Research, Society and Development, v. 11, n. 8, e55711831368, 2022
(CC BY 4.0) | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v11i8.31368

Association and comparison of physical activity with cardiovascular health, quality of life and anthropometric measurements in adult women

Associação e comparação da atividade física com a saúde cardiovascular, qualidade de vida e medidas antropométricas em mulheres adultas

Asociación y comparación de la actividad física con la salud cardiovascular, calidad de vida y medidas antropométricas en mujeres adultas

Received: 06/04/2022 | Reviewed: 06/12/2022 | Accept: 06/17/2022 | Published: 06/19/2022

Pedro Henrique de Almeida Silva
ORCID: https://orcid.org/0000-0002-1832-6776
Universidade Evangélica de Goiás, Brasil
E-mail: pedrohenri.educacaofisica@gmail.com
Patrícia Espindola Mota Venâncio
ORCID: https://orcid.org/0000-0001-5692-0568
Universidade Evangélica de Goiás, Brasil
Instituto Federal Goiano, Brasil
E-mail: venanciopatricia@hotmail.com
Maria Sebastiana Silva
ORCID: https://orcid.org/0000-0001-7265-5872
Universidade Federal de Goiás, Brasil
E-mail: maria2593857@hotmail.com
Amanda Rodrigues Borges
ORCID: https://orcid.org/0000-0003-0182-3888
Universidade Evangélica de Goiás, Brasil
E-mail: amandarodriguesb@outlook.com
Ayse Suzel Martins Cosme
ORCID: https://orcid.org/0000-0002-5990-0770
Universidade Evangélica de Goiás, Brasil
E-mail: ayse.martins@ifpi.edu.br
Péricles Soares Bernardes
ORCID: https://orcid.org/0000-0001-9902-4536
Universidade Federal de Goiás, Brasil
E-mail: periclespeti@gmail.com
Viviane Soares
ORCID: https://orcid.org/0000-0002-1570-6626
Universidade Evangélica de Goiás, Brasil
E-mail: ftviviane@gmail.com

Abstract
Objective: To associate and compare the level of physical activity with cardiovascular health (CVH), quality of life, cardiorespiratory fitness, anthropometric variables and workload of active and sedentary women working in a university environment. Methods: Cross-sectional study, carried out with employees of a higher education institution. The sample was for convenience and 51 healthy adult women participated. Seven metrics were evaluated for CVH, using the international physical activity questionnaire and the Mediterranean diet questionnaire. Quality of life was assessed using the *Short Form-36* instrument and cardiorespiratory fitness using the *shuttle run* test. The *Student-t* test and *Mann-Whitney* U test were used to analyze the data, and a multiple linear regression was performed with data adjusted for age and the climacteric period. Results: Active women had lower values for waist-hip ratio (WHR) (p=0.001) and diastolic blood pressure (DBP) (p<0.001), and higher results for maximal oxygen consumption (VO_{2max}) (p<0.001), CVH score (p<0.001), functional capacity (p=0.004), and general health (p=0.009). There was a direct relationship with the CVH score (p= 0.018) and VO_{2max} (p= 0.012), and an inverse relationship for workload (p=0.013). Conclusion: The level of physical activity contributes to lower values of risk factors for cardiovascular diseases (WHR and DBP) and higher values of VO2max, SCV scores and quality of life in active women.
Keywords: Physical activity; Cardiovascular health; Cardiovascular risk factors; Quality of life; Women.

Resumo
Objetivo: Associar e comparar o nível de atividade física com a saúde cardiovascular (SCV), qualidade de vida, aptidão cardiorrespiratória, variáveis antropométricas e carga horaria de trabalho de mulheres ativas e sedentárias que

trabalham em ambiente universitário. Métodos: Estudo transversal, realizado com funcionárias de uma instituição de ensino superior. A amostra foi por conveniência e participaram 51 mulheres adultas saudáveis. Sete métricas foram avaliadas para a SCV, sendo utilizado o questionário internacional de atividade física e o da dieta do mediterrâneo. A qualidade de vida foi pelo instrumento Short Form-36 e a aptidão cardiorrespiratória pelo o shuttle run teste. Os testes utilizados para analisar os dados foram testes T-student, teste U de Mann-Whitney e, ainda, foi feita uma regressão linear múltipla com dados ajustado por idade e climatério. Resultados: As mulheres ativas apresentaram valores inferiores para relação cintura quadril (RCQ) (p= 0,001), pressão arterial diastólica (PAD) (p <0,001), sendo superiores os resultados do consumo máximo de oxigênio ($VO_{2máx}$) (p <0,001), escore de SCV (p <0,001), capacidade funcional (p= 0,004) e saúde geral (p= 0,009). Houve uma relação direta com o escore de SCV (p= 0,018), $VO_{2máx}$ (p= 0,012), enquanto foi inversa para carga horária de trabalho (p=0,013). Conclusão: O nível de atividade física contribui para valores inferiores dos fatores de riscos para doenças cardiovasculares (RCQ e PAD) e superiores de $VO_{2máx}$, escores de SCV e qualidade de vida em mulheres ativas.
Palavras-chave: Atividade física; Saúde cardiovascular; Fatores de risco cardiovasculares; Qualidade de vida; Mulheres.

