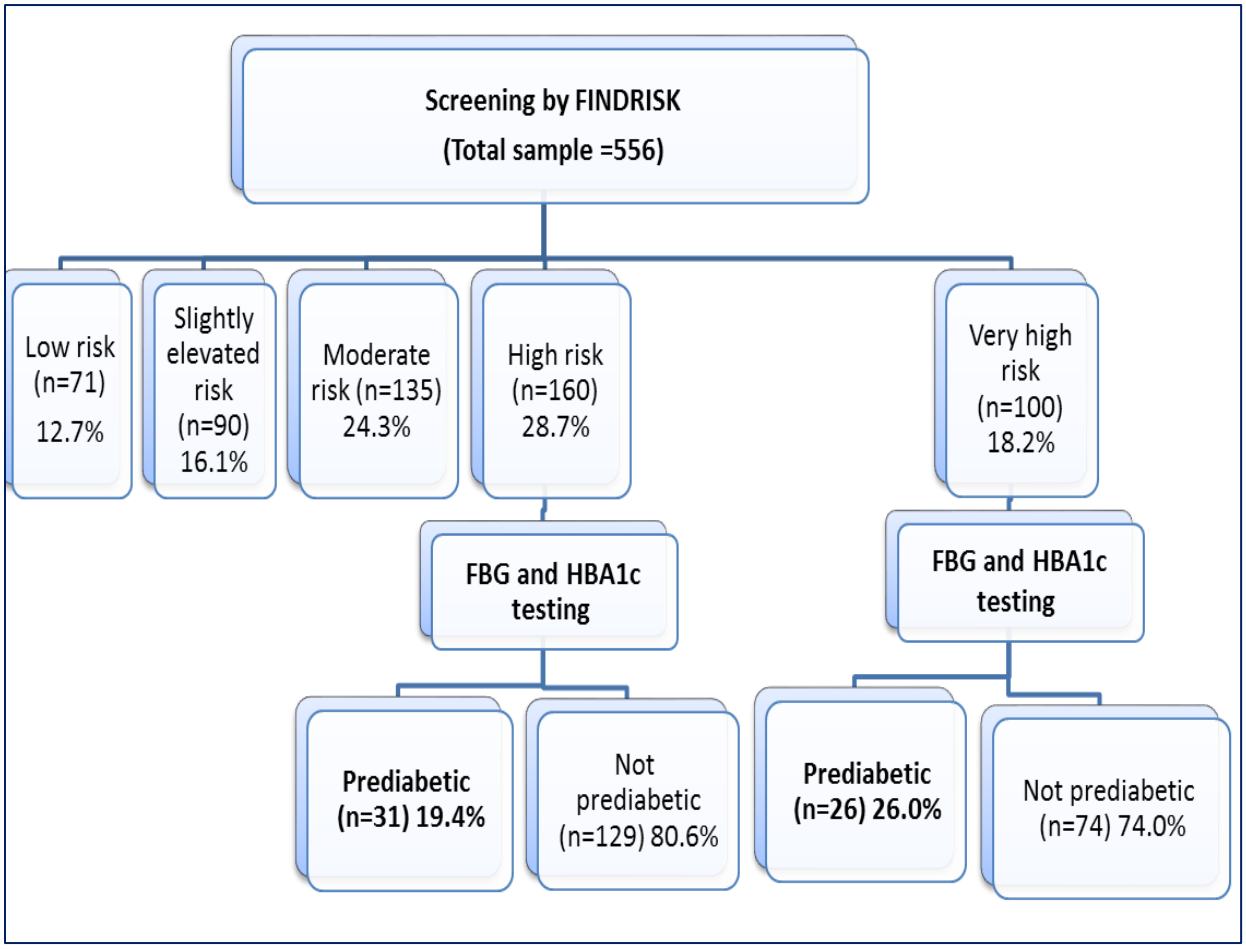

Figure 1: A flow chart for screening and diagnosis of prediabetes.

