

Effectiveness of Interventions Based on a Comprehensive Model for Promoting Physical Activity and Improving Health-related and Fitness Indices in Employees

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Abstract

Purpose To reduce physical inactivity at work, today's work environments require the design of interventions that can effectively enhance the level of physical activity. The purpose of this study was to determine the effectiveness of interventions based on a comprehensive model for promoting physical activity behaviors and improving health-related and physiological physical fitness indices in administrative employees of the industrial sector.

Methods In this randomized, controlled trial study that included 170 administrative employees. The intervention group was subjected to a series of interventions based on a comprehensive model for practical and physical activities for 6 months. Data collection instruments used were a demographic checklist, Baecke Habitual Physical Activity Questionnaire, health-related and physiological physical fitness testing and a researcher-developed questionnaire based on the comprehensive model constructs. Data analysis was conducted by the SPSS 21 using chi-square, independent and paired *t*-test, Wilcoxon-Mann-Whitney U test, and repeated measures ANOVA. The significance level was considered 95%. The mean age of the subjects was 36.99(\pm 7.69 SD) years old and all of them were male.

Results The mean total physical activity index in the intervention group at 3 and 6 months after the intervention significantly increased compared to control group. The mean values of health-related and physiological physical indices, i.e., cardiorespiratory fitness, muscular endurance, flexibility and physical composition, in intervention group significantly increased compared to control group. **Conclusion** Designing interventions based on a comprehensive model to examine the broader and multi-level approaches between environmental, biological and psychological factors can affect physical activity behaviors and promote health behaviors.

Introduction

The inactive nature of many occupations and offices is a feature of today's workplaces [1]. People who spend a longer time sitting in the workplace are twice as likely to be at risk of developing chronic diseases compared to those who are physically active at work [2]. According to recent global estimates, roughly 9% of premature mortality, accounting for about 5.3 million deaths, occurs directly due to physical inactivity [3]. Physical inactivity is a major public health issue that is associated with heavy burden of cardiovascular disease (CVD) and other chronic noncommunicable diseases (NCDs) [4] that leads to a substantial economic burden so that it has recently been reported to account for 11% of health care cost in the United States, estimated to be approximately \$ 120 billion, each year [5]. However, a large part of the population in many countries across the world does not have adequate physical activity and do not enjoy the resulting outcomes [6]. Studies in Iran have reported the rate of physical inactivity to be about 30-70% [7]. Reports from various centers have addressed workplace health as a key point for initiating and maintaining physical activity [8-10] because people a large amount of their time at work. At workplace, communication channels are established, support networks are available and there is an opportunity for the development of behavioral norms, while at the same time, the target population can

be easily reached [10, 11]. According to the United States Department of Health and Human Services, workplace health promotion programs contribute to improving employees' health and productivity and reducing the costs of absence from work and sickness [12], in addition to assisting in stress management, mood enhancement, and disability reduction [10]. To deal with the consequences of physical inactivity in today's work environments, the work environment requires the design of theory-based, feasible and fast implementable interventions to reduce physical inactivity at work [13, 14]. In this regard, the appropriate model recommended for designing and implementing health promotion and physical activity behavior programs is the comprehensive model that suggested a theory-driven by John C. Spence [15]. According to this model, physical activity behavior is considered a health behavior that is influenced by the interactions between environmental, psychological and biological factors and assists in recognizing the opportunities for participation in physical activity and multiple factors affecting behavior [15, 16].

Since behavioral models and theories can be a good guide for interventions in physical activity programs [15], Given the above-mentioned, this study was conducted with the aim of investigating whether comprehensive model-based, integrated interventional strategies can be effective in promoting physical activity and health-related and physiological physical fitness indices in the administrative employees of the oil industry in Iran for the first time.