Resumen
Objetivo: Asociar y comparar el nivel de actividad física con la salud cardiovascular (SCV), calidad de vida, aptitud cardiorrespiratoria, variables antropométricas y carga de trabajo de mujeres activas y sedentarias que trabajan en un ambiente universitario. Métodos: Estudio transversal, realizado con empleados de una institución de educación superior. La muestra fue por conveniencia y participaron 51 mujeres adultas sanas. Se evaluaron siete métricas para SCV, utilizando el cuestionario internacional de actividad física y el cuestionario de dieta mediterránea. La calidad de vida se evaluó mediante el instrumento Short Form-36 y la aptitud cardiorrespiratoria mediante la prueba de carrera de lanzadera. Las pruebas utilizadas para el análisis de los datos fueron la prueba T-student, la prueba U de Mann-Whitney y se realizó una regresión lineal múltiple con datos ajustados por edad y climaterio. Resultados: Las mujeres activas presentaron valores más bajos para el índice cintura-cadera (ICC) (p=0,001), presión arterial diastólica (PAD) (p<0,001), con resultados más altos para el consumo máximo de oxígeno ($VO_{2máx}$) (p< 0,001), SCV score (p<0,001), capacidad funcional (p=0,004) y salud general (p=0,009). Hubo una relación directa con la puntuación SCV (p=0,018), $VO_{2máx}$ (p=0,012), mientras que fue inversa para la carga de trabajo (p=0,013). Conclusión: El nivel de actividad física contribuye a valores más bajos de factores de riesgo para enfermedades cardiovasculares (ICC y PAD) y valores más altos de $VO_{2máx}$, SCV y calidad de vida en mujeres activas.
Palabras clave: Actividad física; Salud cardiovascular; Factores de riesgo cardiovascular; Calidad de vida; Mujeres.

1. Introduction

Physical activity (PA) acts in a protective way on health, helping to prevent chronic non-communicable diseases and reducing the associated risk factors. Current World Health Organization (WHO) guidelines recommend at least 150 to 300 minutes of moderate-intensity aerobic PA per week or 75 minutes of vigorous PA per week for adults with or without chronic conditions (Bull et al., 2020). Thus, the practice of PA reduces the incidence of cancer, diabetes mellitus, anxiety, depression, and cardiovascular diseases, in addition to delaying early aging and favoring aspects related to quality of life (Bull et al., 2020). In this way, a good level of PA increases life expectancy, delaying early mortality from all causes in women (Colpani et al., 2018).

There is evidence that women practice ever decreasing amounts of physical activity and, with the perpetuation of this behavior, the risks for cardiovascular and cardiometabolic events increase, especially with advancing age (Colpani et al., 2018; Fan et al., 2020). The double working day burden, including housework (Chen et al., 2020), and the menstrual period (Schoep et al., 2019) are the most common factors that hinder the acquisition of an active life in women. In addition, the social environment is a major influencer in unhealthy behaviors (alcoholism, smoking, and sedentary lifestyle) which makes it difficult to maintain a good lifestyle (Xue et al., 2021).

The recommended practice of PA favors biological (e.g.: glycemia, total cholesterol, systemic blood pressure), anthropometric aspects [(e.g.: waist circumference (WC), the waist-hip ratio (WHR), and body mass index (BMI)], and is also associated with healthy eating and smoking cessation (Aminian et al., 2021; Shi et al., 2020). In addition, PA acts in a protective way for heart health by reducing risk factors associated with metabolic and cardiovascular diseases (Aminian et al., 2021; Shi et al., 2020).

According to the *American Heart Association* (AHA), cardiovascular health (CVH) is the harmonious work between the heart and the vascular system, without the presence of non-communicable diseases (Lloyd-Jones et al., 2010). It is known that cardiovascular diseases (CVDs) are the main causes of death in the world and, in an attempt to reduce these deaths by 20% and the costs to public health by the year 2020, the AHA established seven metrics to predict the state of CVH, being four behavioral such as: smoking, diet, physical activity level (PAL) and BMI; and three biological frameworks: SBP, total cholesterol, and blood glucose (Lloyd-Jones et al., 2010). A study showed that these parameters, so far, are effective in preventing diseases and increasing the life expectancy of the population (Arnett et al., 2019).

Considering the inflammatory response, there is evidence that the high serum concentration of inflammatory cytokines, especially interleukin-6 (IL-6) is related to the emergence of CVDs or metabolic diseases (Miri et al., 2021; Pang et al., 2021). However, high levels of BMI, blood glucose, total cholesterol, systemic blood pressure, smoking and inadequate food consumption, can induce a chronic inflammatory response (Deloach et al., 2011; Erlanson-Albertsson & Stenkula, 2021; Johannsen et al., 2014; Pang et al., 2021). From this perspective, it is known that these factors primarily assess cardiovascular health (Lloyd-Jones et al., 2010), but to date, only one study in the literature has investigated the relationship between CVH and inflammatory markers (Shpilsky et al., 2018). Although it was reported that less favorable CVH corresponds with higher levels of C-reactive protein and IL-6 (Shpilsky et al., 2018), this finding is only an estimate, and more evidence is needed.

In the literature, there are studies that report the importance of a good level of physical activity in promoting health, in relation to quality of life (QoL) (Bull et al., 2020), anthropometric variables (Cerrone et al., 2020), cardiorespiratory fitness (CRF) (Davarzani et al., 2020), and IL – 6 (Vella et al., 2017), but the association of PA with CVH in women is still not well clarified (Arija et al., 2018). Thus, the present study aimed to associate and compare the level of physical activity with CVH, QoL, CRF, anthropometric variables and workload of active and sedentary women who work in a university environment

2. Methods

2.1 Sample

This is a cross-sectional study, carried out with university employees of an institution located in the city of Anápolis - GO, Brazil. The sample was recruited by convenience and initially, 78 healthy adult women participated, however, 27 women were excluded due to incomplete data. Finally, 51 were included, with a mean age of 37.16 (10.31) years. The inclusion criteria were: aged between 18 and 59 years and an employee of the institution for at least six months. Women with a clinical diagnosis of cardiovascular or chronic pulmonary disease and physical limitations that would prevent them from performing the cardiorespiratory fitness test were excluded.

