THE EFFECTS OF WORKPLACE HEALTH PROMOTION PROGRAMME ON THE RISK OF DEVELOPING DIABETES MELLITUS AMONG PEOPLE LIVING IN ABUJA, NIGERIA

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Abstract

The study investigated the possible effects of a workplace health promotion programme on the lifestyle-related factors that increase the risk of developing Type 2 Diabetes mellitus (T2DM). A pretest posttest quasi experimental research design was adopted, where simple random and purposive sampling techniques were used to select 178 participants for the study. A standardized instrument, the Finnish Diabetes Risk Score (FINDRISC) questionnaire (r=0.77), was used for data collection. The intervention group received a 12-week workplace health promotion programme, after which there were significant mean changes in their body mass index (-1.78), waist circumference (-0.90 cm), physical activity (0.38), daily consumption of fruits/vegetables (0.64), fasting blood glucose (-0.36), and type-2 diabetes risk score (-1.76). The study concluded that a well-structured health promotion programme will have significant positive effects on the T2DM-related risk factors, and by extension may reduce the risk of developing T2DM.

Keywords: *Workplace health promotion programme, Risk factors, Lifestyle modification, Type 2 Diabetes mellitus, FINDRISC questionnaire.*

Introduction

The rising global prevalence of diabetes mellitus is increasingly becoming worrisome as it constitutes a serious threat to public health and socio-economic development of people in the world. As observed by the International Diabetes Federation (IDF, 2017), the prevalence of diabetes mellitus (DM), particularly the Type 2 (T2DM), has reached an epidemic proportion in most regions of the world, thereby positioning the disease condition as one of the serious global health emergencies of the 21st century. The IDF (2015, 2017) further informed that DM is the third leading cause of death globally, and presently affects about 8.8% of the global adult population, with an estimated 135 million people affected. The total number of people living with this disease condition is expected to rise to 300 million by the year 2025; and to about 500 million by the year 2030, with 75% of the affected people expected to be from the developing countries, like Nigeria (IDF, 2015). The general prevalence of T2DM in Nigeria has been estimated to be around 2.8%, while its disease proportional death rate is about 1%; a situation that is expected to worsen in the nearest future (Federal Ministry of Health – FMoH, 2015; WHO, 2018). Furthermore, T2DM is

associated with some debilitating complications, some of which include – peripheral neuropathy, retinopathy, cataracts, diabetic foot ulcers, and nephropathy (FMoH, 2015).

Considering the rising burden of T2DM and the fact that the disease condition does not yet have a cure, the best available method of intervention is to prevent or at least delay its onset. Although in the past decades, the preventive efforts have been directed primarily at detecting undiagnosed T2DM, only recently has the focus turned on the risk factors that are implicated in the development of T2DM (Ryde´n*et al.*, 2007). Based on the submission of McLellan, Wyne, Villagomez and Hsueh (2014), T2DM results from the interaction of multiple risk factors like genetic predisposition, aging process, unhealthy diet, physical inactivity, and increasing weight. For this reason, Franklin and Cushman (2011), contended that the identification and modification of the modifiable risk factors can have a profound and favorable impact on decreasing the incidence of T2DM among the at-risk population. Deploying health promotion as an intervention, with specific focus on risk reduction and lifestyle modification, has been shown to have great potential in significantly reducing the implicated risk factors. According to Wilson (2016), a reduction of chronic disease death rates of just 2% a year by the aid of effective lifestyle intervention, would avert 35 million deaths over 10 years, and prevent or delay at least half of the cases of T2DM. As further argued by Kones (2011), lifestyle intervention programmes, like school or workplace health promotion, can result in more than a five fold return in investment on T2DM prevention when compared with most other clinical preventive measures.

