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Effects of Multilevel Intervention in Workplace Health Promotion on Workers' Metabolic Syndrome Components

Pengaruh Intervensi Multilevel dalam Promosi Kesehatan di Tempat Kerja terhadap Komponen Sindroma Metabolik Pekerja

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Abstract

Approximately 10–30% of adult Asian people had metabolic syndrome. This study aimed to reveal effects of workplace health promotion (WHP) with multilevel interventions on workers' metabolic syndrome component. This study was conducted in 2014-2015 using quasi-experimental design with multilevel subject intervention in Indonesia. The WHP program for multilevel intervention group included 12 weeks of combined physical training, diet, health education, social support, and advocacy. The WHP program for control group included only health education. Instruments used included IPAQ, table of 24-hour food recall, physical measurement tools, and clinical laboratories. Data analysis used Marginal Homogeneity, paired sample t-test, Mc Nemar, and Wilcoxon test. WHP multilevel intervention could improve physical activity and the nutrition in accordance with diet of workers, in particular to increase the amount of fiber and a reduce cholesterol intake. The improved metabolic syndrome components due to the influence of multilevel WHP were systolic and diastolic blood pressure, and fasting blood glucose levels (p value < 0.05). Overall, workplace health promotion multilevel interventions are effective for the management of metabolic syndrome components.

Keywords: Metabolic syndrome, multilevel intervention, workplace health promotion

Abstrak

Sekitar 10-30% orang Asia dewasa mengalami sindrom metabolik. Penelitian ini bertujuan untuk mengungkap efek Promosi Kesehatan di Tempat Kerja PKDTK dengan intervensi multilevel pada komponen/penanda pekerja yang menderita sindrom metabolik. Penelitian ini dilakukan pada tahun 2014-2015 dengan menggunakan desain quasi experimental dengan intervensi subjek secara multilevel di Indonesia. Program PKDTK untuk kelompok intervensi multilevel berupa kombinasi latihan fisik, diet, pendidikan kesehatan, dukungan sosial, dan advokasi salama 12 minggu. Program PKDTK untuk kelompok kontrol hanya pendidikan kesehatan. Instrumen penelitian seperti IPAQ, *table food recall* 24 jam, alat pengukuran fisik, dan laboratorium klinis. Analisis data menggunakan *Marginal Homogeneity, paired sample t, Mc Nemar,* dan uji *Wilcoxon*. Intervensi PKDTK multilevel dapat meningkatkan aktivitas fisik dan asupan makanan yang sesuai dengan diet sindrom metabolik, khususnya untuk meningkatkan jumlah serat pangan dan pengurangan asupan kolesterol. Komponen sindrom metabolik yang membaik karena pengaruh PKDTK secara multilevel adalah tekanan darah sistolik dan diastolik, serta kadar glukosa darah puasa (nilai p < 0,05). Secara keseluruhan, intervensi PKDTK multilevel efektif untuk pengelolaan komponen sindroma metabolik pada pekerja.

Kata kunci: Sindrom metabolik, intervensi multilevel, promosi kesehatan di tempat kerja

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Introduction

A systematic review has shown that approximately 10-13% of East and Southeast Asian populations had metabolic syndrome in 2007.[1] Several studies also showed an increasing incidence of metabolic syndrome among workers.[2-4] Metabolic syndrome incidence among Indonesian workers also tends to increase, as a study conducted by Semiardji,[4] found that 24.4% of diseases among workers were related to metabolic syndrome, and Zahtamal,[5] found the prevalence of metabolic syndrome among workers was 21.58%.