All participants signed and agreed to the Free and Informed Consent Form. The Ethics and Research Committee of Universidade Evangélica de Goiás approved the study under number 4.512.382/2021.

2.2 Data collection and Study variables

On pre-scheduled days, in the morning, afternoon, and evening, sociodemographic and anthropometric data were collected and the cardiorespiratory test was performed. Also, the Short Form-36 (SF-36) quality of life, as well as assessment of food consumption with the Mediterranean diet questionnaire and level of physical activity using the IPAQ-short version questionnaires were applied. Blood collection were performed according to the availability of the participants, always in the morning because of the need for an 8-hour fast. These procedures were performed individually in the Laboratory of Evaluation and Intervention in Physiotherapy and in the institution's multi-sport gym between January and July 2021.

The dependent variable in this study was the level of physical activity (active and sedentary women), while the independent variables were anthropometric measurements (WC and WHR), biochemical variables (HDL-c, LDL-c, triglycerides), QoL, the seven factors of CVH (diet, PAL, smoking, BMI, fasting glucose, total cholesterol, and systemic blood pressure) and the CRF to estimate the maximum oxygen consumption (VO_{2max}).

2.3 Sociodemographic data

For the collection of sociodemographic data, an identification form was completed with the following information: age, marital status (single, married, divorced), monthly income (one minimum wage, two minimum wages, three minimum wages, four or more minimum wages), schooling level (elementary school, high school, incomplete higher education, complete higher education, and postgraduate), pre-installed comorbidities, continuous use of medication, and workload.

2.4 ***Physical activity***

The IPAQ short version instrument was used to determine which women were active and sedentary, according to the frequency and duration of weekly PA practices, with moderate or vigorous intensity or leisure activities (Matsudo et al., 2001). Women classified as active if they had ≥150 min weekly of moderate-intensity PA or ≥75 min of vigorous-intensity PA, or ≥150 min weekly of moderate-intensity PA. In addition, the resting heart rate (RHR) was measured using a sports watch (Polar brand, model M430, Kempele, Finland).

2.5 Anthropometric measurements

An inextensible measuring tape (Cescorf brand, Trena model, São Paulo, Brazil) was used to measure hip circumference (HC) and WC. The first measurement was performed in the hip region, at least three consecutive times, and considering the area of largest bulge, and the second between the superior iliac crest and the midpoint of the last two ribs (WHO, 2008). Through these two measures, the WC/HC calculation was performed to estimate the WHR (WHO, 2008). The reference values considered for WHR and WC in women were < 0.76 cm and ≥88 cm, respectively (WHO, 2008).

2.6 Cardiorespiratory fitness

To assess the CRF, the 20-meter *shuttle run* test was performed, validated for Brazilians (Duarte & Duarte, 2001). The test is multi-stage with the ability to identify maximum aerobic power on a flat surface, with a 20-meter track (Léger et al., 1988). A metronome was used to play sequences of *beeps* with increasing intensities, starting at 8.5 km/h. The test has 20 stages and the number of laps increased with each stage. The test was interrupted when the participants failed to complete two subsequent stages, in which the velocity of the last complete stage was considered to estimate VO_{2max} through the following formula (Duarte & Duarte, 2001; Léger et al., 1988):

VO_{2max} = - 24,4 + 6 x (Vel.) ml/kg/min Equation (1)

2.7 Cardiovascular Health

CVH was evaluated according to the AHA recommendations, which established seven metrics, four behavioral (diet, PAL, smoking, BMI) and three biological (fasting glucose, total cholesterol, and systemic blood pressure) (Lloyd-Jones et al., 2010). After analysis, these metrics were categorized as poor (0 - points), intermediate (1 - points), or ideal (2 - points). These points were added together to determine the CVH status of the women, corresponding to poor (2 - 8 points), intermediate (9 - 10 points), and ideal (11 - 14 points) (supplementary material 1).

The diet metric was adapted, using a Cardioprotective Food Manual developed for the Brazilian public (Brasil, 2018). The manual contains the same food groups as the Mediterranean food-diet frequency questionnaire, applied in another study (Panagiotakos et al., 2006). This instrument contains 11 items (unrefined cereals, fruits, vegetables, potatoes, vegetables, olive oil, fish, red meat, poultry, whole milk derivatives, and alcohol) that have a degree of adherence (Panagiotakos et al., 2006). The score ranges from 0 to 55 points and higher values are related to greater adherence to a diet that represents a healthy and cardioprotective diet (Panagiotakos et al., 2006). In this way, the scores were adapted from the degree of adherence to classify the CVH as poor (0-22 points), intermediate (23-34 points), and ideal (35-55 points).

The other CVH metrics were assessed as follows: smoking, through a self-report questionnaire (never smoked or quit for more than 12 months, quit smoking for less than 12 months, and current smoker); BMI, by calculation (weight (kg) / height m^2), requiring a digital scale (brand G-Tech, model Balgl10, São Paulo, Brazil) to measure body mass and a portable stadiometer (Sanny brand, São Paulo, Brazil) to measure height; PAL was evaluated through the international physical activity questionnaire - short version (IPAQ-short version) as it provides the frequency and duration of moderate and vigorous physical activities and activities of daily living/leisure (Matsudo et al., 2001); glucose and total cholesterol, between 8-12 hours of fasting by the colorimetric enzymatic method; and diastolic blood pressure (DBP) and systolic blood pressure (SBP) were measured using a semiautomatic device (brand, OMRON, model HEM 705CP, Kyoto, Japan).