In order to effectively tackle the rising burden of T2DM in Nigeria, the FMoH (2015), has set 2025 national targets. These targets include – 25% relative reduction in overall mortality from diabetes mellitus; a 30% relative reduction in the prevalence of current tobacco use; a 10% relative reduction in the prevalence of insufficient physical activity; and a halt to the rise in the prevalence of diabetes mellitus. One of the greatest challenges that may serve as a barrier to the actualization of these national targets is the workplace (schools, corporate organisations, etc.). According to the WHO (2011), about half of people suffering from chronic diseases, like T2DM, and about one-quarter of all T2DM-related deaths are recorded among people below the age of 60 years, the workforce of the society. Being the Federal Capital Territory of a developing nation like Nigeria, Abuja is fast industrializing and becoming a major player in the global economy. This has attracted many of the country's young graduates and intellectuals to seek employment in the numerous academic institutions and corporate companies that are based in the city. The modern fast-paced and unhealthy working environment in many work places encourages hazardous job exposures, high job demands, and inflexible work schedules, a situation that significantly contribute to unhealthy lifestyle among the employees (Sorensen *et al.*, 2011). As a measure of

addressing these challenges, the study investigated the effects of workplace health promotion programme on the risk of developing diabetes mellitus among people living in Abuja.

The following hypotheses were tested in the study;

1. Workplace health promotion programme will not have a significant effect on the Body Mass Index of people living in Abuja.
2. Workplace health promotion programme will not have significant effect on the waist circumference of people living in Abuja.
3. Workplace health promotion programme will not have a significant effect on the physical activity level of people living in Abuja.
4. Workplace health promotion programme will not have a significant effect on the rate daily consumption of fruits/vegetables among people living in Abuja.
5. Workplace health promotion programme will not have a significant effect on the fasting blood glucose level of people living in Abuja.
6. Workplace health promotion programme will not have a significant effect on the type 2 diabetes risk score of people living in Abuja.

Methodology

The population for this Pre-test Post-test quasi-experimental design study was 232, 112 public and private formal employees in Abuja (National Bureau of Statistics, 2010). The sample size for this intervention study was 184 participants, which were calculated using Research Sample Size Formula by Cochran: $n = z^2pq/d^2$.A multi-stage sampling technique was used. Out of the 6 areas councils (Local Government Areas) of Abuja, a simple random sampling technique was used to select 2 area councils (namely Abuja Municipal and Gwagwalada). Within the Abuja Municipal Area Council, the State House Complex, Abuja was selected as the workplace location for the Intervention group, using the purposive sampling technique. Ninety-two (92) staff were subsequently selected from this organization for the study through the simple random sampling technique, but eighty-eight (88) completed the study. While within the Gwagwalada Area Council, the Federal Inland Revenue Services (FIRS) Area Office was selected as the Control group using the purposive sampling technique. Ninety-two (92) staff were also selected from this organization for the study through the simple random sampling technique, but 90 completed the study. Prior to the commencement of the study, ethical clearance was collected from the National Health Research Ethics Committee of Nigeria and the ethical committee of the National Hospital, Abuja. Also, verbal and written consent was obtained from all the participants before their enrollment into the study.

The inclusion criteria for the study centered only on staff who had mobile phones with WhatsApp, while the exclusion criteria excluded any participants

with a self-reported history of Diabetes mellitus and pregnancy, any staff that is on anti hyper glycaemic medication(s), and/or were noticed to have a Fasting Blood Glucose (FBG) level of ≥ 7.0 mmol/l.

A standardized and validated instrument, the Finnish Diabetes Risk Score (FINDRISC) questionnaire (r=0.77) was adopted for data collection. The collected data were categorised into eight variables that clearly correlated with the risk of developing diabetes mellitus, age, body mass index (BMI), waist circumference, physical activity, daily consumption of fruits/vegetables, use of anti-hypertensive medication, history of elevated blood glucose, and history of diabetes in the family. Other instruments that were used for this study were: Glucometer, Standgiometer, measuring Tape (non-stretchable), and a Health Education Manual. The manual was a self-developed health education manual on lifestyle modification and diabetes risk reduction developed in accordance to the guidelines and recommendations from two standardized World Health Organization's health education manuals on diabetes prevention.

Administration of research instruments and data collection section was carried out in three phases: Pre-Intervention Phase, Intervention Phase and Post-Intervention Phase.

