Sys Rev Pharm 2022; 13(12): 833-839
A multifaceted review journal in the field of pharmacy
N 0976-2779 P-ISSN 0975-8453 / DOI: 10.31858/0975-8453.13.12.833-839

Research Article

Effect of Educational Intervention on Modifiable Risk Factors of Metabolic Syndrome among Middle-Age Nekemte Populations: Quasi-Experimental Study

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Article History: *Submitted: 01.11.2022* *Accepted: 25.11.2022* *Published: 02.12.2022*

ABSTRACT

Background: Unhealthy lifestyles are potential risks for development of metabolic syndrome; however effect of educational intervention on modifiable risk factors of metabolic syndrome did not stated in west Ethiopia.

Objective: To evaluate the effect of healthy lifestyle education intervention on modifiable risk factors of metabolic syndrome.

Materials and methods: A quasi- experimental design (pretest-posttest method with control group) was applied from 1st February to 30th of July, 2019 on middle-aged Nekemte populations of Western Ethiopia. Intervention group received healthy lifestyle educations while nothing given for control. The prevalence of metabolic syndrome was measured at baseline and post of six month intervention. Statistical significant was described at p<0.05.

Results: Common modifiable behavioral and physiological risk factors metabolic syndrome measured at baseline and post-test. A total 266 were included at baseline and 257 participants were completed the intervention period. Study showed the overall prevalence of metabolic syndrome and associated factors changed in six months of intervention. The prevalence of metabolic syndrome and elevated blood pressure declined by 2.36% and 4.79% respectively as compared to baseline. Similarly the mean of central obesity and systolic BP decreased by 1 ± 1.1 (P=0.001) and 0.46 ± 3.06 respectively. Six-month post intervention, also showed a significantly more likely to present with high triglycerides (OR: 74.15; 95% CI; p<0.001) and low HDL-cholesterol (OR: 22.58; p<0.001) in control group.

Conclusion: This educational intervention on healthy lifestyle significantly improves the prevalence of modifiable risk factors metabolic syndrome. These findings indicate that large scale community based structured and intensive intervention is the research outlook.

Keywords: Metabolic syndrome, HDL-cholestrol, Blood pressure

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INTRODUCTION

Nowadays metabolic disturbance is global issue (Alberti KG, *et al*., 2009); however early diagnosis at community level not adopted (Blaha MJ, *et al*., 2008; Grundy SM, *et al*., 2005). Health is an essential attainment in human life to improve quality of life and avoid chronic diseases and reduce premature death (Kieny MP, *et al*., 2017). The individuals' lifestyles and choices are necessary to be healthy and enhance life (Nies MA and McEwen M, 2014; Zeidi MI, *et al*., 2012).

Unhealthy lifestyle factors are known potential risks for development of metabolic syndrome (Trinh OT, *et al*., 2010; Duc Son LE, *et al*., 2004), special in developing countries. Having one or more: unhealthy diet, tobacco use, risk alcohol drinking, and physical inactivity increases mortality risk (Loef M and Walach H, 2012; Hoevenaar-Blom MP, *et al*., 2014; Gómez DM, *et al*., 2013).

Lifestyle intervention reduce metabolic risk development (Yamaoka K and Tango T, 2012; Mohamed SA, 2014; Muchiri JW, *et al*., 2016; Makrilakis K, *et al*., 2012). Healthy diet and physical activity in reducing rates of disability and death from chronic diseases has been well established in developed countries (McNulty J, 2013). Optimal health and wellness are achieved when patients adopt positive lifestyle behaviors (Kushner RF, *et al*., 2014).

The magnitude of metabolic syndrome is rapidly increasing globally across populations (Oguz A, *et al*., 2008) and almost one-quarter of the adults have metabolic disorder (IDF, 2006). The prevalence of metabolic syndrome varies, ranging from <10% to 84%, depending on the region, sex, age and ethnicity of the population being studied (Alberti KG, *et al*., 2009; Blaha MJ, *et al*., 2008; Grundy SM, *et al*., 2005). In Africa, the prevalence of chronic diseases increasing in alarming rate that poses a great public health challenge in Sub-Saharan Africa (Motala A and Ramaiya K, 2010).