2.8 Quality of life

The validated Short Form-36 (SF-36) questionnaire for Brazilians was used to assess QoL (Ciconelli et al., 1999). This questionnaire assesses eight domains through a multi-item scale with 11 multiple-choice questions, referring to the last four weeks lived by the participant. The domains are divided as follows: functional capacity (10 items), limitations caused by physical (4 items) and mental health problems (3 items), social function (2 items), emotional well-being (5 items), pain (2 items), vitality (4 items), and perception of general health (5 items) (Ciconelli et al., 1999). The SF-36 has a score of 0-100 with higher values corresponding to better QoL, and lower values to a less favorable QoL (Ciconelli et al., 1999).

2.9 Data analysis

Data normality was tested using the *Kolmogorov-Smirnov* test, expressed as mean, standard deviation, minimum, maximum, frequency, and percentage. The comparisons between the groups of women (active and sedentary) were performed using the *student-t* test for independent samples, with symmetrical distribution, and the *Mann-Whitney U* test for independent samples with asymmetrical distribution. Cohen's d was used to identify the effect size when comparing the groups, classified as insignificant (< 0.19), small (0.20 - 0.49), medium (0.50 - 0.79), large (0.80 - 1.29), and very large (> 1.30) (Rosenthal, 1996). Multiple linear regression was performed using the *stepwise* method for dependent (CVH score) and independent (VO_{2max} and RHR) samples, with data adjusted for age and climacteric period. The software used for analysis was the *Statistical Package for the Social Sciences* (SPSS) and the value considered was $p < 0.05$. Sampling power was calculated using the free domain *GPower software* (version 3.1, Universitat Dusseldorf, Germany), in which multiple linear regression with three predictors, a mean effect size 0.15, significance level of 5%, were considered for analysis, with a sampling power of 82%. As for the classification between sedentary and active women, each group would need proportionally 21 women to reach the aforementioned sample power.

3. Results

Table 1 refers to the baseline and demographic characteristics of the sample studied, which included the participation of 51 adult women. Married women participated more frequently (58.8%), and most of them had never smoked or quit for

more than 12 months (98%). In addition, 24 (47.1%) received approximately one monthly minimum wage, 15 (29.4%) were graduates, and 29 (56.9%) were sedentary.

Table 1. Baseline and demographic characteristics of the sample studied (n=51).

Variables	Value (n=51)
Baseline data, mean (SD)	
Age (years)	37.2 (10.3)
Height (cm)	161.3 (6.8)
Body mass (kg)	65.8 (12.9)
Marital status, n (%)	
Married	30 (58.8)
Single	19 (37.3)
Divorced	2 (3.9)
Smoking, n (%)	
Smokers	1 (2.0)
Former smokers (quit for less than 12 months)	0 (0)
Never smoked or quit for more than 12 months	50 (98.0)
Income (salary-R$), n (%)	
One minimum wage	24 (47.1)
Two minimum wages	22 (43.1)
Three minimum wages	3 (5.9)
Four or more minimum wages	2 (3.9)
Level of schooling, n (%)	
Elementary	1 (2.0)
High	11 (22.6)
Incomplete higher education	13 (25.5)
Complete higher education	15 (29.4)
Postgraduate	11 (21.6)
Practice of physical activity/exercise, n (%)	
Sedentary	29 (56.9)
Active	22 (43.1)
Comorbidities, n (%)	
Respiratory tract	3 (5.9)
Depression/anxiety	9 (17.6)
Others	3 (5.9)
Drugs, n (%)	
Contraceptive	5 (9.8)
Antidepressant/Anxiolytic	9 (17.6)
Multivitamin	3 (5.9)
Anticoagulant	1 (2)

Abbreviations: SD= standard deviation. Source: Authors (2022).

The comparison of anthropometric and biochemical variables, cardiovascular health metrics and score, cardiorespiratory fitness, and quality of life between active and sedentary women are shown in Table 2. In total, 26 (51%) women were classified as obese and 25 (49%) as eutrophic. In addition, active women had lower results for WHR (Δ= 0.07 cm, d= 0.11, p=0.001) and DBP (Δ= 6.3 mmHg, d= 0.52, p<0.001), while the VO_{2max} values (Δ= 2.9, p<0.001), CVH score (Δ= 2.2, p<0.001), PAL (Δ= 93 min/week, d= 0.76, p<0.001) functional capacity (Δ= 11.8, p=0.004), and general health (Δ= 2.9, p=0.009) were higher compared to sedentary women.

Table 2. Anthropometric and biochemical parameters, workload, cardiorespiratory fitness, cardiovascular health metrics and score, and quality of life of active and sedentary women (n=51).