Pre-intervention Phase: A pre-test assessment was carried out on all the participants (intervention and control groups)who met the inclusion and exclusion criteria. Here, the fasting blood glucose, body mass index, and waist circumference of all the participants were assessed, while the T2DM risk score was determined through the FINDRISC questionnaire.

Intervention Phase: Here, only the intervention group was exposed to Workplace Health Promotion programme for 12weeks. The programme had 3components:

1. Health Seminar,
2. Health Education Manual, and
3. Mobile Communication through WhatsApp Platform.

i. Health Seminar: This took place twice a week for 4 weeks. The sessions were carried out with the aid of educational materials like posters, handbills, and charts.

ii. Health Education Manual: All the participants in the intervention group were given a health education manual and encouraged to study it at their convenience. The manual contains information on steps to ensure a healthy lifestyle and reduce the risk of developing diabetes.

iii. Mobile Communication through WhatsApp Platform: A WhatsApp platform was created for the intervention group. The interactive platform allows the researcher to effectively follow – up with the participants with more information on healthy lifestyle, behavioural change, and diabetes risk reduction.

iv. Post-Intervention Phase: The post-test data were collected from all the participants. During the intervention period, the control group was given a health talk on Hepatitis B preventive practices.

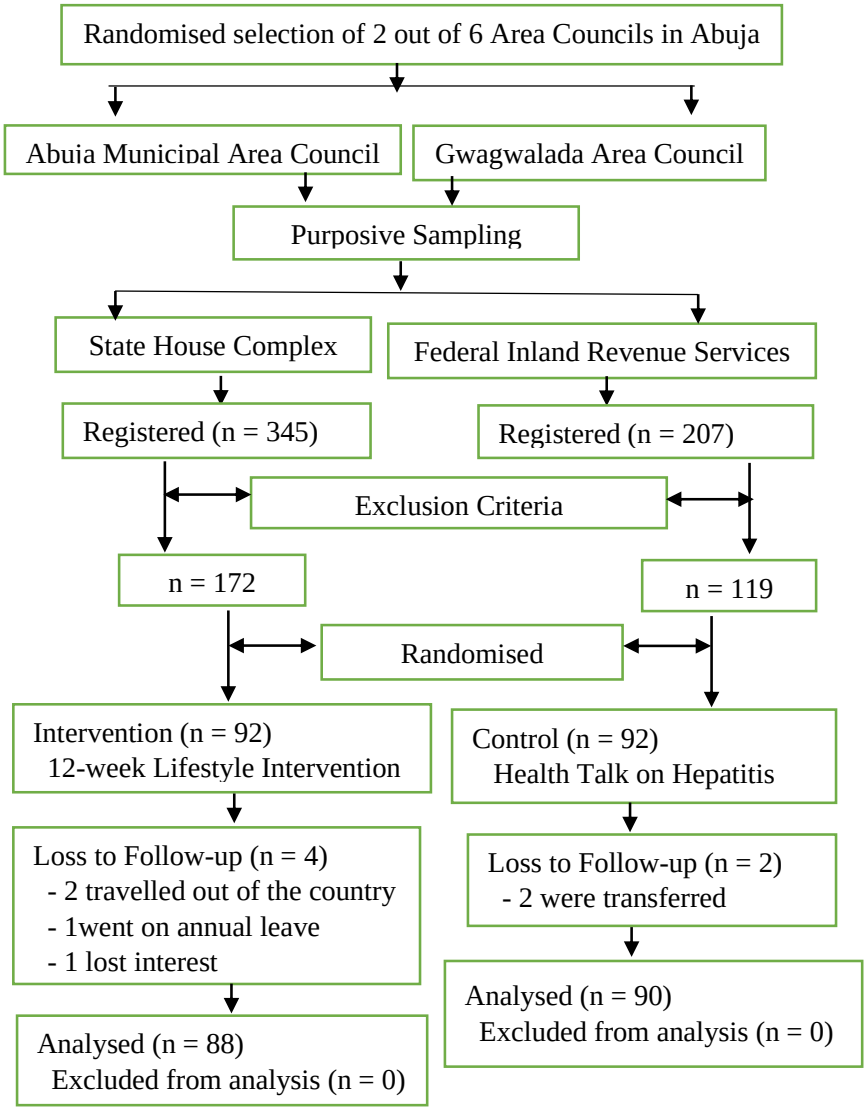

Figure 1: Flowchart of the study

Results

The Statistical Package of Social Sciences (SPSS) was used for data analysis. The descriptive statistics of frequency counts, mean, and percentages were done to describe the basic features of the collated data of the study. While the inferential

statistics of Analysis of Covariance (ANCOVA) was used to test the hypothesis. All hypotheses were tested at a 0.05 level of significance.