This scenario was amended by different studies in Ethiopia (Sinaga M, *et al*., 2018; Abrha S, *et al*., 2016; Tefera G, 2014; Abda E, *et al*., 2016; Asfaw HA, *et al*., 2015; Tolu G, *et al*., 2016; Tran A, *et al*., 2011). Still, there are insufficient data regarding effect of healthy lifestyle education on prevalence of metabolic syndrome and physiological risks in west Ethiopia. This study evaluated the effect of six month healthy lifestyle educational intervention on modifiable risks factors of metabolic syndrome among middle-aged Nekemte populations in western Ethiopia.

MATERIALS AND METHODS

Study design

A quasi-experimental independent samples pretest and post assessment group design was applied to evaluate the change because of education between intervention and control group on metabolic syndrome and its modifiable risks among middle aged urban residents. The education was given from 1 February to 30 July 2019 for intervention group and post-test data was collected in august 2019.

Recruitment of participants and sampling techniques

We determined the sample size for each objectives using information from different literatures and the largest value will be taken to conduct the study. The minimum sample size was calculated using single proportion formula taking prevalence of dependent variable among healthy Ethiopian adults. According to IDF, 2018,

the most common prevalent was abdominal obesity with 19.6%. So, with margin of error of 5%, a confidence level of 95% and 10% gnawing away, minimum sample of 266 participants.

From six communes of Nekemte city, one commune was randomly selected and the other purposively allocated with buffering zone through natural geographical boundary to avoid information contamination. Grouping participants, (n=133) were grouped into intervention and under planned healthy lifestyle education for a period of 6 months. Education was presented to the participants using teaching aids by professionals. During the training sessions, a guide to improving healthy lifestyles for the adults, like healthy diet, physical activity, smoking, risk alcohol and chat; as well as metabolic syndrome facts listed in the training manual were given for intervention group with command.

Operational definition

Metabolic syndrome status was determined using the new clinical definition of the metabolic syndrome given by International Diabetes Federation (IDF), 2018. It requires the presence of the following: Central obesity as defined by: (Waist circumference ≥ 90 cm in male, female ≥ 80 cm; Plus any two of the following four factors) ; Raised triglycerides (≥ 150 mg/dL); Reduced HDL-C (<40 mg/dL for males, < 50 mg/dL for females); Raised blood pressure (systolic ≥ 130 mm Hg or diastolic ≥ 85 mm Hg); Raised plasma glucose (fasting plasma glucose >100 mg/dL) (Kaur J, 2014; Allain CC, *et al*., 1974; WHO, 2005;WHO, 2008; Alberti KG, *et al*., 2009).

System of interventional organization

There is strong evidence showing that chronic diseases can be prevented and controlled through comprehensive and integrated actions. Having this, a community based healthy lifestyle education for reducing risk of developing metabolic syndrome and its compartments. The intervention comprises leaflet, healthy lifestyle education sessions, attending mass walking that provide information and encourage participants to improve their physical activity and healthy eating behaviors during the three months period. The control group participants will receive standard/routine health information and one time advice during baseline.

Measurements were taken at baseline and post intervention to evaluate program effectiveness and improvement of health related quality of life. Meaning, quasi-experimental designs with untreated nonequivalent control group designs with pretest-post-test. During education sessions the participants (n=133) in intervention commune was divided into four groups, that is, 33 participants per group and one general leader. Systematically; the team, single group and whole group were organized to control process.

Eligible criteria

All adults aged 41-64 years were selected while individuals receiving medication for NCDs; have taken part in any behavioral change program; pregnant/current lactating women; serious mental conditions; bariatric surgery; use of weight-impacting medication and physically disables was excluded.