	Women				
	Sedentary (n=29)		Active (n=22)		
Parameters	Mean (SD)	Med (Min–Max)	Mean (SD)	Med (Min–Max)	p
Anthropometric					
WC (cm)	84.2 (12.4)	81 (67-119)	77.6 (11.1)	76.8 (62-102)	0.058
WHR (cm)	0.8 (0.9)	0.8 (0.7-1.1)	0.8 (0.1)	0.8 (0.6-0.9)	0.001
Biochemical					
LDL-c (mg/dL)	103.1 (33.8)	101 (39 -155)	103.4 (31.3)	101.5 (56-189)	0.203
HDL-c (mg/dL)	53.8 (6.5)	53 (43-63)	57.9 (7.1)	59.5 (45-69)	0.469
Triglycerides (mg/dL)	115.4 (64.7)	103 (55-391)	92.8 (47.3)	80 (40-223)	0.051
Iterleucin-6 (mg/dL)	2.9 (1.8)	2 (1.5-8.6)	2.2 (0.9)	2 (1.5-5.1)	0.325
Cardiorespiratory fitness					
VO_{2max}	27.3 (1.3)	26.6 (26.6-29.6)	30.2 (3.1)	29.6 (26.6-38.9)	<0.001
Workload					
Hours/day	8.3 (0.5)	8.0 (8-9)	8.0 (1.3)	8.0 (5-10)	0.239
Cardiovascular health					
Behavioral factors					
Diet (points)	29.9 (6.5)	31 (15-41)	28.1 (6.6)	27 (15-42)	0.317
PAL (min/wk)	134.7 (127.9)	80 (0-420)	227.7 (116.7)	262.5 (135-590)	<0.001
BMI (kg/m^2)	26.1 (5.2)	24.8 (19.3-36.4)	24.3 (4.4)	24.1 (14.8-32.3)	0.210
Biological factors					
Glycemia (mg/dL)	80.7 (6.3)	80 (70-97)	80.9 (8.8)	79.5 (71-102)	0.452
Total Cholesterol (mg/dL)	180.1 (37.5)	173 (117-263)	179.8 (35.2)	180 (120-260)	0.391
SBP (mmHg)	123.9 (18.5)	121 (102-175)	114.4 (14.9)	116 (73-149)	0.114
DBP (mmHg)	82.5 (12.8)	80 (62-108)	76.2 (11.5)	75.5 (49-97)	<0.001
CVH (score)	9.3 (1.8)	10 (6-12)	11.5 (1.8)	12 (8-14)	<0.001
Quality of life					
Functional capacity	73.9 (18.9)	80 (20-100)	85.7 (18.2)	90 (25-100)	0.004
Physical aspects	86.2 (30.3)	100 (0-100)	82.9 (35.7)	100 (0-100)	0.812
Pain	70.3 (28.7)	74 (22-100)	69.5 (24.6)	67 (31-100)	0.853
General health	52 (17.8)	57 (15-72)	54.9 (18.2)	58.5 (25-85)	0.009
Vitality	53.5 (20.5)	55 (0-90)	53.9 (18.9)	50 (25-100)	0.605
Social aspect	67.2 (22.5)	75 (25-100)	67.1 (22.7)	62.5 (25-100)	0.992
Emotional aspect	64.4 (41.7)	100 (0-100)	65.2 (45.4)	100 (0-100)	0.866
Mental health	63.0 (16.4)	60 (28-100)	68.2 (14.8)	70 (44-96)	0.260

Abbreviations: SD= standard deviation; Med= Median; Min= Minimum; Max= Maximum; WC= waist circumference; WHR= Waist-hip ratio; PAL= Physical activity level; BMI= Body Mass Index; SBP= Systolic blood pressure; DBP= Diastolic blood pressure; CVH= Cardiovascular health. Source: Own authorship (2022).

Table 3 refers to a linear regression between the total time (minutes) spent in weekly physical activities/exercise with VO_{2max}, RHR, cardiovascular health score, and quality of life. There was a positive relationship between VO_{2max} (p=0.012) and CVH score (p=0.018), while it was inverse for resting heart rate (p=0.010) and workload (p=0.013), with the data adjusted by age and climacteric period.

Table 3. Linear regression between the amount of time (minutes) spent in weekly physical activities/exercise with VO_{2max}, resting heart rate, cardiovascular health score, and quality of life.

	Amount of time (minutes) spent on weekly physical activities/exercise		
	β (95%CI)	**Adjusted R^2 (%)**	**p**
Variables			
VO_{2max}	0.351(4.310 – 33.433)	19.5	0.012
Resting heart rate	-0.340 (-7.189 – -1.013)	20.0	0.010
Cardiovascular health score	0.335 (4.080 – 41.759)	18.3	0.018
Physical aspects	-0.70 (-1.498 – - 0.889)	8.4	0.610
Functional capacity	0.189 (- 0.609 – 3.376)	11.5	0.169
Workload	-0.349 (- 95.478 – - 12.033)	19.4	0.013

Abbreviations: CI= Confidence Interval. Adjustment variables: Age and climacteric period. Data for $p<0.05$. Source: Own authorship (2022).

4. Discussion

The main findings of the study indicate that active women had lower values for WHR and DBP, while VO_{2max} and CVH scores and QoL functional capacity and general health domains were higher when compared to sedentary women. In addition, a direct relationship was identified between the time (minutes) spent in weekly physical activities/exercise with VO_{2max} and the CVH score, which, on the other hand, was inverse for workload. Furthermore, although IL-6 did not show a relationship with CVH in this study, recent research has shown the importance of maintaining a greater number of CVH metrics at optimal levels, as this is associated with a low chronic inflammatory response (Shpilsky et al., 2018).

The results identified that sedentary women had higher values for WHR and DBP, and lower values for VO_{2max} and scores of the functional capacity and general health QoL domains. Evidence suggests maintenance of these parameters is important, with the regular practice of physical activity together with an adequate diet, since they are considered risk factors for cardiometabolic and cardiovascular diseases (Gottesman et al., 2018; Holben et al., 2017; Marín-Jiménez et al., 2020). When the CVH score was analyzed and compared, active women had higher values. This aspect is still not well clarified in the literature, although a study evaluated the benefits of PA in CVH, the CVH metrics established by the AHA were not all studied (Arija et al., 2018). However, a good level of PA is associated with better control of blood glucose, total cholesterol, systemic blood pressure, and BMI, as well as increasing VO_{2max} and improving QoL (Gottesman et al., 2018; Holben et al., 2017; Marín-Jiménez et al., 2020). In this way, the functional capacity and general health domains of QoL can be improved if sedentary women start to practice PA.