Materials And Methods

Study design and population

This randomized, controlled trial study was conducted with one intervention group and one control group, in Asaluyeh port, south Iran, in August 2016 to December 2016. The sample size of each group was calculated at 70 using the *G-power* software, taking into account a significance level of 5% and the test power of 90%, in order to achieve a 7.5- point significant difference at the average peak oxygen consumption (VO_2 max) before and after the intervention. Given an attrition rate of 20%, the sample size in each group was decided to be 85 [17]. In order to select participants, two centers with comparatively larger number of employees were selected from about 20 administrative offices of the Pars Special Economic Energy Zone (PSEEZ) by purposive sampling, and then one of the two centers was randomly assigned as intervention group and the other one as control. Next, the potential participants were randomly selected from among personnel working in selected administrative centers. For this purpose, first, the purpose and procedure of the study were explained face-to-face for all the employees (about 1000 individuals) in the two centers, and then a demographic information checklist and the Baecke Habitual Physical Activity Questionnaire (an indirect, self-report measure of physical activity) were distributed among them to invite them to participate in the study. After collecting questionnaires filled out, 300 respondents provided an oral informed consent for participation in the study. Because 6 questionnaires had not been filled out completely, 294 individuals were enrolled. After the selected individuals filled out a health record checklist and their preparation to participate in the exercises was assured, those who did not fulfill the inclusion criteria were excluded from the study, and ultimately 170

individuals were randomly selected as participants after they provided an informed written consent form (to observe ethical considerations). Eighty five individuals from one administrative center were assigned to intervention group and 85 from another administrative center to control group. Random allocation was performed by random number table. Both groups were blinded to which groups they had been assigned. To further ensure lack of bias, data were entered into the software by a person who was blinded to whether the participants had been assigned to control group or intervention group.

Inclusion and Exclusion criteria

Inclusion criteria were: age range of 20-60 years, lack of suffering from rare diseases, adequate physical ability to perform exercises, and lack of history of cardiovascular disease, asthma, and diabetes, and exclusion criteria: lack of attending more than two sessions in the training sessions and transferring from the current workplace to another organization.

Data collection tools

The instruments used in this research were a demographic information checklist, the Baecke Habitual Physical Activity Questionnaire [18], and a researcher-developed questionnaire based on the comprehensive model constructs. The demographic information checklist included age, gender, marital status, number of children, education level, economic status, working hours and work experience. The Baecke Habitual Physical Activity Questionnaire [19] is an international questionnaire for indirectly and subjectively assessing the level of physical activity. The questionnaire contains 16 items, rated on a 5-point Likert scale (1-5), to measure the levels of physical activity at work and in exercise and leisure time. In order to determine the internal consistency of the questionnaire, Cronbach's alpha was used, which was calculated at 0.79% for the questionnaire, confirming the internal consistency of the items. In order to determine the level of physical activity in an objective and direct manner, health-related physical fitness (cardiorespiratory fitness, muscular strength and endurance, and flexibility), and body composition [body mass index (BMI), fat percentage and waist-hip ratio (WHR)] indices were measured. In order to measure cardio respiratory fitness, the maximum oxygen consumption (VO₂ max) index was measured. The aerobic capacity was measured by measuring the maximum oxygen consumption (VO₂ max) using the Quinine exercise test and Queens College step test, and is expressed in oxygen consumed (mL) in one minute per one kg of body weight (ml/min/kg). It is frequently used as an index to assess cardiovascular (aerobic) capacity [20]. In order to measure muscular strength, the left and right handgrip strength (HGS) were separately measured by using a grip strength meter and summed, and then the result was divided by 2 to obtain the muscular strength for each participant. The HGS of both hands was measured using the Jamar® Plus+ Digital Hand Dynamometer (Patterson Medical, Warrenville, IL, USA). The reliability of the Jamar dynamometer has already been confirmed in many populations [21, 22]. In order to measure muscular endurance, the Crunch (partial curl-up) test was used, and to measure flexibility, the trunk-flexure test with some modifications was used [23]. It should be mentioned that before performing the above-mentioned physical fitness tests, the participants performed a brief warm-up and some stretches for 7-10 minutes. In order to measure BMI, the weight (Secca) and height were first measured, and then