Results

Table 1:Demographic Characteristics of the Participants

	Intervention		Control	
	Frequency	**%**	**Frequency**	**%**
Gender				
Male	51	57.9	49	54.4
Female	37	42.1	41	45.6
Age (years)				
40 - 49	51	57.9	62	68.8
50 - 59	32	36.4	26	29.0
≥ 60	5	5.7	2	2.2

The study outcome revealed that most of the study participants were within the active age group of 40 to 49 years, while the male gender were slightly more in both the intervention and control groups.

Table 2: Effect of Workplace Health Promotion on the Body Mass Index of the Participants

	Groups	**N**	**Pre-test**		**Post-test**		
			Mean	**SD**	**Mean**	**SD**	**Mean diff.**
Body mass index (BMI)	Intervention	88	26.98		25.20	2.90	-1.78
	Control	90	26.42	3.17	26.61		0.19
					3.1	3.18	
				3.19			

* N – Number of participants, SD – Standard Deviation

The pre-test mean BMI scores of participants in the intervention and control groups were 26.98 and 26.42 respectively (Table 2). After the treatment, the intervention group had a lower mean BMI score of 25.20 compared to those in the control group (mean = 26.61, SD = 3.18). The mean difference has a negative value of -1.78 in the intervention group. Using one-way ANCOVA at 0.05 level of significance, the mean difference in the BMI was statistically significant. Hence, we can concluded that the 12-week workplace health promotion programme was effective in reducing the BMI of the participants.

Table 3: Effect of Workplace Health Promotion on the Waist Circumference of Participants

	Groups	N	Pre-test		post-test		
			Mean	SD	Mean	SD	Mean diff.
Waist circumference (cm)	Intervention	88	90.01		89.11	6.69	-0.90
	Control	90	88.59	7.18	89.14	7.17	0.55
				7.30			

* N – Number of participants, SD – Standard Deviation

The pre-test mean waist circumference scores of the participants in the intervention and control groups were 90.01cm and 88.59cm respectively (Table 3). After the treatment, the intervention group had a lower mean waist circumference score of 89.11 compared to those in the control group (mean = 89.14, SD = 7.17). The mean difference has a negative value of -0.90 cm in the intervention group. Using one-way ANCOVA at 0.05 level of significance, the mean difference of the waist circumference was statistically significant. Hence, we can conclude that the 12-week workplace health promotion programme was effective in reducing the waist circumference of the participants.

Table 4: Effect of Workplace Health Promotion on the Physical Activity Level of Participants

			Pre-test			Post-test			
	N	Groups	%	Mean	SD	%	Mean	SD	MD
≥ 30 min. of Daily Physical Activity	88	Intervention	31.8	1.32	.47	70.5	1.70	.46	0.38
	90	Control	40.0	1.40	.49	44.4	1.46	.50	0.06

* N – Number of participants, SD – Standard Deviation, MD – Mean Difference

The pre-test mean physical activity level scores of participants in the intervention and control groups were 1.32 and 1.40 respectively (Table 4). After the treatment, the intervention group had a higher mean score of 1.70 compared to those in the control group (mean = 1.46, SD = 0.50). The mean difference has a positive value of 0.38 in the intervention group. Using one-way ANCOVA at 0.05 level of significance, the mean difference in the physical activity level was statistically significant. Hence, we can conclude that the 12-week workplace health promotion programme was effective in improving the physical activity level of the participants.