It is noteworthy that the ideal CVH is associated with a lower incidence of cardiovascular and cardiometabolic diseases (Gao et al., 2020). This is justified by the fact that the seven parameters (smoking, diet, physical activity level, BMI, SBP, blood glucose, and total cholesterol) considered to assess CVH are factors associated with the development of these pathologies (Lloyd-Jones et al., 2010). Thus, keeping these metrics at optimal levels for health is a key resource to increase life expectancy and reduce costs to public health (Lloyd-Jones et al., 2010). However, it was indicated that a good CVH score is directly associated with the amount of time (minutes) spent in weekly physical activities/exercise, that is, the regular practice of activity and physical exercise contributes to a better CVH. This aspect was similar in another study, with sedentary behavior being reported to have an inverse relationship with ideal CVH and physical fitness when data were adjusted for sex and age. However, unfortunately, a sedentary lifestyle is becoming increasingly common among adults and its persistence leads to installations of non-communicable diseases (Young et al., 2016). It is important to emphasize that this was the first research to relate PA with the CVH score of women within the pandemic period and that more studies are needed given its importance for health promotion.

Good CRF protects people's health by reducing the development of noncommunicable diseases and decreasing associated risk factors (Tikkanen et al., 2018). In the cardiovascular system, it reduces cardiac stiffness, contributing to better

blood distribution (Howden et al., 2018), which is associated with a lower incidence of heart failure (Kokkinos et al., 2019), in addition to maximizing mitochondrial respiration and increasing the eddectivity of blood distribution in the vascular system (Strasser & Burtscher, 2018). Furthermore, good CRF is directly related to the amount of time (minutes) spent in weekly physical activities/exercise. This aspect was similar to the study of Lavie et al., (2019), who reported that one of the benefits of PA is a significant improvement in VO_{2max}, and as a result, according to the increase in the level of physical activity, better CRF.

Regarding the workload, a study reports a positive correlation with poor food consumption, especially with the intake of hypercaloric and fatty foods (Padilla et al., 2019). In addition, exhaustion after work is negatively correlated with the practice of moderate and vigorous PA, that is, after a large workload, tiredness/exhaustion interferes with the performance of exercises, which leads to a more sedentary life (Padilla et al., 2019). These aspects were similar to those reported in the present study, which found an inverse relationship between workload and the amount of time (minutes) spent on weekly physical activities/exercise, since there was a negative relationship between both variables. Regarding adherence to physical activity, active women were aware of risk factors for CVDs. In other words, better practice of PA is undermined by a high workload and the literature states that coronary heart disease, cardiovascular disease, and stroke are directly associated with a daily workload of more than 10 hours a day and/or 55 hours a week (Lee et al., 2019; Trudel et al., 2020; Virtanen & Kivimäki, 2018).

The limitations of the current study include the low adherence of the institution's employees to the study, the lack of establishment of the cause-effect relationship due to the type of study performed, and the lack of measurement of the time spent sitting or standing during work, which are relevant variables that could be associated with CVH. The strengths of the study are the adaptation of the CVH metrics established by the AHA according to standardized measures for Brazilians regarding diet and PA level. This is the first study to relate the PAL with the CVH metrics and score of adult women, with all seven parameters being accurately evaluated. In addition, the dosage of the cytokine, IL-6, an important marker of pro-inflammatory response and high cost-effectiveness, was collected from all women in the present study.

5. Conclusion

In conclusion, the results suggest that the regular practice of physical activity and the time of weekly practice have a positive relationship with the CVH score, maximum oxygen consumption (VO_{2max}), and quality of life. SBP and WHR were lower in active women. Furthermore, workload is inversely related to the amount of time (minutes) spent on weekly physical activities/exercise. However, it is essential that the habits of life are improved through an educational conduct with regular practice of activities and physical exercises together with an adequate diet. Since these behavioral factors influence the biological ones over time. In this way, the CVH score, CRF and QoL will be better, in addition to reducing risk factors for cardiovascular events and increasing life expectancy.

References

Aminian, O., Saraei, M., Pour, S. N., & Eftekhari, S. (2021). Association between type of physical activity and risk factors for cardiovascular disease, Islamic Republic of Iran. *Eastern Mediterranean Health Journal*, *27*(11), 1061–1068.

Arija, V., Villalobos, F., Pedret, R., Vinuesa, A., Jovani, D., Pascual, G., & Basora, J. (2018). Physical activity, cardiovascular health, quality of life and blood pressure control in hypertensive subjects: Randomized clinical trial 11 Medical and Health Sciences 1117 Public Health and Health Services 11 Medical and Health Sciences 1102 Cardiorespir. *Health and Quality of Life Outcomes*, *16*(1), 1–11.

Arnett, D. K., Blumenthal, R. S., Albert, M. A., Buroker, A. B., Goldberger, Z. D., Hahn, E. J., Himmelfarb, C. D., Khera, A., Lloyd-Jones, D., McEvoy, J. W., Michos, E. D., Miedema, M. D., Muñoz, D., Smith, S. C., Virani, S. S., Williams, K. A., Yeboah, J., & Ziaeian, B. (2019). 2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. In *Circulation* (Vol. 140, Issue 11).

Brasil. (2018). O Guia Alimentar Para a População: alimentação cardioprotetora. *Ministerio Da Saúde e Hospital Do Coração*.

Bull, F. C., Al-Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., Carty, C., Chaput, J. P., Chastin, S., Chou, R., Dempsey, P. C., Dipietro, L., Ekelund, U., Firth, J., Friedenreich, C. M., Garcia, L., Gichu, M., Jago, R., Katzmarzyk, P. T., & Willumsen, J. F. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British Journal of Sports Medicine*, *54*(24), 1451–1462.