Data collection and analysis

Data were collected by the World Health Organization Stepwise approach for non-communicable disease surveillance (Grave DR, *et al*., 2010). First, necessary information were collected by a structured questionnaire. At phase two anthropometric measurements taken by using SECA weight measuring scale, measuring tape at the midpoint of the inferior margin of the last rib and the iliac crest at the end of expiration (Weigensberg MJ, *et al*., 2014), and Blood pressure were measured by sphygmomanometer from the right arm after participants rested for 5 minutes. At third phase for the biochemical analysis, 5 milliliters fasting venous blood was taken from each study participant. After allowing the formation of clots by staying the whole blood for 30 minutes, the serum was separated by centrifuging the clotted blood at 3,000 revolutions per minute. Blood glucose and lipid profiles were determined from serum blood using the DIRUI CS-T240 Auto chemistry analyzer by laboratory technologists following the standard operating procedures.

The data were collected at baseline and end line then checked, entered into a pre-drafted coding sheet on Epi-info software (version 3.5.3) by two different data clerks and analyzed using SPSS software (version 24, SPSS Inc., Chicago, IL, USA). Besides with the normality and abnormality distribution of data: descriptive statistics and inferential statistical tests were used. All linear variables with normal distribution are expressed as mean ± SD scores. Binary logistic regression determines the odd ratio between effect of healthy lifestyle education and presence/absence of metabolic syndrome. The effectiveness of the education was evaluated by comparing intervention that has taken education and comparison groups for the outcome measures. Significance level was considered at alpha as <0.05.

Data quality management

Questionnaires are prepared in English, and translated to Afan Oromo and back to English by experts of the language to keep its consistency. Training was given for data collectors and supervisors on the tools and data collection methods by the Principal investigators. Monitoring of intervention implementation was conducted by principal investigator and supervisors. Filled questionnaires were checked for completeness and entered to software. To keep data quality and avoid measuring bias, the study objective and hypothesis were hidden from data collectors.

RESULTS

Baseline socio-demographic and lifestyle behaviors of participants

Two hundred sixty six undiagnosed participants for metabolic syndrome, of those majorities (62.8%) of them were females. The average age of adults was 52.2 years and those aged between 41-64 years accounted for 54.5%. Regarding to income, more than half (54.89%) of the participants were live below poverty threshold (<$1.25/day) (Baseline data).

Besides socio demographic, healthy lifestyle behavior were assessed, accordingly few of participants (2.3%) were currently smoking cigarette, 9.8% of participants currently drink risk alcohol and 1.1% chew khat. Large proportion of participants (91.0%) was engaged in low physical activity. Similarly, more than half (68%) of them consumed unhealthy diet and 75.2% of them had in adequate sleep pattern or deprived (Baseline data).

Effect of community based education on lifestyles practices

Two hundred fifty three (95.11%) of the participants completed the six month intervention from 266 samples. Comparatively high dropout (6.02%) was seen in control group than intervention. The number of current smoker in intervention group reduced from 3.8% to 2.3%. Similarly, current alcohol drunker withdraws by 9.4% from 11.3% and chat chewer declined from 1.5% to 0.8%. Besides the four major modifiable lifestyles factors, the prevalence of inadequate sleeping pattern decreased by 19.5% among intervention group during post-test (*Table 1*).

The dietary diversity intake of control group at six month post-test was almost similar to baseline. However, there was slight deviation on the intervention meaning middle aged Nekemte residents regarding to consuming healthy diet like fruits (44.53%), vegetables (53.91%) and 60.16% did not consume saturated fat showed change (*Table 2*).