Table 5: Effect of Workplace Health Promotion on the Daily Consumption of Fruits/Vegetables among the Participants

			Pre-test			Post-test			
	N	**Groups**	**%**	**Mean**	**SD**	**%**	**Mean**	**SD**	**MD**
Frequent fruit and Vegetable intake	88	Intervention	8.0	1.08		77.3	1.72	.45	0.64
	90	Control	11.1	1.11	.27	13.3	1.13	.34	0.02
					.32				

* N – Number of participants, SD – Standard Deviation, MD – Mean Difference

The pre-test mean scores of daily consumptions of fruits/vegetables of participants in the intervention and control groups were 1.08 and 1.11 respectively (Table 5). After the treatment, the intervention group had a higher mean score of 1.72 compared to those in the control group (mean = 1.13, SD = 0.34). The mean difference has a positive value of 0.64 in the intervention group. Using one-way ANCOVA at 0.05 level of significance, the mean difference of daily consumptions of fruits/vegetables was statistically significant. Hence, we can conclude that the 12-week workplace health promotion programme was effective in improving the daily fruits/vegetable consumption among the participants.

Table 6: Effect of Workplace Health Promotion on the Fasting Blood Glucose of Participants

	Groups	**N**	**Pre-test**		**post-test**		
			Mean	**SD**	**Mean**	**SD**	**Mean diff.**
Fasting blood Glucose (mmol/l)	Intervention	88	5.32		4.96		-0.36
	Control	90	5.19	0.73	5.22	0.61	0.03
				0.85		0.83	

* N – Number of participants, SD – Standard Deviation, MD – Mean Difference

The pre-test mean fasting blood glucose (FBG) scores of participants in the intervention and control groups were 5.32 and 5.19 respectively (Table 6). After the treatment, the intervention group had a lower mean score of 4.96 than those in the control group (mean = 5.22, SD = 0.83). The mean difference has a negative value of -0.36 in the intervention group. Using one-way ANCOVA at 0.05 level of significance, the mean difference in the FBG was statistically significant. Hence, we can conclude that the 12-week workplace health promotion programme was effective in reducing the fasting blood glucose of the participants.

Table 7: Effect of Workplace Health Promotion on the Type 2 Diabetes Risk Score of the Participants

Groups	N	Pre-test		post-test		
		Mean	SD	Mean	SD	Mean diff.
Intervention	88	7.82	4.90	6.06	3.79	-1.76
Control	90	6.43	4.57	6.71	4.77	0.28

* N – Number of participants, SD – Standard Deviation

The pre-test mean Type 2 Diabetes Risk score of the participants in the intervention and control groups were 7.82 and 6.43 respectively (Table 7). After the treatment, the intervention group had a lower mean type 2 diabetes score of 6.06 compared to those in the control group (mean = 6.71, SD = 4.77). Using one-way ANCOVA at 0.05 level of significance, the mean difference (-1.76) in the Type 2 Diabetes Risk score of the intervention group was statistically significant. This result indicate that the 12-week workplace health promotion programme wasan effective in reducing the type 2 diabetes risk score of the participants.

Summary of Findings

The body mass index (BMI), waist circumference, physical activity level, rate of daily consumption of fruits/vegetables, fasting blood glucose level, and the type 2 diabetes risk score of the participants improved after a 12-week workplace health promotion programme. Using one-way ANCOVA at 0.05 level of significance, all the changes were statistically significant.

Discussion of Findings

The result of the demographic distribution of the study (Table 1) revealed that the male and female participants in the intervention group were 57.9% and 42.1% respectively, while those in the control group were 54.4 and 45.6 respectively. In terms of age distribution, the majority, 94.3% and 97.8%, of the participants in the intervention and control groups respectively were in the working-age group of less than 54 years of age. According to the DF (2017), the global prevalence of diabetes mellitus is slightly more in the male gender below 69 years compared to the female gender. Since ageing is an independent risk factor for T2DM, workplace health promotion provides an opportunity to implement diabetes prevention measures in the middle-aged majority workforce.

