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Association of Physical Activity level with the COVID-19 Incidence in Patients with Type 2 Diabetes

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ABSTRACT

Background & Objective: Type 2 Diabetes Mellitus (T2DM) is among the epidemic metabolic chronic diseases that attenuates physiological functions, including hematopoiesis and immune responses, developing a higher risk of COVID-19 incidence. This study purposed to study the association of physical activity level (PAL) with the COVID-19 incidence in patients with T2DM.

Materials & Methods: All patients with T2DM from Kermanshah (Iran) were among the statistical population of this study. Using Cochran's formula, 424 patients with T2DM (220 women, 224 men) were chosen. The International Physical Activity Questionnaire (IPAQ) assessed the PAL. To compare the variables between men and women the independent t-test was used. Also, to evaluate the relationship between variables the Pearson correlation coefficient test was used (SPSS software version 24) at a significant level of ($P \leq 0.05$).

Results: Based on the results, no significant difference was observed in PAL and COVID-19 incidence between women and men (P=0.342). Also, a significant positive relationship was observed between low and high PAL with COVID-19 incidence in men (r=0.638, P=0.039; r=0.231, P=0.048) and women (r=0.728, P=0.011; r=0.331, P=0.018), respectively. However, there was a significant inverse relationship between the moderate PAL and the incidence of COVID-19 among women (r=-0.791, P=0.021) and men (r=-0.731, P=0.029).

Conclusion: Most of the patients with T2DM had an inadequate PAL. Compared with low and high PALs, moderate PAL might have lowered the incidence of COVID-19 more effectively. Finally, a moderate PAL is recommended to patients with T2DM to boost the immune system and prevent COVID-19 infection than high or low PAL.

Keywords: Exercise, T2DM, Infection, COVID-19

Introduction

Type 2 Diabetes Mellitus (T2DM) is among the epidemic metabolic chronic diseases that attenuates various physiological functions, including hematopoiesis and immune responses. The novel coronavirus SARS-CoV2 spread worldwide with unusual patterns originating from Wuhan, China, on December 12, 2019, with about 4.5 million cases and 6 million deaths (1-3). The results of several studies suggest that individuals with underlying diseases such as patients with T2DM are generally more susceptible to COVID-19 (4, 5) and development of severe complications including multi-organ failure and acute respiratory distress syndrome (ARDS) (6, 7). It is also known that well-managed younger T2DM patients generally have a lower risk of severe COVID-19 than elderly unmanaged patients (8). However, the COVID-19 quarantine, social restriction, and economic consequences indulged significant lifestyle changes, including altered physical activity level (PAL) (9, 10), irregular insulin or oral medications intake, and avoiding the health care center visit in T2DM patients (11).

On the one hand, a sedentary lifestyle can lead to obesity, metabolic diseases (such as diabetes), and infections that increase the need for hospitalization (12, 13). On the other hand, the potential beneficial effects of regular physical activity on mental health, chronic diseases, and immunity are well established (12, 14). Also, regular PAL and an active lifestyle might induce faster recovery from COVID-19 via improving metabolism and physical fitness (15). This study purposed to study the association of low, moderate, and high PAL with the COVID-19 incidence in patients with T2DM in Kermanshah, Iran.

Materials and Methods

Statistical population

This descriptive cross-sectional research studied T2DM patients from Kermanshah (the Kermanshah Diabetes Association member) with a statistical population of 25,000 individuals according to the latest inquiry from the

University of Medical Sciences, Kermanshah, Iran. The sample size was estimated to be 384 using Cochran's sample size formula. Due to the 28.5% probability of falling, 537 available samples received the questionnaire, and 424 individuals completed the questionnaire accurately (220 women, 224 men). The Research Committee of the Sports for all, Kermanshah, Iran approved the current examination (code: IR.PSB.REC.1399.1144). Inclusion criteria included: age group of 30-70 years, having information about COVID-19, blood sugar above 126 mg/dL or HbA1C above 6, at least three years' history of having T2DM, LDL above 100 mg/dL, and TG above 150 mg/dL. Exclusion criteria include: inaccurate completion of the questionnaire, having other chronic diseases. Before answering the questionnaires, the importance of the study was explained to the subjects; ethical considerations were observed.