Table 1: Effect of educational intervention on lifestyle factors, Nekemte, West Ethiopia, 2019

Intervention group					Control group		
Variable	**Categories**	**Pre-test (%)**	**Post-test (%)**	**p**	**Baseline**	**Post-test (%)**	**p**
DDS	Low: <7 group	127(95.5)	90(70.3)	<0.001	130(97.7)	114(91.2)	<0.001
	High: ≥ 7 group	6(4.5)	38(29.7)		3(2.3)	11(8.8)	
Physical activity	Low	120(90.2)	66(51.6)	0.184	122(91.7)	103(82.4)	0.369
	High	8(9.8)	62(48.4)		11(8.3)	22(9.6)	
Smoking	Currently	5(3.8)	1(0.8)	<0.001	1(0.8)	1(0.8)	<0.001
	Quit	12(9)	9(6.8)		9(6.8)	6(4.8	
Risk alcohol	Currently	15(11.3)	11(8.3)	0.166	11(8.3)	9(7.2)	0.001
	Quit	28(21.1)	12(9)		12(9)	11(8.8)	
Khat	Currently	2(1.5)	1(0.8)	0.408	1(0.8)	0	<0.001
	Quit	13(9.8)	5(3.8)		5(3.8)	6(4)	
Sleep	<6 hrs/day	81(60.9)	53(41.4)	0.13	119(89.5)	102(81.6)	0.279
	6-9 hrs/day	52(39.1)	75(58.6)		14(10.5)	23(18.4)	

Table 2: Proportion of food groups consumed at least once in the last day before post-test by Nekemte populations, Western Ethiopia, 2019

Food groups	Intervention (%)		p	Control (%)	p
Fruits (Papaya, mango, avocado, banana, pineapple, oranges)	Yes	57(44.53)	0.004	12(9.6)	0
	No	12(55.47)		113(90.4)	
Vegetables (Carrots, tomato, green leafy vegetables)	Yes	59(53.91)	0.717	35 (28%)	0.286
	No	69(46.09)		90(72%)	
Tuber and root (Potato, sweet potato, anchote, kocho, cassava)	Yes	50(39.1)	0.001	39 (68.8)	0.091
	No	78(60.9)		86(90.4)	
Cereals (Teff, wheat, sorghum, barley, maize, rice, millet)	Yes	128(100)	0	125(100)	0
	No	0		0	
Legumes and pulses (pea, beans, soybean, lentils, nut, niger seed)	Yes	95(74.22)	0.983	90(72)	0.001
	No	33(25.78)		35(28)	
Meat products (Beef, eggs, mutton , fish, chicken)	Yes	30(23.44)	0.727	2(1.6)	0.336
	No	98(76.56)		123(98.4)	
Saturated fat (clotted oil, animal butter)	Yes	51(39.84)	0.095	89(71.2)	0.215
	No	79(60.16)		36(28.8)	
Dairy products (Milk, yogurt, cheese)	Yes	10(7.8)	0.614	2 (1.6)	0.336
	No	118(92.2)		123(98.4)	
Eggs	Yes	28(21.88)	0.189	5(4)	0.495
	No	100(78.12)		120(96)	

Comparison of the mean and standard deviation scores of physiological risk factors

The differences in mean values of biological risks were seen among participants at baseline and post intervention. Among participants had taken education; waist circumference, hip circumference, systolic blood pressure, fasting blood sugar and triglycerides were showed reduction in mean and standard deviation by 1.40 ± 1.10, 2.16 ± 2.43, 0.46 ± 3.06, 1.65 ± 1.80, and 1.51 ± 2.95 respectively. While slightly mean ± SD increment was seen in control group on waist circumference, hip circumference, FBS and triglycerides as compared to intervention group (*Table 3*).

Effect of healthy lifestyle education on metabolic syndrome and its modifiable risk factors

The prevalence of metabolic syndrome declined by 2.36% among intervention group; but increased by 4.5% in control group during six month duration. Similarly, the prevalence of blood pressure decreased significantly from 15.79% to 11% (p<0.001) while only 1.05% decline seen among control group. likewise, the prevalence of high fasting blood sugar level increased significantly from 6.77% to 7.2% (p<0.001) among control group while it declined from 7.52% to 6.25% (p<0.001) in intervention group (*Table 4*).

In general, the comparison between two groups at post test showed that the prevalence of metabolic syndrome, raised blood pressure, elevated fasting blood glucose, elevated triglyceride and low HDL cholesterol were more prominent, except central obesity in the control group as compared to intervention group (*Table 4*).