Table 2: Prediabetics with satisfactory knowledge before and after the health education program

Items	Before education (n=52) No. (%)	After education (n=52) No. (%)	P value*
Definition of prediabetes	4 (7.6)	49 (94.2)	0.000
Risk factors for prediabetes	11 (21.1)	40 (76.9)	0.000
Complications of prediabetes	9 (17.3)	44 (84.6)	0.000
Management of prediabetes	3 (5.7)	47 (90.3)	0.000
Normal health profile values	3 (5.7)	33 (63.4)	0.000

*P <0.05 considered significant

Table 3: Prediabetics with healthy dietary intake and lifestyle practices before and after the health education program

Items	Before education (n=52) No. (%)	After education (n=52) No. (%)	P value*
Never skip breakfast	24 (46.1)	40 (76.9)	0.000
Never eat Fast foods	36 (69.2)	46 (88.5)	0.004
Whole grains	43 (82.6)	49 (94.2)	0.041
Fruits	21 (40.3)	29 (55.7)	0.013
Vegetables	29 (55.7)	39 (75.0)	0.004
Dairy products	19 (36.5)	39 (75.0)	0.000
Meat/chicken/fish	25 (48.1)	34 (65.3)	0.007
Fried foods	13 (25.0)	33 (63.4)	0.000
Snacks	14 (26.9)	25 (48.1)	0.002
Fats/oils	17 (32.6)	29 (55.7)	0.001
Sugar/sweets	16 (30.7)	41 (78.8)	0.000
Soft drinks	26 (50.0)	39 (75.0)	0.000
Salt	19 (36.5)	39 (75.0)	0.000
Watching TV ≤ 2 hours/ day	17 (32.6)	25 (48.1)	0.013
Physical activity ≥30 min/5days/week	18 (34.6)	38 (73.1)	0.000

* P <0.05 considered significant

Table 4: Prediabetics' health profile before and after the health education program

Items	Before education (n=52)	After education (n=52)	P value
BMI (kg/m2)			
Mean ±SD	30.98±1.92	30.42±2.34	0.008*
% of overweight/obesity	52 (100.0)	46 (88.4)	0.041*
WC (cm)			
Mean ±SD in men	109.78±5.57	107.28±3.46	0.020*
Mean ±SD in women	93.05±7.33	88.57±7.97	0.001*
% of abdominal obesity in both sexes	29 (55.7)	22 (42.3)	0.023*
Blood pressure (mm Hg)			
Mean ±SD of SBP	129.51±11.08	128.07±10.34	0.034*
Mean ±SD of DBP	81.92±13.72	80.48±13.07	0.021*
% of Hypertension	31 (59.6)	24 (46.1)	0.023*
Blood glucose (mg/dl)			
Mean ±SD of FPG	113.11±7.02	83.03±13.38	0.000*
Mean ±SD of HbA1c	6.04±0.30	4.53±0.97	0.000*
% of IFG and/or abnormal HbA1c	52 (100.0)	13 (25.0)	0.000*
HDL-CHOL (mg/dl)			
Mean ±SD	41.30±12.74	41.88±12.86	0.035*
% of Low HDL	27 (51.9)	22 (42.3)	0.073
TG (mg/dl)			
Mean ±SD	146.82±11.12	146.78±11.11	0.532
% of Hypertriglyceridemia	9 (17.3)	6 (11.5)	0.248

BMI: Body Mass Index, WC: Waist Circumference, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure, FPS: Fasting Plasma Glucose, HDL-CHOL: High-Density Lipoprotein-Cholesterol and TG: Triglyceride, IFG: Impaired Fasting Glucose. *P <0.05 considered significant

DISCUSSION

Many studies used the FINDRISC questionnaire as the first step followed by lab investigations for detection of prediabetes. The simultaneous combination of FINDRISC score and HbA1c can increase the sensitivity to identify pre-diabetes. [21] One study found that participants with FINDRISC score value of ≥ 12 represented 48.1%, 6.6% of them had Impaired Fasting Glucose (IFG).[22] Another study found that the participants with a FINDRISC score value of ≥15 was equal to 9.6% among them 29% had IFG.[23]