Metabolic syndrome is a group of metabolic risk factors directly related to the occurrence of degenerative diseases. Patients with at least 3 of these 5 criteria may be considered to have the diagnosis. The criteria of metabolic syndrome are elevated triglyceride levels or drug treatment of these elevated levels (≥ 150 mg/dL [≥ 1.7 mmol/L]); reduced high density lipoprotein (HDL) cholesterol levels or drug treatment of these reduced levels (< 40 mg/dL [1.0 mmol/L] in men; < 50 mg/dL [1.3 mmol/L] in women); elevated blood pressure or treatment of hypertension (systolic 130 mmHg and/or diastolic ≥ 85 mmHg); elevated fasting glucose levels or treatment with antihyperglycemic medications (≥ 100 mg/dL); and elevated waist circumference (defined as waist circumference ≥ 90 cm for Asian men and ≥ 80 cm for Asian women).[6]

Many factors were associated with the metabolic syndrome onset as a trigger of degenerative diseases, among other job factors, which included sedentary lifestyle, unhealthy diet, smoking, stress, and so on. Many workers complained about getting fatter without realizing the calories they overconsumed, which were usually due to snacking or eating too much. As they had less physical activities to offset any hoarded calories, the hoarding would lead to fat accumulation.[7]

In order to overcome workers' health problems, occupational health act is considered necessary to reduce morbidity and mortality of occupational or work related diseases, for example, working health promotin (WHP) activities which are conducted specially to change behavior. Most WHP implementation at companies in Indonesia is aiming merely at workers (conventional approach). Instead, WHP implementation in behavioral change interventions in workplace should be a comprehensive approach. This comprehensive approach is intended to integrate several models of behavior change in overall context, so in this case, the involved parties and the predictors were used as measures of behavioral changes. The parties that would be the subjects and targets of the health promotion were multilevel, including primary, secondary and tertiary targets.[7] The WHP program for multilevel intervention group included 12 weeks of combined physical training, diet, health education, social support, and advocacy.

This study was conducted to identify the differences of behaviour (physical activity and food intake) and metabolic syndrome components on workers before and after WHP. The study was intended to contribute to the company and especially to occupational health practitioners in implementing WHP with multilevel interventions, particularly for metabolic syndrome management.

Method

This study was a quasi-experimental design with non-equivalent control group design. This study was conducted in two companies with high prevalence of metabolic syndrome cases that are oil refining and plantation company. Most of jobs at both companies are already facilitated with high technology equipment to support the company performance. This situation leads to a working environment with less physical activity. Subjects in this study were employees at both companies, with the inclusion criteria of those suffering metabolic syndrome diagnosed by physician of the company, either men or women, and willing to be a participant. Furthermore, the exclusion criteria was for those suffering from muscle and bone defects, heart disease, asthma triggered by physical activity, severe illness requiring hospitalization, and suffering or consuming drugs that affect body composition; such as Cushing syndrome, type-1 diabetes mellitus, and hypothyroidism. On the other hand, the dropout criteria were applied for any subject who did not follow the program for 12 weeks due to death, and refusing or otherwise ceasing to become participants. Subjects were divided into two groups namely group 1 with WHP multilevel intervention in company A, and group 2 with conventional WHP interventions in company B. The number of participants (both in group 1 and 2) was determined in accordance with quota sampling, with about 20 workers in each group. It was based on empirical evidence and previous studies confirming that a learning process with the number of participants of 10-20 persons would be effective and efficient to influence behavior through face-to-face learning and intervention in a relatively long period of time and in groups.[8-10] The number of participants who joined the study in group 1 was 14, and group 2 was 20, thus, the participation rate of the sample in this study was 85%.

Instruments utilized in this study were International Physical Activity Questionnaire (IPAQ), table of 24-hour food recall, checklist of metabolic syndrome marker monitoring and tools for checking blood glucose and lipid profile. Variable data were processed to determine the quantitative description. In particular, food intake data were processed using Nutrisurvey program.[11] To see the effectiveness of different models of WHP, paired t-test was also performed only if the data were normally dis-

tributed. Otherwise, Wilcoxon test would be preferred. This study used statistical significance of $p < 0.05$.