Effect of healthy lifestyle education on metabolic syndrome

We determined the odd ratio between effect of healthy lifestyle education and metabolic syndrome with presence/absence by binary logistic analysis. Central obesity, body mass index, blood pressure, fasting blood sugar, triglycerides and low HDL-cholesterol were risk factors for the metabolic syndrome. The highly associated significant risk factors among intervention group was the high triglycerides (OR=12.93, p<0.0001), followed by a low HDL (OR=5.98, p=0.001), high BMI (OR=4.86, p=0.001), and high FBS (OR=0.18, p=0.021) (*Table 5*).

In the control group high triglycerides (OR=74.15, p<0.0001) was showed strong significant association with the prevalence of metabolic syndrome and followed by a low HDL (OR=22.58, p<0.0001), central obesity (OR=3.27, p=0.010), and high BMI (OR=0.22, p=0.001) (*Table 5*).

Table 3: The mean and SD scores of physiological risks, middle aged, Nekemte, Ethiopia, 2019

Variables	Intervention group (Mean ± SD)			Control group (Mean ± SD)		
	Baseline	End line	p	Baseline	Post test	p
Waist circumference	85.59 ± 7.77	84.19 ± 6.67	0.001	85.19 ± 8.96	85.60 ± 8.92	0.001
Body mass index	23.06 ± 3.59	23.28 ± 2.96	0.001	22.65 ± 3.76	22.72 ± 3.79	0.001
Hip circumference	93.32 ± 8.73	91.06 ± 11.16	0.001	93.66 ± 9.38	93.93 ± 9.40	0.001
Systolic BP	117.78 ± 15.85	117.32 ± 12.79	0.001	122.26 ± 12.07	122.08 ± 12.3	0.001
Diastolic BP	76.32 ± 9.67	78.07 ± 5.95	0.001	77.90 ± 8.19	77.72 ± 7.87	0.001
Fasting blood sugar	101.30 ± 25.51	99.65 ± 23.71	0.001	89.09 ± 33.20	98.23 ± 34.18	0.001
Triglycerides	129.66 ± 25.83	128.15 ± 22.88	0.001	133.60 ± 23.92	133.51 ± 23.80	0.001
HDL- cholesterol	54.47 ± 10.57	54.70 ± 10.56	0.001	49.62 ± 9.54	49.54 ± 9.55	0.001

Table 4: Effect of education on modifiable metabolic risk factors, urban, West Ethiopia, 2019

Variables	Intervention group				Comparison group		p-value
	Circumference	Baseline (%)	Post-test (%)	p-value	Baseline (%)	Post-test (%)	
Central obesity	≥ 90 cm/80 cm	58%	57.89%	0.093	62.41%	53.60%	0.005
	<90 cm/80 cm	42%	42.11%		37.59%	46.40%	
BMI	≥ 25 Kg/cm^2	27.82%	26%	<0.001	23.31%	23%	<0.001
	<25 Kg/cm^2	72.18%	74%		76.69%	77%	
Blood pressure	>130/85 mmHg	15.79%	11%	<0.001	21.05%	20%	<0.001
	<130/85 mmHg	84.21%	89%		78.95%	80%	
FBS	>100 mg/dl	7.52%	6.25%	<0.001	6.77%	7.20%	<0.001
	<100 mg/dl	92.48%	93.75%		93.23%	92.80%	

TG	>150 mg/dl	16%	15.79%	<0.001	19.55%	20%	<0.001
	<150 mg/dl	84%	84.21%		80.45%	80%	
HDL-cholesterol	<40/50 mg/dl	15.79%	15.63%	<0.001	23%	23.20%	<0.001
	>40/50 mg/dl	84.21%	84.37%		77%	76.80%	
Metabolic syndrome	Yes	19.55%	17.19%	<0.001	20.30%	24.80%	<0.001
	No	80.45%	82.81%		79.70%	75.20%	

Note: High waist circumference for male is >90 cm and 80 cm for female; HDL-C is <40/50 for male/female