the formula $\text{weight (kg)} / \text{height (m)} \times \text{height (m)}$ was calculated [24]. Skin fold method and Slim Guide Skinfold Caliper (made in USA) were applied to estimate the body fat percentage (BFP) (Caliper can measure subcutaneous fat of 80 mm diameter). It is suitable for non-athletic adults that may be needed. It also can be read to the nearest 0.5 mm. subcutaneous fat was measured in the following body sites: abdominal fat, triceps, and suprailiac. For more accurate measurement, each point was calculated three times and then the average of these three measurements was recorded. Later, the recorded mean scores were put into the Jackson and Pollock formula (as represented below) and participants' BFP was calculated. $\% \text{ Body Fat} = (0.39287 \times \text{sum of three skinfolds}) - (0.00105 \times [\text{sum of three skinfolds}]^2) + (0.15772 \times \text{age}) - 5.18845$ [25].

In order to measure the abdominal obesity, the WHR, i.e., the ratio of waist circumference to hip circumference, was measured [23]. The anthropometric indices were measured in an indoor sport club at a temperature of 25-35 °C. Data were collected from 16pm to 20pm in the evening. Another tool used in this study was a researcher-developed questionnaire based on the components of the comprehensive model, to identify the factors affecting the physical activity behavior according to the protocol recommended by John C. Spence. After careful review of the relevant literature and references, and due to the lack of a previously developed instrument, a questionnaire was developed in accordance with the constructs of the comprehensive model (Figure 1) for measuring the components physical environment, pressure for macrosystem, mesosystem, exosystem, and microsystem changes, and individual factors including psychological factors (awareness, attitude, and self-efficacy).

Then, the psychometric analyses (item clarity, face validity, content validity and reliability coefficient calculation) were also performed on the instrument. In order to determine the face and content validity of the questionnaire, it was provided to 12 professors and experts, consisting of 8 health education experts, 2 physical education and sports science experts, one psychologist and one biostatistician. According to their suggestions and comments, certain changes were made to the wording and phrases of the items, and then the instrument was found as reliable to gather the data of interest. Content validity index and ratio were also obtained over 0.79 and over 0.59, respectively. In order to calculate the reliability of the questionnaire, internal consistency (Cronbach's alpha) coefficient and test-retest reliability coefficient were measured. In this study, the questionnaire was also piloted with a small group (n: 30) of employees, and the Cronbach's alpha coefficients for different constructs of the questionnaire was obtained to range between 0.73 and 0.95, which are statistically acceptable. Before the intervention, the questionnaire was completed by both groups and the drawn data were analyzed.

Interventions based on comprehensive model constructs

According to the comprehensive model, certain interventions focusing on the comprehensive model constructs, such as environmental and social factors, changes in organizational rules and policies, and training in individual (psychological and biological) factors were performed in the intervention group, including: establishing a health center and providing the necessary facilities and equipment for physical activity in the workplace and the residential campus, daily advice exercise consultation in the workplace,

giving a training booklet, pamphlet and theoretical-practical training in the methods of performing physical activities, the situations in which physical activities can be performed, seemingly simple behaviors at work and home and in leisure time that do not require sports equipment, as well as for optimal use of opportunities and times lost during the daytime and at work, demonstrating physical activities involving the lower extremities, the trunk, and the upper extremities, which do not require any sports equipment and can be carried out at work and home, for participants and their families within a short (5-10 min) time, demonstrating a few physical activities and giving recommendations for starting physical activity, such as using the stairs instead of the escalator, sharing a trash bin away from the table with colleagues, using the toilet or drinking water of the other storeys, getting out of the bus service or parking the car at a 10-minute commuting distance from the workplace or walking around for 5 minutes every hour during the workday; and doing household chores such as washing car, gardening or making a small garden, biking and walking for everyday shopping journeys, and other moderate-intensity activities while housekeeping, house shopping, and commuting that can increase physical activity level.