In group 1, the intervention targets were intended to be multilevel, which consisted of tertiary target, head of the company; secondary target, family members, health workers and other supportive personnels (fitness instructors and food handlers); and primary target, workers suffering from metabolic syndrome. Intervention for the head of the company was carried out through advocacy. The advocacy was implemented in order that the leaders of the companies would provide facilities or opportunities to allow workers to carry out any metabolic syndrome management program, and optimize particular policies related to workers' metabolic syndrome management. The advocacy material included pre-survey data (the number of workers suffering from metabolic syndrome) and manuscript of policy briefs on the importance of metabolic syndrome management among workers. Advocacy was implemented at the beginning of the intervention in the form of discussion and lobbying to the head of the company.

On the other hand, family members, the secondary target, were provided with lectures and personal counseling conducted in early intervention. Furthermore, the intervention was continued with collaborative learning in week 7. Also interventions on health workers, fitness instructors and food handlers were implemented in the form of discussion and information sharing about metabolic syndrome management among workers. The activities were carried out at the beginning of intervention and when considered necessary. These intervention methods aimed at giving the workers social support to perform metabolic syndrome management.

Furthermore, the intervention on workers in form of health education was conducted through giving lectures and sharing printed information (handbooks and leaflets) on guidance to physical exercises and diet for metabolic syndrome management. These methods were expected to improve the workers' components of behavior (knowledge, attitude, subjective norm, self-efficacy, intention, and practice). Afterward, the intervention was continued with mentoring the process of metabolic syndrome management for 12 weeks. Process mentoring conducted comprised several activities such as discussion groups, personal counseling, skills training, demonstration, and reinforcement. Education was also performed in the form of collaborative learning which was conducted in the 7th week of intervention.

WHP activities for group 2 utilized conventional approach, in which the target was only the workers. The group was provided with an intervention in the form of health education lectures. In this activity, the participants shared some informative guidance to physical exercises and diet management. After providing them with health education, the participants were only observed (without any intervention) for 12 weeks.

Results

The average age of participants in group 1 was 50.5 years old (24-54 years) and group 2 was 47.5 years old (33-53 years). Applying Mann-Whitney test showed that there was no statistically significant difference in age among both groups (p value = 0.20). Based on the education variable, the most participants in group 1 were high school educated (78.6%), and the other ones in group 2 were college educated (50%). Moreover, chi-square test result also showed that there was no statistically significant difference of education level among them.

WHP influenced the food intake of both groups. There was an increase dietary fiber intake (gram) and decreased intake of cholesterol (mg) to workers who have metabolic syndrome, particularly in the intervention group who were given a multilevel WHP (Table 1). Especially for the average intake of dietary fiber in group 1, in which there was significant difference before and after the intervention (p value = 0.028). Although, most categories of nutrient intake (protein, carbohydrate, fat, SAFA, dietary fiber and cholesterol) of both groups, before and after the treatment, were not in accordance with the diet. In addition, nutrient intake category for polyunsaturated fatty acids (PUFA) and monunsaturated fatty acids (MUFA) in both groups, either before or after the treatment, was in accordance with the diet (Table 1 and Table 2). However, in absolute amount, group 1 had an increase in the category in which saturated fatty acids

Table 1. Results of the Wilcoxon Test for Food Intake (Fiber and Cholesterol)

Nutrient	Location	Category of Intake		p Value
		Pre-test	Post-test	
Fiber (gr)	Multilevel WHP	8.30 ± 2.10	10.20 (7.40 - 17.60)	0.028
	Conventional WHP	9.14 ± 3.31	10.15 (6.60 - 26.90)	0.232
Cholesterol (mg)	Multilevel WHP	313.81 ± 133.53	239.95 (166.00 - 561.00)	0.683
	Conventional WHP	200.85 (61-593)	239.80 ± 134.83	0.502