Table 5: Binary analysis with absence or presence of metabolic syndrome at end line of middle-aged Nekemte populations in West Ethiopia, 2019

Variables	End line test for intervention, n=128						Six month post-test for control, n=125				
	Mets (N)			P	OR	95% CI	Mets (N)		P	OR	95% CI
		Yes	No				Yes	No			
High WC	Yes	19	55	0.007	0.17	0.05,0.61	23	44	0.01	3.27	1.33,8.04
	No	2	51		1		8	50		1	
High BMI	Yes	10	85	0.001	4.86	1.85,12.76	23	36	0.001	0.22	0.09,0.54
	No	12	21		1		8	58		1	
High BP	Yes	11	3	0	0.03	0.01,0.12	20	6	0	0.04	0.01,0.11
	No	11	103		1		11	88		1	
High FBS	Yes	4	4	0.021	0.18	0.04,0.77	8	1	0.001	0.03	0.01,0.26
	No	18	102		1		23	93		1	
High TGs	Yes	12	9	0	12.93	4.38,38.16	22	3	0	74.15	18.52,296.84
	No	10	97		1		9	91		1	
Low HDL	Yes	9	11	0.001	5.98	2.08,17.16	21	8	0	22.58	7.94,64.19
	No	13	95		1		10	86		1	

Note: High WC>90 cm/80 cm for male/female; High BMI>25 kg/cm^2; High BP>130/85 mmHg; High FBS >100 mg/dl; high TGs>150 mg/dl; low HDL-cholesterol <40 mg/dl/50 mg/dl for male/female

DISCUSSION

This study was given a face to face healthy lifestyle education for intervention group for six months based on social cognitive behavioral theory long term effectiveness of longitudinal study while nothing for control group rather than routine health information. The finding of the study revealed a significant reduction in the prevalence of metabolic syndrome was seen in the intervention group compared to control group.

Lifestyle intervention helps to reduce unhealthy behaviors that increase the risk of developing metabolic syndrome or individual metabolic abnormalities (Armitage P, *et al*., 2008). The study in California among Latino population showed that sedentary behavior decreased by 38% and moderate physical activity increased by 29% in the guided imagery intervention group when compared to digital storytelling intervention group (Askari F, *et al*., 2013).

In line with the study, our finding showed physical inactivity declined by 38.6% among individuals had taken healthy lifestyle education. Additionally, an improvement was also observed in intervention group in terms of sleep adequacy pattern and increased by 19.5% at six month post-test. Similar to this study, nutrition education improved dietary behavior and physical activity (Liu Y, *et al*., 2015; Hutton B and Fergusson D, 2004; TOHP Collaborative Research Group, 1992).

Previous studies confirmed lifestyle interventions have positive outcomes in metabolic parameters (Hutton B and Fergusson D, 2004; Ford ES, *et al*., 2011). The findings of the current study demonstrated constant agreement with those stated studies.

Little improvement in the blood pressure risks may have a profound impact on the population's health. Another study in America by trials of hypertension phase 1 two-kilogram weight loss over a six-month period resulted in a decline of 3.7 mmHg in systolic blood pressure.

CONCLUSION

In this study we found that systolic blood pressure in intervention groups significantly declined by 3.52 mmHg. This implies, community based lifestyle education reduce systolic blood pressure by 3.11 mmHg and improve health. Community based healthy lifestyle educational intervention targeting middle age reduces the prevalence of metabolic syndrome, improves its behavioral lifestyle and physiological factors. So, adopting in wide scale and establishing healthy lifestyle training center were recommended.

ETHICAL APPROVAL

The research protocol was approved by Jimma University; Institute of Health; Institutional Review Board (IRB; Approval No: IHRP-GD/596/2019). Individuals signed a consent form, confidentiality of the respondents was ensured and each individual had its own identification number. The results will be disseminated through publications, conference and presentations.

FUNDING

This work has drawn from a PhD dissertation and supported by the research grant of Jimma University of Institute of Health, Ethiopia.

CONSENT FOR PUBLICATION

Participants signed consent form prior to participating in the study.

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