Certain changes were also made to new laws and regulations with an emphasis on organizational support for promoting employees' physical activity behaviors and health, so that employees' were allowed to refer to the established health center during the workday and have 30 minutes of physical activity during the daytime depending on their working hours. A commuting service was provided for participants to facilitate their participation in the (1-hour) public exercise program in the morning. To further encourage employees, sports clothing and equipment were provided for them and they were allowed to use the sports pool for one hour (the last working hour). General training was also given to intervention group, including the harms and risks of physical inactivity in the workplace, including overweight and obesity, musculoskeletal problems, cardiovascular disease and other adverse health effects, the role of physical activity in life, and the techniques of physical exercises, emphasis on the psychological factors, i.e., knowledge, attitude and self-efficacy, with respect to physical activity, changing employees' attitudes towards physical activity and increasing their awareness of the importance of the role of colleagues, friends and family in promoting the activity by accompanying them in performing physical activities and encouraging each other to perform physical activities in a friendly group to create a supportive and persuasive environment to do physical activities. Besides that, face-to-face verbal encouragement of the participants and telephone counseling were also done to increase physical activity level. Another purpose of this intervention was to emphasize self-efficacy.

One way to increase self-efficacy is to successfully do a certain behavior. Given this, the physical activity was divided into smaller and simpler components representing the subdivisions of the whole behavior in question. Other measures included training the ways of removing the barriers to physical activity including neglect and laziness. The training that mainly addressed the comprehensive model constructs was given in 5 sessions of 50 minutes. Training programs were conducted both in working and otherwise hours during the daytime. In order to facilitate potential group discussions, the participants under intervention were divided into different subgroups according to respective administrative units. The training content was the same for all participants in the intervention group. No educational intervention was performed in the control group. At 3 and 6 months after the intervention, the effects of intervention

on the participants' levels of physical activity were measured. After completing the study and in order to observe research ethics, control group were invited to attend a training session on the effective factors and strategies for promoting physical activity using the components of the comprehensive model, in which they were also given a booklet, a pamphlet and an educational CD.

Data Analyses

All statistical analyses were performed by the SPSS version 21. Chi-square test was used to compare the demographic characteristics of the two groups, and independent and paired *t*-test and the non-parametric tests Wilcoxon-Mann-Whitney U test and ANOVA to compare the data of the groups. The significance level of the tests was considered to be 95%.

Results

In the present study, 170 men working in the administrative office of the oil company (PSEEZ, Asaluyeh, Iran) with an average age of 36.90 (± 7.7 SD) years, height of 174.4 (± 6.3) cm, weight of 84.5 (± 12.2) kg and BMI of 27.8 (± 3.4) kg/m² were included. Most participants (n: 156, 91.8%) were married and the rest single. 77.6% of the subjects had a moderate economic status, 12.4% a good economic status and the rest a low economic status. Most participants (45.9%) had bachelor's degree, 23.5% master's degree, and the rest associate's degree and high school diploma. 53.6% had a work experience of at least 11 years and 8.8% a work experience of less than 3 years. 2.71% of participants had at least 10 working hours/day. Regarding history of physical activity, 59.6% had no physical activity history and 39.8% low to moderate physical activity levels. However, there was no statistically significant difference in demographic characteristics between the two groups. According to the chi-square test results, there was a significant difference in the subjective measure of physical activity levels (by the questionnaire) before and after the intervention in intervention group ($P \leq 0.002$), but not in the control group ($P = 0.41$) (Table 1).