WHP = Working Health Promotion

Table 2. Results of the McNemartest for Dietary Intake

Types of Nutrients	Location	Category Intake			Total	p Value
		Pre-test	Post-test			
			NAWD	AWD		
Protein	Multilevel WHP	NAWD	8	1	9	1.000
		AWD	2	3	5	
	Conventional WHP	NAWD	5	6	11	0.754
		AWD	4	5	9	
Carbohydrate	Multilevel WHP	NAWD	13	0	13	1.000
		AWD	0	1	1	
	Conventional WHP	NAWD	10	2	12	0.453
		AWD	5	3	8	
Fat	Multilevel WHP	NAWD	9	1	10	1.000
		AWD	2	2	4	
	Conventional WHP	NAWD	8	7	15	0.549
		AWD	4	1	5	
PUFA	Multilevel WHP	NAWD	0	14	14	1.000
	Conventional WHP	AWD	0	3	3	1.000
		NAWD	3	14	17	
MUFA	Multilevel WHP	AWD	0	14	14	1.000
	Conventional WHP	NAWD	0	20	20	1.000
SAFA	Multilevel WHP	AWD	7	5	12	0.219
		NAWD	1	1	2	
	Conventional WHP	AWD	15	1	16	0.375
		NAWD	4	0	4	
Fiber	Multilevel WHP	AWD	14	0	14	1.000
	Conventional WHP	NAWD	19	1	20	1.000
Cholesterol	Multilevel WHP	AWD	7	4	11	1.000
		NAWD	3	0	3	
	Conventional WHP	AWD	8	2	10	1.000
		NAWD	3	7	10	

NAWD = Not in Accordance with The Diet; AWD = In Accordance with The Diet

Table 3. Results of the Marginal Homogeneity Test for IPAQ Category

Location			IPAQ Category After Treatment			Total	p Value
			Low	Moderate	Vigorous		
Group 1	IPAQ category before treatment	Low	0	2	0	2	0.257
		Moderate	0	7	3	10	
		Vigorous	0	2	0	2	
Total			**0**	**11**	**3**	**14**	
Group 2	IPAQ category before treatment	Low	3	2	1	6	0.132
		Moderate	2	6	3	11	
		Vigorous	0	0	3	3	
Total			**5**	**8**	**7**	**20**	

(SAFA) and cholesterol intake was in accordance with the diet. For group 2, the increased category was the dietary intake of protein and fat.

Most of physical activities of the participants in both groups, before and after the treatment, were categorized as moderate (600-2,999 MET-minutes/week). Applying Marginal Homogeneity testing to measure the effect of WHP on physical activity showed that there was no statistically significant difference on participants' physical activity either before or after the treatment, and neither in multilevel WHP (p value = 0.257) nor in conventional WHP group (p value = 0.132). However, in terms of absolute amount, there was the increasing number of participants in both groups during the physical activity either in moderate and vigorous category (Table 3).

Table 4 shows the general differences of metabolic syndrome markers with WHP influence. Before the treatment, the most common metabolic syndrome compo-

Table 4. Changes in Metabolic Syndrome Indicators

Indicators of Metabolic Syndrom	Location	Measurement		p Value
		Pre-test	Post-test	
Abdominal circumference (cm)	Group 1	99,79 ± 9,57	98,86 ±11,42	0.177
	Group 2	102,10 ± 7,97	99,35 ±10,71	0.032
SBP (mmHg)	Group 1	144,29 ± 25,03	117,86±12,20	0.002
	Group 2	136,75 ± 23,97	131,25 ±23,72	0.164
DBP (mmHg)	Group 1	90,71 ±13,81	77,14 (60-90)	0.007
	Group 2	90,00 (80-110)	84,00 ±13,82	0.014
Fasting blood glucose levels (mg/dL)	Group 1	116,79 (79-238)	95 (78-158)	0.014
	Group 2	111,50 (91-355)	119,05 (60-229)	0.020
HDL-C levels (mg/dL)	Group 1	41,57 ±8,88	37,21 ±5,28	0.089
	Group 2	40,00 (39-46)	38,75 ±8,12	0.434
Triglyceride levels (mg/dL)	Group 1	183,07 ±83,40	175,50 (110-372)	0.490
	Group 2	155,70 ± 41,95	136 (101-277)	0.940