As observed in table 2, after the workplace health promotion programme, the mean changes in the body mass index (BMI) of the intervention group was -1.78, while that's of the control group increased by 0.19. This result is similar to the reports of most previous studies. A study that investigated the effects of health promotion programme on the health risks of American adults, noticed a significant mean change of -0.42 in the BMI of the intervention group (Aldana *et*

al., 2005). Since overweight and obesity have been categorized not only as major but also as one of the three most significant risk factors for Type 2 diabetes mellitus (T2DM) (Alberti, Zimmet, & Shaw, 2007;WHO, 2016), any intervention that significantly reduces BMI may likely reduce the risk of developing T2DM among the participants.

After the treatment, the mean changes in the waist circumference of the intervention group were -0.90 cm while that's of the control group increased by 0.55 cm (Table 3). This result is similar to the reports of most previous studies. A randomized control trial that was conducted by Bo *et al.* (2007) to determine the effect of a health promotion programme on metabolic syndrome shows that after the treatment, there was a significant waist circumference reduction of -2.55 cm among the intervention group, while the waist circumference of the control group increased by 1.96 cm.

The three most significant behavioural factors that predispose people to T2DM are overweight/obesity, abdominal obesity, and physical inactivity (Alberti, Zimmet,& Shaw, 2007). Waist circumference positively correlates with abdominal fat content, while the presence of excess fat in the abdomen out of proportion to total body fat is an independent risk factor for T2DM(WHO, 2008). Furthermore, series of epidemiological studies have shown a positive correlation between high waist circumference and increased risk for T2DM; the increased risk is valid even in people with normal BMI (National Institute of Health, 1998). To this end, the IDF (2015) recommended interventional measures that reduce the unhealthy behavioural factors implicated in the accumulation of excess abdominal fat, as important in T2DM prevention.

The post-intervention mean changes in the physical activity level of the intervention group statistically significantly improved by 0.38, while that's of the control group was 0.06 (Table 4). This result is similar to the reports of most previous studies. A randomized control trial that was conducted by Bo *et al.* (2007) to determine the effectiveness of a structured health promotion programme on metabolic syndrome shows that after the treatment, there was a significant improvement in the physical activity level of the intervention group by 4.73, while that's of the control group reduced by -0.26. According to the IDF (2015), the increasing global prevalence of T2DM is associated with an equally increasing prevalence of physical inactivity. Physical inactivity is also recognized as one of the most important risk factors for T2DM (Alberti, Zimmet, & Shaw, 2007; IDF, 2015). To this end, the Diabetes United Kingdom (2009) have recommended that all the people that are identified as 'at-risk' of developing T2DM should reduce their sedentary lifestyle and ensure they engage in adequate physical activity.

The post-intervention mean changes in the level of daily consumption of fruits/vegetables in the intervention group statistically significantly improved 0.64, while that's of the control group was 0.02 (Table 5). This result is similar to

the reports of most previous studies as well. An intervention study that was conducted by Merrill *et al.* (2008) on American population revealed that after health promotion intervention, the mean fruits/vegetable intake at baseline was 8.2; this improved to 14.2 after 6 weeks, and further to 16.8 after 18 months' post-intervention. In most countries, the prevalence of T2DM has increased alongside rapid cultural and social changes like ageing populations, increasing urbanization, reduced physical activity, increased sugar consumption, and low fruit and vegetable consumption (IDF, 2015). Furthermore, an unhealthy diet, like irregular intake of vegetables and fruits, is an identified risk factor in the development of T2DM (Alberti, Zimmet,&Shaw, 2007). For this reason, one of the recommended lifestyle practices for T2DM prevention is to regularly consume varieties of fruits and vegetables (IDF, 2015).

The post-intervention mean changes in the fasting blood glucose (FBG) level of the intervention group was a negative value of -0.36 mmol/l, which was statistically significant, while within the same period, the mean FBG level of the control group slightly increased by 0.03 mmol/l (Table 6). This result is similar to the reports of most previous studies. A health promotion intervention study that was conducted by Prabhakaran *et al.*(2009) on Indian workforce revealed that after the treatment, the blood glucose in the intervention group reduced by -9.4%. It has been noticed that people with impaired glucose tolerance (raised blood glucose levels that are not high enough for a diagnosis of diabetes mellitus) are at increased risk of developing T2DM (IDF, 2015). However, a large body of scientific-evidences indicates that the progression of high blood glucose or pre-diabetes to T2DM can be mitigated by the adoption of effective healthy lifestyle practices and lifestyle modification (Diabetes United Kingdom, 2009; IDF, 015).