The results of statistical analysis also did not showed any significant difference in the score on total physical activity level in sports, leisure time, and the workplace between the two groups before intervention ($P > 0.05$). The repeated measures ANOVA results showed there was an interaction effect between time passage and intervention group ($P > 0.001$) (Table 2). Therefore, the difference in the mean score on the total physical activity (in sports, leisure and the workplace) between the two groups was separately measured at 3 and 6 months after the intervention. To this end, at each measurement, after the difference between the two groups due to its effect before intervention was controlled for, the mean physical activity score was measured using multiple linear regression models. The results of multiple linear regression showed that after controlling for the effect of the mean difference, the total physical activity scores before and 3 months after intervention were significantly different between intervention and control groups ($P < 0.01$), with the mean score of total physical activity in intervention group being higher by 1.63 points when compared to control group; and the scores six months after intervention were significantly different between intervention and control groups, with the mean score of total physical activity in intervention group being higher by 3.69 points when compared to control group. The repeated

measures ANOVA results showed in intervention group, the mean score of the total physical activity level (in sports, leisure time, and the workplace) was significantly different among before and 3 and 6 months after intervention ($P < 0.001$) with an increasing trend, but not in control group ($P > 0.11$).

The results of statistical analysis showed there was no significant difference in the health-related and physiological physical fitness indices between the two groups before intervention (Table 3). The independent t -test results showed mean VO2 max, Muscular endurance, muscular strength, BMI, BFP and WHR in intervention group significantly changed at 6 months after intervention compared to control group. The Mann-Whitney U test showed the mean flexibility in intervention group significantly changed compared to control group 6 months after intervention ($P < 0.001$). The paired t -test results on the changes in each group showed, first, in intervention group a significant difference in the mean VO2 max and the Sit-up test was observed before and 6 months after intervention, with an increasing trend; and a significant difference in the mean BMI, BFP, and WHR was observed before and 6 months after intervention, with a decreasing trend ($P < 0.03$). Second, the intra-group changes in control group showed there was no significant difference in the mean VO2 max, Sit-up test, muscular strength, BFP and WHR before and 6 months after intervention, but the difference in mean BMI before and 6 months after intervention was significant, with an increasing trend ($P < 0.03$), that is, participants' BMI increased and they developed overweight. The Wilcoxon test results showed there was a significant difference in the mean flexibility index before and 6 months after intervention in the intervention group, with an increasing trend ($P < 0.001$), but, there was no significant difference in flexibility index in the control group before and 6 months after the intervention ($P > 0.066$).

Discussion And Conclusion

Although different models and behavioral theories have been used to promote the behavior of physical activity in different countries, there is scarce evidence in Iran on sustainable promotion of health-related physical activity as a platform for interventions using environmental models at workplace[26]. Therefore, this research was conducted with the aim of investigating the effect of comprehensive model-based interventional strategies for promoting physical activity and health-related and physiological physical fitness indices in the administrative employees of the oil industry. The results of this study showed after implementing an intervention program based on the comprehensive model, the physical activity level of the administrative employees of the industry, according to both indirect (the standard self-report questionnaire) and direct (objective observation by measuring the health-related and physiological physical fitness indices) measures, was improved.

Regarding physical activity behavior scores obtained by the Baecke Habitual Physical Activity Questionnaire, the statistical tests showed a significant difference in mean total physical activity score between intervention group and control group in *all* the three measurements, i.e., before, and 3 and 6 months after intervention (Table 2). And before intervention, 61.2% of the participants had a low physical activity level, but after intervention, a very high proportion of them had moderate and high physical activity levels (67.1% and 21.2%, respectively). Different studies have reported contradictory results

regarding physical activity level, and we did not find any study with the model used in the current study for physical activity behavior interventions in the administrative employees of the industrial sector.

Consistent with our findings, a study by Fleury and Lee [27] on the physical activity of African American women using the social Ecology model, showed individuals' access to sports facilities and environmental resources made it easier for the women to do physical activity and improved their overall physical activity level. In addition, a study conducted by Gargari AS (2018) on the effect of the Social Ecological Model on promoting physical activity of Female employees in Iran, showed after 8 weeks of intervention, based on the model including general education, 4 sessions of group discussion and walking around for 30 minutes every workday in leisure time, the number of steps in the intervention group increased from 4204 to 7882, and the total physical activity of the intervention group significantly increased compared to the non-intervention group, In contradiction with the current study, a study by Aittasalo M et al. (2004) about the effects of physical activity counseling in the workplace using the Trans Theoretical Model, did not show any significant changes in the physical activity level of the leisure time in the studied groups.