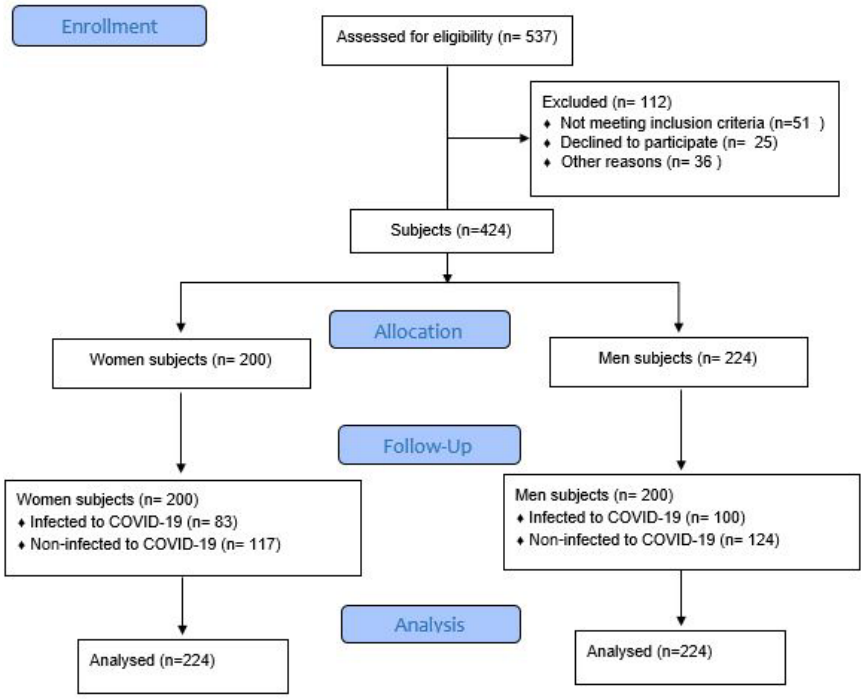

Figure 1. The study Flow-chart

In this study, the short edition of the International Physical Activity Questionnaire (IPAQ-SF) assessed the PAL. T2DM patients received the questionnaire electronically and answered all the questions attentively within a four-day time limit as requested **(16)**. The questionnaire comprised of 7 questions classified into 4 parts of high-intensity physical activity, moderate-intensity physical activity, walking, and sitting **(17)**. The duration and intensity of physical activity over the past week were asked, and over 10-minute activities were admitted **(16, 17)**. The high-intensity physical activities were intense cycling and running, prolonged aerobic exercise, and heavy weight training. Moderate-intensity physical activity included tennis, regular steady-state cycling, and lightweight training. Walking included walking at home, leisure time, and work. The amount of time spent sitting when reading, watching TV, meeting friends, at home, work, and during leisure time was considered as sitting **(18, 19)**. Klishadi et al. (2007) confirmed the reliability and validity of the questionnaire among the Iranian population **(20)**. According to the IPAQ questionnaire scoring method, the PAL over the past week was computed as MET per Minute per Week; walking=3.3, moderate-intensity=4, and high-intensity physical activity=8 METS. The amount of walking, moderate moderate-intensity, and high-intensity physical activity were calculated as MET.Min.Day, over the past week, and three scores were summed **(21)**. The final PAL scores below 600 were assumed as a low, between the range of 600 to 3000 as a moderate, and above 3000 as a high PAL.

Statistical analysis

The SPSS software version 24 was used for all of the analyzes; the independent t-test for comparing men and women, and the Pearson correlation coefficient test for evaluating the relationship between variables at a significant level of ($P<0.05$).

Results

Demographic specifications, PAL, and COVID-19 incidence are shown in Table 1. Based on the results, there were no significant differences in PAL and COVID-19 incidence between women and men. However, women had higher PAL than men while men had higher rates of COVID-19 incidence (Table 1).

Table 1. Demographic specifications among the subjects

Variables	Men (n=224)	Women (n=200)
Age (years)	47.76±10.39	45.98±9.47
Height (cm)	173.05±10.84	163.93±6.14
Weight (kg)	80.37±11.08	73.61±8.11
BMI (kg/m)^2	28.49±4.98	27.41±2.84
PL (MET)	733.85±395.75	846.24±220.52
COVID-19 Incidence (%)	44.6	41

According to the results, most diabetic men and women with COVID-19 also had low PAL. Interestingly, most of the non-infected men and women with T2DM had moderate levels of physical activity (Figure 2).

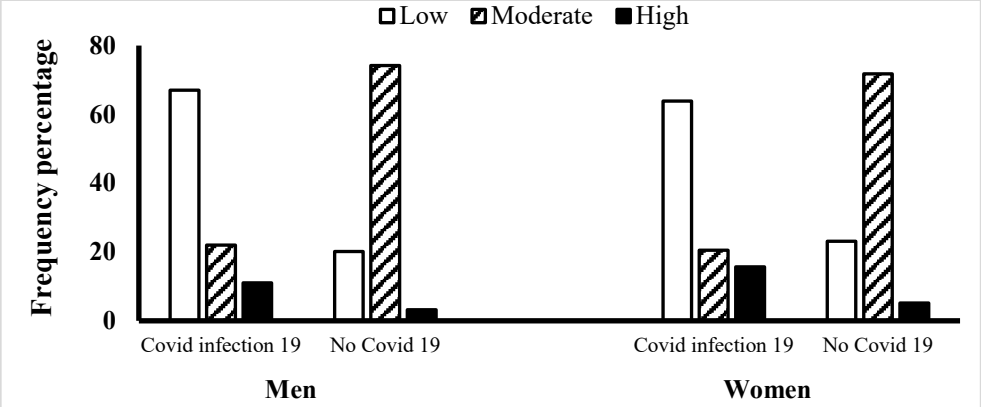

Figure 2. The rate of COVID-19 incidence in different PALs

Table 2 shows a positive and significant relationship between high and low PALs and COVID-19 incidence in women (r=0.728, P=0.011; r=0.331, P=0.018) and men (r=0.638, P=0.039; r=0.231, P=0.048) with T2DM. In comparison, a significant negative correlation was observed between moderate PAL and COVID-19 incidence among men (r=-0.731, P=0.029) and women (r=-0.791, P=0.021). (Table 2).