As seen in Table 7, the post-intervention mean changes in the type 2 diabetes risk score of the intervention group was a negative value of -1.76, which was statistically significant, while within the same period, the mean type 2 diabetes risk score of the control group increased by 0.28. As informed by Ishaque, Shahzad, Muhammad, Usman, and Ishaque (2016), diabetes risk scoring system is a simple and cost-effective method of identifying people with undiagnosed type 2 diabetes or at risk of developing diabetes in the future. The Diabetes United Kingdom (2009); IDF (2015) further informed that the general population should be subjected to routine type 2 diabetes risk scoring system, while the people with elevated risk score can then be screened properly for diabetes using a blood test. Type 2 diabetes risk scoring system, like the FINDRISC, is also an effective objective method of monitoring the progress of people in their attempts to reduce the risk of developing T2DM after a specific period of time.

Conclusion

The study concluded that a well-structured workplace health promotion programme is an effective intervention measure that is capable of significantly reducing the lifestyle-related risk factors that are implicated in the rising prevalence of type 2 diabetes mellitus (T2DM). The cumulative reduction in the relative risk of developing T2DM will likely lead to the significant reduction of Type 2 diabetes risk score, and by extension reduce the risk of developing type 2 diabetes mellitus. Subsequently, the researchers recommended the followings:

1. Relevant governmental and non-governmental agencies and individuals stakeholders should embark on public health campaigns to educate the workforce in the country on the role that obesity (especially truncal obesity), physical inactivity, unhealthy diets (especially poor consumption of fruits/vegetable),and other risk factors plays in the increasing burden of T2DM.
2. All organisations and institutions in Nigeria, should engage the services of health educator/promotion specialists, with the mandate of conducting regular diabetes risk assessment (especially using the FINDRISC scoring system) and workplace health promotion programmes. The programme should emphasize the knowledge and skills needed to effectively reduce the risk factors that are implicated in the development of T2DM.
3. All organisation and institution in Nigeria should enact policies, and ergonomics that discourage unhealthy lifestyle in the workplace.

Conflict of Interest

The authors declare no conflict of interest

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References

Alberti K. G. M. M, Zimmet P. & Shaw J. (2007), International diabetes federation: A consensus on type 2 diabetes prevention. *Diabetic Medicine, 24*, 451–463.

Aldana S. G., Greenlaw R. L., Diehl H. A., Salberg A., Merrill R. M, Ohmine S., & Thomas C. (2005). Effects of an intensive diet and physical activity modification program on the health risks of adults. *Journal of the American Dietetic Association, 105* (3), 1 – 20.

Bo S. 1., Ciccone G., Baldi C., Benini L., Dusio F., Forastiere G., … Pagano G. (2007). Effectiveness of a lifestyle intervention on metabolic syndrome. A randomized controlled trial. *Journal of General Intern Medicine., 22*(12), 1695 – 703. http://DOI:10.1007/s11606-007-0399-6.

Diabetes United Kingdom (2009). *Prediabetes - preventing the type 2 diabetes epidemic*. Retrieved fromhttp://www.diabetes.org.uk/Prediabetes-Preventing-Type-2-DM-epidemic.pdf.

Federal Ministry of Health, Nigeria (2015). *National strategic plan of action on prevention and control of non-communicable diseases*. Access date: 31/12/2018. https://www.medbox.org/Nigeria-national...prevention-and-control...non-communicablediseases.pdf.

Franklin, B. A. & Cushman, M. (2011). Recent advances in preventive cardiology and lifestyle medicine. *Circulation, 123*, 2274 – 2283. http://DOI:10.1161/CIRCULATIONAHA.110.981613.