This difference can be attributed to differences in the environmental conditions of the target group, type of intervention, measurement tools and other factors, such as social and cultural conditions, and the interaction effects between the constructs of the comprehensive model[28]. Other causes of inconsistency include the duration of educational intervention, the environmental conditions and the participants enrolled. Health-related physical fitness indices were also measured to objectively measure physical activity. These indices provide a great deal of information about the health and well-being of individuals [23]. In this phase of the study, the results of statistical tests regarding the health-related and physiological physical fitness indices showed the mean scores of intervention group were significantly different compared to those of control group ($P \leq 0.05$). Cardiorespiratory fitness represent the functional capacity of the heart, vessels, blood, lungs and muscles during exercise, which in this study increased from an average level to higher-than-average level [23] 6 months after intervention according to the subjects age and VO₂max norms.

The mean scores of muscular strength and endurance, and the fitness of individuals, measured by the test Sit-and-reach, increased from moderate levels to good ones, and regarding body composition, as shown in Table 3, BMI, BFP and WHR of intervention group significantly decreased in comparison with the control group ($P < 0.05$). Consistent with our results, Haines et al. (2007) conducted a study to promote walking and motivate participation in physical activity programs in the university employees, and therefore improve their health status within 12 weeks, and observed the mean BMI significantly decreased from 29.06 to 28.68. Simon C et al. (2014) used a socio-ecological approach to promote physical activity and restrict physical inactivity behaviors in adolescents, reducing their BMI and fat mass. It is concluded that health behaviors are formed through complex interactions of determinants at different levels of the model, and the multiple layers of effect interact at different levels and affect the level of physical activity behavior in the workplace [29] The findings of this part of our study demonstrated the overall positive effects of interventions in improving physical activity and health outcomes, and it can be argued that interventions based on a comprehensive model (such as equipping the physical environment and

removing physical barriers to doing physical activities such as access to a physical environment close to the workplace and place of residence, and to use the organizational support strategy and potential policy-level change [30], aimed at improving the work environment, creating more opportunities for performing physical activities, and utilizing comprehensive educational methods to encourage and support employees to do physical activity, have been able to increase physical activity indirectly, and also to enhance physical activity objectively and improve health-related and physiological physical fitness indices. It is therefore recommended that in order for interventions designed to promote physical activity to be successful, physical and social environments and support policies, in addition to individual and psychological factors, be incorporated in them [31, 32], as studies have found that multi-organizational and group work is effective in implementing such interventions [33].

Conclusion

Overall, the results of this study showed that designing interventions based on a comprehensive model to examine the broader and multilevel approaches between environmental, biological and psychological factors can affect the physical activity behavior and promote health behavior in the administrative employees of the industrial sector in Iran.

It is therefore suggested that health professionals in work and industrial settings use this theory as a useful theoretical framework (due to the availability of staff and their families and the role of employers in developing public policies and removing barriers to physical activity and sports, which can be an important step to implementing a physical activity program and affecting other sectors, such as health care and public health).

Declarations

Ethics approval and consent to participate

Ethical considerations in this study include obtaining approval of the Ethics Committee (at Yazd Shahid Sadoughi University of Medical Sciences, code: 95906 on 12 February, 2015) for the study protocol before beginning the study and informed consent from the participants, and assuring the participants that every efforts would be made to keep their information confidential.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analysed during this study are included in this article

Competing interests

The authors declare that they have no Competing Interests.

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Authors' contributions

RM initiated the research concept, presented the results and discussions, wrote up of the draft manuscript, reviewed and finalized the manuscript document, and is the corresponding author. MMSS edited the manuscript, and had primary responsibility for the final content of the manuscript. FH analyzed the data and drafted the manuscript. FM and SM contributed to the study conceptualization, and provided constructive feedback on each draft of the manuscript.

All authors read and approved the final manuscript.