SBP = Sistolic Bood Pressure; DBP = Diastolic Blood Pressure; HDL-C = High Density Lipoprotein Cholesterol

nents in group 1 was the abdominal circumference and blood pressure (92.90%), while in group 2, it was abdominal circumference (100%). After the treatment, the metabolic syndrome components in group 1, abdominal circumference, changed to 85.70%, and in group 2, the abdominal circumference changed to 95%. In relation to the survey results, mean and data distribution of abdominal circumference before the treatment in group 1 was 99.79 ± 9.57 cm and after the treatment decreased to 98.86 ± 11.42 cm. Furthermore, mean and data distribution of abdominal circumference before the treatment in group 2 was 102.10 ± 7.97 cm, and decreased to 99.35 ± 10.71 cm after the treatment. Paired sample t-test found no statistically significant difference in abdominal circumference measurement results in group 1 (p value = 0.177). Quite the opposite, there was significant differences in group 2 (p value = 0.032).

The survey results explained that mean and data distribution of systolic blood pressure (SBP) before the treatment in group 1 was 144.29 ± 25.03 mmHg, and decreased to 117.86 ± 12.20 mmHg after the treatment. Mean and data distribution of diastolic blood pressure (DBP) before the treatment in group 2 was 136.75 ± 23.97 mmHg, and decreased to 131.25 ± 23.72 mmHg after the treatment. Paired sample t-test showed the significantly different results on SBP measurements in group 1 before and after the treatment (p value = 0.002), which showed opposite the results in group 2 (p value = 0.164).

According to the survey results, mean and data distribution of DBP before the treatment in group 1 was 90.71 ± 13.81 mg/dL, and decreased to 77.14 (60-90) mg/dL after the treatment. Besides, mean and data distribution of DBP before the treatment in group 2 was 90.00 (80-110) mg/dL, and decreased to 84.00 ± 13.82 mg/dL after the treatment. Through Wilcoxon test, it turned out that there were significantly different DBP measurement results in group 1 (p value = 0.007), and in group 2 (p value = 0.014), both before and after the treatment.

Mean and data distribution of FBG before the treatment in group 1 was 116.79 (79-238) mg/dL, and decreased to 95 (78-158) mg/dL after the treatment. While in group 2, mean and data distribution of FBG before the treatment was 111.50 (91-355) mg/dL, and increased to 119.05 (60-229) mg/dL after the treatment. According to Wilcoxon test result, the results of FBG measurement in group 1 (p value = 0.014) and group 2 (p value = 0.020) before and after the treatment were significantly different. Mean and data distribution of HDL-C levels in group 1 before the treatment was 41.57 ± 8.88 mg/dL, and decreased to 37.21 ± 5.28 mg/dL after the treatment. Paired sample t-test showed statistically significant difference on HDL-C measurement results both before and after the treatment (p value = 0.089). In group 2, mean and data distribution HDL-C before the treatment was 40.00 (39-46) mg/dL, and decreased to 38.75 ± 8.12 mg/dL after the treatment. Then, Wilcoxon test result showed that there was no statistically significant difference on HDL-C measurement result (p value = 0.434).

For triglyceride levels in group 1, the mean and data distribution before the treatment was 183.07 ± 83.40 mg/dL and decreased to 175.50 (110-372) mg/dL after the treatment. In group 2, mean and data distribution of triglycerides before the treatment was 155.70 ± 41.95 mg/dL, and decreased to 136 (101-277) mg/dL after the treatment. Based on Wilcoxon test result was found no statistically significant difference in the measurement result of triglycerides in group 1 (p value = 0.490) and group 2 (p value = 0.940), neither before nor after the treatment.

The survey results showed that after the intervention there were five participants (35.70%) who no longer met metabolic syndrome criteria in the multilevel WHP

group, while in conventional WHP group only three participants (15.00%) no longer met metabolic syndrome criteria. Consequently, the multilevel intervention was considered effective to lower the number of cases or diseases.