The concept of prediabetes was unfamiliar for most participants. This was obvious from lack of knowledge about prediabetes that was observed before the intervention. That may pay attention to the need for more educational campaigns directed to the whole community. After the intervention, the percent of prediabetics having satisfactory knowledge about the disease increased significantly. This increase in knowledge may be an explanation for the increase in adoption of healthy lifestyle among participants. Many studies proved the significant effect of knowledge on the adoption of healthy lifestyles. [24] Moreover, knowledge-based perception of personal risk for the disease plays an essential role in the adoption of many preventive health behaviors. [25]

Unhealthy lifestyle was followed by most participants before the intervention, so it was an important focus for the program. That not only provided knowledge but also used simple cognitive behavioral change methods like goal setting, action planning, problem-solving that were designed to build self-efficacy and to help link intentions and actions.[18] Also, the intervention provided ongoing support throughout the study period. So, it succeeded to produce a significant improvement in both physical activity and dietary practices. Many studies explored the causes to non-engagement of healthy lifestyle for example; the lack of a structured health education,[26,27] the lack of continuous support,[28] poor disease understanding, lack of motivation to adopt healthy life style and low self-efficacy.[29] Lifestyle changes may be undertaken if they did not affect daily routine activities.[26] Finally, the causes may be outside the control of a person such as education and social status or inside the control such as the culture, hopelessness, wellness, mood and feelings of failure.[26,31] The intervention was designed taking into consideration all these barriers. This might explain its effectiveness in changing lifestyle.

One of the main targets of this intervention was to assess the prediabetics' health profile before and after the intervention as a method of its evaluation. The success of the intervention to improve knowledge and lifestyle practices reflected on the biophysical and biochemical parameters of the participants, which also improved after intervention. This improvement was highly significant for FPG and HbA1c followed by BMI and WC of women while it was slightly significant for WC of men, blood pressure and HDL-cholesterol and not significant for TG. In a Malaysian study, it was found that the lifestyle intervention for six months had induced a significant reduction in body weight, BMI, WC, FPG, 2 hours post-prandial (2HPP) with a significant increase in HDL-cholesterol and with no effect on blood pressure and TG. [30] The Diabetes Prevention Program recommended the lifestyle interventions as it may reduce the cardiovascular risk in persons with prediabetes through inducing a significant reduction in blood pressure and waist circumference. [31]

This study was one of the few studies in Egypt that conducted a community-based screening of prediabetes and applied an educational program to control it. Moreover, the investigators used two valid tools for screening in the form of FINDRISC questionnaire and lab investigations that increase the sensitivity of diagnosing the cases. There were several limitations to this study as; the limited financial resources forced the researchers to perform lab investigations for the participants with high and very high risk FINDRISC scores only. The relatively small sample size and the application of the study on the employees who are most likely different in their health literacy level than the general population could interfere with generalizability of the results. The study design is a weak design as it is liable to many of the threats to internal validity and the non-use of a control group with randomization interferes with generalizability of the results. Finally, the short duration of intervention made it difficult to assess the long-term effect of the program.

CONCLUSION AND RECOMMENDATIONS

A well-designed health education program can significantly improve the knowledge and lifestyle practices which in turn can induce a significant reduction in FPG and HbA1c and can modify other risk factors for cardiovascular disease. such as obesity, abdominal obesity, hypertension and high HDL. Community-based screening for prediabetes among high risk population by valid tools followed by health education targeting lifestyle should be one of the priorities to prevent T2D especially with the rapid increase in the T2D prevalence in Egypt nowadays. Future studies should be conducted on a larger number of participants with long-term follow-up to ensure a more effective intervention. Further evaluation is necessary to determine the cost-effectiveness of this intervention.

Conflict of Interest: None to declare.

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