Cerrone, L. A., Caranti, D. A., Fidalgo, J. P., Sanches, R. B., Nascimento, M. A., Astride, R. R., Poli, V. F., de Campos, C. E., Oyama, L. M., Yi, L. C., Dâmaso, A. R., Teixeira, C. V., & Gomes, R. J. (2020). Thirty-two weeks of randomized interdisciplinary therapy or combined physical training promote similar improvements in anthropometric and biochemical parameters of obese women. *Journal of Sports Medicine and Physical Fitness*, *60*(6), 903–911.

Chen, L., Fan, H., & Chu, L. (2020). The Double-Burden Effect: Does the Combination of Informal Care and Work Cause Adverse Health Outcomes Among Females in China? *Journal of Aging and Health*, *32*(9), 1222–1232.

Ciconelli, R. M., Ferraz, M. B., Santos, W., Meinao, I. M., & Quaresma, M. R. (1999). Tradução para a língua portuguesa e validação do questionário genérico de avaliação de qualidade de vida SF-36 (Brasil SF-36). In *Arthritis And Rheumatism. Philadelphia: Lippincott-raven*, *30(3)*, 143–150.

Colpani, V., Baena, C. P., Jaspers, L., van Dijk, G. M., Farajzadegan, Z., Dhana, K., Tielemans, M. J., Voortman, T., Freak-Poli, R., Veloso, G. G. V., Chowdhury, R., Kavousi, M., Muka, T., & Franco, O. H. (2018). Lifestyle factors, cardiovascular disease and all-cause mortality in middle-aged and elderly women: a systematic review and meta-analysis. *European Journal of Epidemiology*, *33*(9), 831–845.

Davarzani, S., Babaei, N., Ebaditabar, M., Djafarian, K., & Shab-Bidar, S. (2020). Associations of physical activity with cardiorespiratory fitness, muscle strength, and body composition. *Pediatric Endocrinology, Diabetes and Metabolism*, *26*(4), 183–191.

Deloach, S., Huan, Y., Martinez Cantarin, M. P., Falkner, B., & Keith, S. W. (2011). Relationship of blood pressure and obesity with inflammatory cytokines among African Americans. *Therapeutic Advances in Cardiovascular Disease*, *5*(3), 149–157.

Duarte, M. de F. da S., & Duarte, C. R. (2001). Validade do teste aeróbio de corrida de vai-e-vem de 20 metros. *Rev. Bras. Ciên. e Mov.*, *9*(3), 7–14.

Erlanson-Albertsson, C., & Stenkula, K. G. (2021). The importance of food for endotoxemia and an inflammatory response. *International Journal of Molecular Sciences*, *22*(17), 1–8.

Fan, J., Ding, C., Gong, W., Yuan, F., Ma, Y., Feng, G., Song, C., & Liu, A. (2020). The relationship between leisure-time sedentary behaviors and metabolic risks in middle-aged chinese women. *International Journal of Environmental Research and Public Health*, *17*(19), 1–11.

Gao, B., Wang, F., Zhu, M., Wang, J., Zhou, M., Zhang, L., & Zhao, M. (2020). Cardiovascular health metrics and all-cause mortality and mortality from major non-communicable chronic diseases among Chinese adult population. *International Journal of Cardiology*, *313*, 123–128.

Gottesman, K., Rawal, S., Parrott, J. S., Byham-Gray, L. D., Touger-Decker, R., & Radler, D. R. (2018). The relationships between physical activity and cardiometabolic risk factors among women participating in a university-based worksite wellness program. *Journal of Occupational and Environmental Medicine*, *60*(12), 1098–1107.

Holben, D. H., Rambo, C., Howe, C., Murray, D. H., & Shubrook, J. H. (2017). Cardiovascular disease risk factors after an employer-based risk reduction program: An observational cohort study. *Journal of the American Osteopathic Association*, *117*(7), 425–432.

Howden, E. J., Sarma, S., Lawley, J. S., Opondo, M., Cornwell, W., Stoller, D., Urey, M. A., Adams-Huet, B., & Levine, B. D. (2018). Reversing the Cardiac Effects of Sedentary Aging in Middle Age-A Randomized Controlled Trial: Implications for Heart Failure Prevention. *Circulation*, *137*(15), 1549–1560.

Johannsen, A., Susin, C., & Gustafsson, A. (2014). Smoking and inflammation: Evidence for a synergistic role in chronic disease. *Periodontology 2000*, *64*(1), 111–126.

Kokkinos, P., Faselis, C., Franklin, B., Lavie, C. J., Sidossis, L., Moore, H., Karasik, P., & Myers, J. (2019). Cardiorespiratory fitness, body mass index and heart failure incidence. *European Journal of Heart Failure*, *21*(4), 436–444.

Lavie, C. J., Ozemek, C., Carbone, S., Katzmarzyk, P. T., & Blair, S. N. (2019). Sedentary Behavior, Exercise, and Cardiovascular Health. *Circulation Research*, *124*(5), 799–815.

Lee, D. wook, Kim, H. R., Myong, J. P., Choi, J., Hong, Y. C., & Kang, M. Y. (2019). Does working long hours increase the risk of cardiovascular disease for everyone? *Journal of Occupational Health*, *61*(6), 431–441.

Léger, L. A., Mercier, D., Gadoury, C., & Lambert, J. (1988). The multistage 20 metre shuttle run test for aerobic fitness. *Journal of Sports Sciences*, *6*(2), 93–101.