International Diabetes Federation (2015). *IDF diabetes atlas 7th ed.* . Access date:12/6/2017. http://www.oedg.at/pdf/1606_IDF_Atlas_2015_UK.pdf.

International Diabetes Federation (2017). *IDF diabetes atlas 8thed.*. Access date: 23/10/2018.https://diabetesatlas.org/resources/2017-atlas.html.

Ishaque A., Shahzad F., Muhammad F. H., Usman Y., & Ishaque Z. (2016). Diabetes risk assessment among squatter settlements in Pakistan: A cross-sectional study. *Malaysia Family Physician, 11*(2 & 3), 9 – 15.

Kones, R. (2011). Is prevention a fantasy, or the future of medicine? A panoramic view of recent data, status, and direction in cardiovascular prevention. *Therapeutic Advances in Cardiovascular Diseases, 5* (1), 61 – 81. https://DOI:10.1177/1753944710391350.

McLellan K. C. P., Wyne K., Villagomez E. T., & Hsueh W. A. (2014). Therapeutic Interventions to reduce the risk of progression from prediabetes to type 2 diabetes mellitus. *Therapeutics and Clinical Risk Management, 10*, 173 – 188.

Merrill R. M., Aldana S. G., Greenlaw R. L., Diehl H. A., Salberg A., & Englert H. (2008). Can newly acquire healthy behaviors persist? An analysis of health behavior decay. *Prevention of Chronic Diseases, 5* (1), 1 – 13.http://www.cdc.gov/pcd/issues/2008/jan/07_0031.htm.

National Bureau of Statistics (2010). *National manpower stock and employment generation survey, 2010 Abuja*. National Bureau of Statistics Headquarter Complex.

National Institute of Health (1998). *Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: The evidence report*. Access date: 5/6/2016.https://www.nhlbi.nih.gov/files/docs/guidelines/ob_gdlns.pdf.

Prabhakaran D., Jeemon P., Goenka S., Lakshmy R., Thankappan K. R., Faruq A. F., … Reddy K. S. (2009). Impact of a worksite intervention program on cardiovascular risk factors: A demonstration project in an Indian industrial population. Journal of *America College of Cardiology, 53*(18), 1718 – 1728. https://DOI:10.1016/j.jacc.2008.12.062.

Ryde´n L., Stand E., Bartnik M., Van den Berghe G., Betteridge J., de Boer M., … Thrainsdottir I. (2007). Guidelines on diabetes, pre-diabetes, and cardiovascular diseases: The task Force on diabetes and cardiovascular diseases of the European Society of Cardiology (ESC) and of the European Association for the Study of Diabetes (EASD). *European Heart Journal Supplements, 9*, 3 – 74. https://DOI:10.1093/eurheartj/ehl261.

Sorensen, G., Landsbergis, P., Hammer, L., Amick III, B. C., Linnan, L., Yancey A., … Pratt, C. (2011). Preventing chronic disease in the workplace: A workshop report and recommendations. *American Journal of Public Health, 101*, 196 – 207.

Wilson, P. W. F. (2016). *Estimation of cardiovascular risk in an individual patient without known cardiovascular disease*. Access date: 14/3/2017.http://www.uptodate.com/contents/estimation-of-cardiovascular-risk-in-an-individual-patient-without-knowncardiovascular-disease.pdf.

World Health Organization (2008). *Waist circumference and waist-hip ratio: Report of a WHO expert consultation*. Access date: http://apps.who.int/iris/bitstream/10665/44583/1/9789241501491_eng.pdf.

World Health Organization (2011). *Global status report on non-communicable diseases 2010*. Retrieved from http://apps.who.int/iris/bitstream/10665/ 44579/1/9789240686458_eng.pdf.

World Health Organization (2016). *Preventing disease through healthy environments: A global assessment of the burden of disease from environmental risks*. http://apps.who.int/iris/bitstream/10665/204585/1/9789241565196_eng.pdf?ua=1.

World Health Organization (2018). *Non-communicable diseases country profiles 2018*. Access date: 5/6/2019.https://www.who.int/nmh/publications/ncd-profiles-2018/en/.