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Tables

Table 1 Frequency distribution of participants (n: 170) according to physical activity level in intervention and control groups before and 6 months after intervention

Total physical activity Group		Low	Moderate	High	P-value
		(%) N	(%) N	(%) Number	
Intervention	Before	(61/2)52	(36/5)31	(2/4)2	0/002*
	After	(11/8)10	(67/1)57	(21/2)18	
Control	Before	(63/5)54	(35/3)30	(1/2)1	0/41
	After	(61/2)52	(37/6)32	(1/2)1	

Table 2. The distribution of mean(\pm standard deviation) total physical activity index (in sports, leisure time and the workplace) before, 3 and 6 months after intervention in intervention and control groups

Variables	Group	Before intervention M \pm SD	3 months after intervention M \pm SD	6 months after intervention M \pm SD	p- value
Total physical activity index	Intervention	7/02 \pm 1/83	9/23 \pm 1/63	11/07 \pm 2/33	0.001
	Control	7/10 \pm 1/51	7/6 \pm 1/84	7/03 \pm 1/54	0.11
	p-value	0/6	(0/01	0/001	
	RMANOVA *				
Sportsindex	Intervention	2/46 \pm 0/85	3/3 \pm 0/55	4/1 \pm 0/89	0.001
	Control	2/57 \pm 0/9	2/69 \pm 0/87	2/55 \pm 0/87	0.28
	p-value	0/42	0/001	0/001	
	RMANOVA *				
Leisure time index	Intervention	0/62 \pm 2/24	3/1 \pm 0/32	3/59 \pm 0/7	0.001
	Control	62/0 \pm 24/2	61/0 \pm 43/2	61/0 \pm 21/2	0.03
	p-value	0.39	0.02	0.001	
	RMANOVA *				
Workplace index	Intervention	2/20 \pm 0/73	2/83 \pm 0/21	3/38 \pm 0/75	0.001
	Control	2/29 \pm 0/62	2/48 \pm 0/32	2/26 \pm 0/61	0.33
	p-value	0.39	0.001	0.001	
	RMANOVA *				

p-value RMANOVA(before and after intervention in each group)

*p-valueRMANOVAbetween intervention and control groups

Table 3 The distribution of mean(\pm standard deviation) physiological physical fitness indices before and 6 months after intervention in intervention and control groups

Variables	Group	Before intervention	6 months after intervention	p-value
		M±SD	M±SD	
VO2 max	Intervention	39/04 ±6/22	49/03 ± 6/1	0.001
	Control	39/19± 5/61	40/18± 5/4	0.487
	p-value*	0/704	0/041	
Muscular endurance (Sit-up test)	Intervention	27/07± 12/83	27/42± 12/27	0.001
	Control	25/04± 13/41	24/97± 13/29	0.1
	p-value*	0.192	0.048	
Muscular strength (handgrip strength)	Intervention	101/07± 6/83	111/4± 8/56	0.001
	Control	1022/04± 5/41	103/7± 4/41	0.51
	p-value*	0.1	0.03	
Flexibility (Sit-and reach)	Intervention	15/29± 9/32	20/42± 10/84	0.001
	Control	14/47± 8/69	14/24± 8/03	0.09
	p-value*	0.684	0.001	
Body mass index	Intervention	26/92± 3/43	26/66±3/23	0.001
	Control	27/9± 3/88	27/92± 3/93	0.03
	p-value*	0.08	0.02	
(BFP%)	Intervention	34/1± 8/72	33/66± 8/58	0.002
	Control	36/61± 11/44	36/62± 11/45	0.2
	p-value*	0.1	0.05	
Waist-hip ratio	Intervention	0/91± 0/073	0/90± 0/072	0.001
	Control	0/92± 0/054	0/92± 0/055	0.15
	p-value*	0.36	0.045	

Paired *t*-test and Wilcoxon test (before and after intervention in each group)

* Independent *t*-test and Mann-Whitney U test (between intervention and control groups)