Lloyd-Jones, D. M., Hong, Y., Labarthe, D., Mozaffarian, D., Appel, L. J., Van Horn, L., Greenlund, K., Daniels, S., Nichol, G., Tomaselli, G. F., Arnett, D. K., Fonarow, G. C., Ho, P. M., Lauer, M. S., Masoudi, F. A., Robertson, R. M., Roger, V., Schwamm, L. H., Sorlie, P., & Rosamond, W. D. (2010). Defining and setting national goals for cardiovascular health promotion and disease reduction: The american heart association's strategic impact goal through 2020 and beyond. *Circulation*, *121*(4), 586–613.

Marín-Jiménez, N., Ruiz-Montero, P. J., De la Flor-Alemany, M., Aranda, P., & Aparicio, V. A. (2020). Association of objectively measured sedentary behavior and physical activity levels with health-related quality of life in middle-aged women: The FLAMENCO project. *Menopause (New York, N.Y.)*, *27*(4), 437–443.

Matsudo, S., Araújo, T., Matsudo, V., Andrade, D., Andrade, E., Oliveira, L. C., & Braggion, G. (2001). Questionário Internacional De Atividade Física

(Ipaq): Estupo De Validade E Reprodutibilidade No Brasil. *Questionário Internacional De Atividade Física (Ipaq): Estupo De Validade E Reprodutibilidade No Brasil*, *6*(2), 5–18.

Miri, Y., Leander, K., Eriksson, P., Gigante, B., & Ziegler, L. (2021). Interleukin 6 trans-signalling and the risk of future cardiovascular events in men and women. *Open Heart*, *8*(2), 4–10.

Padilla, H. M., Wilson, M., Vandenberg, R. J., Davis, M., & Clark, M. A. (2019). Health behavior among working adults: Workload and exhaustion are associated with nutrition and physical activity behaviors that lead to weight gain. *Journal of Health Psychology*, *26*(6), 892–904.

Panagiotakos, D. B., Pitsavos, C., & Stefanadis, C. (2006). Dietary patterns: A Mediterranean diet score and its relation to clinical and biological markers of cardiovascular disease risk. *Nutrition, Metabolism and Cardiovascular Diseases*, *16*(8), 559–568.

Pang, Y., Kartsonaki, C., Lv, J., Fairhurst-Hunter, Z., Millwood, I. Y., Yu, C., Guo, Y., Chen, Y., Bian, Z., Yang, L., Chen, J., Clarke, R., Walters, R. G., Holmes, M. V., Li, L., & Chen, Z. (2021). Associations of Adiposity, Circulating Protein Biomarkers, and Risk of Major Vascular Diseases. *JAMA Cardiology*, *6*(3), 276–286.

Rosenthal, J. A. (1996). Qualitative descriptors of strength of association and effect size. *Journal of Social Service Research*, *21*(4), 37–59.

Schoep, M. E., Nieboer, T. E., van der Zanden, M., Braat, D. D. M., & Nap, A. W. (2019). The impact of menstrual symptoms on everyday life: a survey among 42,879 women. *American Journal of Obstetrics and Gynecology*, *220*(6), 569.e1-569.e7.

Shi, R., Cai, Y., Qin, R., Yan, Y., & Yu, D. (2020). Dose-response association between physical activity and clustering of modifiable cardiovascular risk factors among 26,093 Chinese adults. *BMC Cardiovascular Disorders*, *20*(1), 1–8.

Shpilsky, D., Bambs, C., Kip, K., Patel, S., Aiyer, A., Olafiranye, O., Reis, S. E., & Erqou, S. (2018). Association between ideal cardiovascular health and markers of subclinical cardiovascular disease. *Clinical Cardiology*, *41*(12), 1593–1599.

Strasser, B., & Burtscher, M. (2018). Survival of the fittest: VO2max, a key predictor of longevity? *Frontiers in Bioscience - Landmark*, *23*(8), 1505–1516.

Tikkanen, E., Gustafsson, S., & Ingelsson, E. (2018). Associations of fitness, physical activity, strength, and genetic risk with cardiovascular disease: Longitudinal analyses in the UK biobank study. *Circulation*, *137*(24), 2583–2591.

Trudel, X., Brisson, C., Gilbert-Ouimet, M., Vézina, M., Talbot, D., & Milot, A. (2020). Long Working Hours and the Prevalence of Masked and Sustained Hypertension. *Hypertension*, 532–538.

Vella, C. A., Allison, M. A., Cushman, M., Jenny, N. S., Miles, M. P., Larsen, B., Lakoski, S. G., Michos, E. D., & Blaha, M. J. (2017). Physical Activity and Adiposity-related Inflammation: The MESA. *Medicine and Science in Sports and Exercise*, *49*(5), 915–921.

Virtanen, M., & Kivimäki, M. (2018). Long Working Hours and Risk of Cardiovascular Disease. *Current Cardiology Reports*, *20*(11), 1–7.

World Health Organisation (WHO). (2008). *WHO | Waist Circumference and Waist–Hip Ratio. Report of a WHO Expert Consultation. Geneva, 8-11 December 2008. December*, 8–11.

Xue, Y., Huang, Z., Liu, G., Zhang, Z., Feng, Y., Xu, M., Jiang, L., Li, W., & Xu, J. (2021). Associations of environment and lifestyle factors with suboptimal health status: a population-based cross-sectional study in urban China. *Globalization and Health*, *17*(1), 1–12.

Young, D. R., Hivert, M. F., Alhassan, S., Camhi, S. M., Ferguson, J. F., Katzmarzyk, P. T., Lewis, C. E., Owen, N., Perry, C. K., Siddique, J., & Yong, C. M. (2016). Sedentary behavior and cardiovascular morbidity and mortality: A science advisory from the American Heart Association. *Circulation*, *134*(13), e262–e279.