Table 2. The relationship between the PALs and the incidence of COVID-19

	PLs					
	Men			Women		
Incidence of COVID-19	Low	Moderate	High	Low	Moderate	High
	r=0.638	r=-0.731	r=0.231	r=0.728	r=-0.791	r=0.331
	P=0.039*	P=0.029*	P=0.048*	P=0.011*	P=0.021*	P=0.018*

*: Significantly relationship with PALs and the incidence of COVID-19; the value is calculated using the Pearson's Correlation Coefficient test.

Discussion

The present research showed that the PAL in men and women was 733.85 ± 395.75 and 846.24 ± 220.52, respectively. According to the IPAQ, PALs score below 600 is considered low, between 600 and 3000 as a medium, and above 3000 as a high PAL indicates the insufficient PAL among the participants of this research. According to the previous studies, the low PAL increases the risk of insulin resistance risk factors playing an essential role in developing cardiovascular disease and inflammatory response in diabetic individuals (22). In this regard, the global role of physical activity in the control and treatment of diabetes should not be ignored. Studies have shown that different types of exercise (resistance, aerobics, and combination) help control diabetes via increasing glucose uptake by skeletal muscle, inducing post-exercise hypoglycemia, decreasing fat mass, and increasing insulin sensitivity (23). Praet et al. (2006) suggested that physical activity might improve insulin sensitivity by affecting on the skeletal muscle GLUT4

glucose transporter and insulin receptor substrate 1 (IRS-1) and increasing muscle mass (24). Elevated insulin activates 5' AMP-activated protein kinase (AMPK), starting cascades of events inside the cell that led to the translocation of GLUT4 to the sarcolemma (25). Exercise also reduces body fat percentage and results in weight loss, increased high-density lipoprotein, and decreased low-density lipoprotein (26). Since a sedentary lifestyle is the cause of obesity and overweight and is also considered as an initial risk factor in diabetes; therefore, considering exercise-induced weight loss as a method to control and improve T2DM seems reasonable (27). Sigal et al. (2006) reported that attending in a regular physical activity for 150 minutes per week reduces the risk of diabetes by 5-7% (28). In other words, exercise is an effective non-pharmacological approach reducing insulin resistance in diabetic patients (29).

Regular exercise training increases the immune system capacity, particularly in individuals having underlying diseases (such as T2DM), by improving immune system biomarkers, modulating the oxidative phenotype, and modifying the function of nearly all circulating immune cells during exercise and recovery (30). Also, this study indicated that the PAL in women was significantly higher than in men, which probably explains the lower COVID-19 incidence in women than men. According to the results of other studies, long-term physical activity lowers the hazard of viral and bacterial infections and non-communicable chronic diseases (31, 32). Interestingly, significant positive relationships were observed between high and low PAL and the rate of COVID-19 incidence. While, there was a significant negative correlation between moderate PAL and the rate of COVID-19 incidence, both in men and women. The results of several studies indicate the anti-inflammatory effects of regular moderate-intensity exercise on diseases associated with chronic inflammation (31) through increasing the immune response (32), T cell proliferation, activity of neutrophil phagocytic and cytotoxic t cells, myokines (such as IL-12) production, and decreasing inflammatory circulating cytokine levels (33). Thus, regular moderate-intensity exercise might improve or maintain the immune system response to infections positively (34, 35). Also, intense exercise increases infection risk by suppressing circulating immune parameters such as leukocytes and cytokines (36). Studies indicate the reduction of immune system parameters such as serum immunoglobulin following vigorous and strenuous exercise, which reduces the rate of specific antibody production (37). During the onset of infectious pandemics, some measures will help boost the immune system and reduce complications and the severity of the disease. According to the results, exercise, along with considering the hygiene protocols, is effective in strengthening the immune system and reducing the complications of COVID-19 in people with chronic diseases such as T2DM (38). New research shows that moderate-intensity exercise improves the immune response to respiratory viral infections and decreases the inflammation (39). Therefore, exercise as a generally accepted, inexpensive, and available method might reduce the negative effects of COVID-19 in patients with T2DM. According to the results of the present study, in patients with T2DM, the moderate level of physical activity is inversely related to the COVID-19 incidence.

Conclusion

Finally, most of the patients with T2DM had an inadequate PAL. Compared with low and high PALs, moderate PAL might have lowered the incidence of COVID-19 more effectively. Finally, a moderate PAL is recommended to patients with T2DM to boost the immune system and prevent COVID-19 infection than high or low PAL.

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Ethical standards statement:

The Research Committee in Public Sports Board, Kermanshah, Iran approved the current study (code:1399.1144).

Conflict of Interest

There was no conflict of interest in this study.

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