Figures

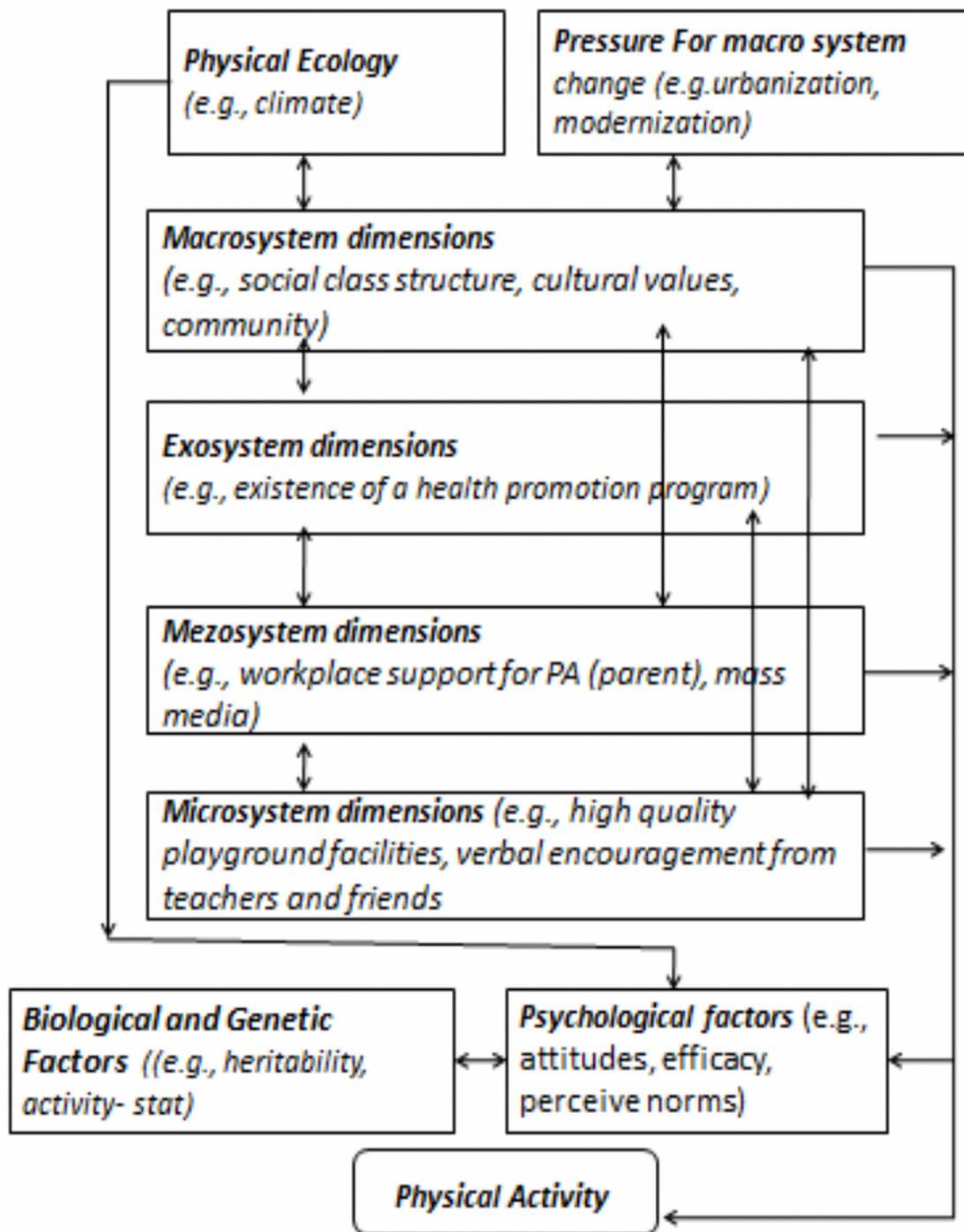


Figure 1

Schematic illustration of the Comprehensive Model of Physical Activity