Discussion

Based on the results, multilevel WHP intervention was considered effective in positively affecting food intake of participants. This was due to the fact that participants in group 1 prefer to have metabolic syndrome diet, especially for dyslipidemia. In consideration of intake levels of SAFA, MUFA and PUFA and cholesterol, the multilevel WHP intervention was clearly indicated to support metabolic syndrome management (especially in lowering hypertriglyceride and raising HDL-C). To decrease hypertriglyceridemia or increase HDL-C on metabolic syndrome patients, they should limit or change the type of fat intake (from saturated to unsaturated fat), and lower the intake of dietary cholesterol.[12-14]

On multilevel intervention group, the amount (grams) consumed dietary fiber intake has been increased, although it has yet to reach the target (25 grams) per day. The reasons behind it may vary, such as having lunch or dinner which lack of fiber or being unfamiliar with daily menus which contain more fuits and vegetables. The reasons above were supported by a study which showed that on average, Indonesian's daily fiber consumption rate was only 10.5 grams.[15] The impact of this low level is shown by a large body of study that shows an inverse correlation between fiber consumption and metabolic disorders, particularly the complication of degenerative diseases. Consuming about 35 grams of fiber per day would allow someone to have a 1/3 lower risk of CHD compared to those who consumed less than 15 grams of fiber per day. Article reviews by Health Promotion, Chronic Disease and Injury Prevention Division have also shown several study results concluding that there was a positive effect of WHP on workers' eating habits.[16]

The study results indicated that both models of WHP increased the number of workers who did more active physical exercises, despite the insignificance. One possibility that might occur was that some participants had difficulty to do physical exercises due to having too much work. Thus, implementing WHP still requires much effort to increase the number of workers who exercise regularly.

A positive indication of the study results was the improved metabolic syndrome components of the participants which were caused by physical exercise, which included the improvement of SBP and DBP as well as FBG. This is in line with the other study results that suggested a correlation between physical exercises with improved BP and FBG.[17-19] Several other studies had also proved the influence of health promotion to increase physical activity.[20-21] Several article reviews by Health Promotion, Chronic Disease and Injury Prevention Division also showed some of study results concluding that there was a positive effect of WHP on workers' physical fitness and activity.[16]

This study also found that there was no statistically significant difference in abdominal circumference. Several other studies also showed a significant correlation between lifestyle intervention with a decrease in abdominal circumference.[22-24] The results of this study clearly indicated that the WHP multilevel is effective to lower the blood pressure of metabolic syndrome patients. Other studies have also proved that lifestyle intervention could lower blood pressure.[22,24]

Another indication of the effectiveness of multilevel WHP was the lowering of metabolic syndrome patients' FBG levels. Several studies proved that there were differences of FBG levels in the group which were given health promotion interventions.[14-23] Other studies also found that there was no statistically significant difference between lifestyle intervention and a decrease in triglycerides.[22] To increase HDL-C, a big effort was required, such as stop smoking, lowering body weight, avoiding food containing saturated and trans-fat which could increase LDL cholesterol and blood vessel damage.[13] Other studies also found that although respondents had a diet and physical exercises, they did not yet experience a meaningful increase in HDL-C and decrease in triglycerides.[14,24] However, the researcher believed that the increase would be achieved through WHP dyslipidemia condition, if it was implemented consistently, in a relatively longer period of time, and with high compliance of the participants.

Survey results above showed that the multilevel intervention lowered the number of cases or diseases. A study by Anderssen *et al*. found that an metabolic syndrome patient who was given some integrated management programs (regular counseling, behavior combined with diet management and regular physical exercise), would experience a significant decrease on his or her metabolic syndrome prevalence.[14] A study by Pronk also showed a decrease of workers' metabolic syndrome prevalence from 51% to 43% after undergoing an intensive lifestyle change.[25]

Conclusion

WHP aims at the multilevel subject, better influenced physical activity and food intake in the management of metabolic syndrome than conventional WHP. WHP with multilevel intervention approach is better than the conventional WHP, in the management of metabolic syndrome, which is proven by the number of participants

that no longer meets criteria for metabolic syndrome after the intervention.

Recommendation

Companies, are recommended to apply WHP with multilevel intervention approach (involving workers as the main target and social support from family, co-workers, and the company leadership) to overcome the problems of health/disease in workers.

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