Book Chapter

Study on Little Active and Sedentary Women: Comparison Between Protocols and Prospects for Admission in Physical Activity Program

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Abstract

The aim of this work was to study little active and sedentary women through physical assessments using anthropometric measurements and exercise testing using the Naughton and Bruce protocols. Approximately 53 women were evaluated:Group 1 - comprised of 17 completely sedentary women, aged 25-58 years, mean age 44.4 years, and Group 2 - comprised of 36 women who answered doing physical activities once or twice a week (low active), aged 28-54 years, mean age 39.5 years. The results were statistically compared using the Student t-test, two-tailed, significance level of $p>0.05$. The results compared between the heart rate of groups 1 and 2 were different from the 3rd to the 5th stage between the protocols used. Resting and recovery systolic blood pressure showed a statistically different result. As for diastolic blood pressure, a difference was detected at 5% in the recovery phase in the stages 1-4 of the protocols used. Double product showed significant differences at 5% in stage 3 and in the recovery phase.

Keywords

Exercise Testing; Sedentary Lifestyle; Double Product; Heart Rate; Blood Pressure

Introduction

A sedentary lifestyle is the lack or decrease of physical activity. A sedentary person is one who spends few calories per week with occupational activities, not necessarily in sports activities. This entails a great risk to health: physical inactivity is associated with increased incidence of various diseases and ailments such as obesity, diabetes, increase bad cholesterol

(LDL), fat deposits in arteries, hypertension and myocardial infarction [1].

Today, the leading causes of deaths in Brazil may be related to lack of physical activity. Only 13% of Brazilians practice exercises and more than 60% of the population is completely sedentary. Sedentary lifestyle increases in 54% the cases of myocardial infarction and in 50% the risk of death from stroke. Every year, more than 300,000 die in Brazil by lack of physical activity. The risk of death from heart disease is reduced by 40% by becoming a little more active [2].The authors has described that physical inactivity is considered the main risk factor for sudden death and is most often associated directly or indirectly to causes or worsening of most diseases [3].

[4] Report that more and more people have acquired the habit of regular physical activity, whether spontaneous or controlled by physical education professionals. Overall, this option of incorporating exercise habits to everyday life brings important benefits to the body in various organs and systems, favorably reflecting on the overall health of the individual. Obviously, this conduct in relation to physical exercise must be encouraged at various levels and segments of society, given its scientifically proven effectiveness with regard to disease prevention, health promotion and improved overall levels of quality of life.

Physical assessment must precede any type of exercise program. It is of fundamental importance to carry physical assessments before starting a physical activity program, not only to check possible health problems of a general nature, but also to verify the evolution of the individual in the post-assessment [5].

Physical activity is a way to restore health from the harmful effects of work routine. It can be observed that the more the individual has an active life the better their quality of life. Furthermore, there are differences between people who practice physical activity and those who do not, regarding the quality of life and psychological and cognitive aspects [5].

Exercise is a form of leisure and restores health from the harmful effects that the stressful work produces through routine. Thus, stress is the way the body responds to any stimulus that alters its equilibrium state, and this stimulus can be good or bad, real or imaginary [6].

Research conducted by the Society of Cardiology of the State of São Paulo [7] found that half of the state population has a sedentary life. The regional SOCESP also revealed that most residents do not engage in exercise as they should.

[8]"Sedentary lifestyle can be included as the major risk factor for cardiovascular diseases and is a major cause of death in the country," he said. According to the cardiologist, who also works with sports medicine, the lack of routine exercise increases the chances of developing new diseases in the body. The study also showed that women are more sedentary than men: 57% are not physically active. Among men, this number drops to 42%.

The elders would also be more sedentary, since 56% of people over 35 do not exercise. From 14 to 17 years the rate is 30%, between 18 and 24 it is 43%, and from 25 to 34 it rises to 50%. SOCESP emphasizes that the ideal is to do aerobic exercises like swimming, running and walking three times a week, and more intense exercise as weight training twice a week.

[9] Investigated the association between anthropometric indicators and metabolic variables in 69 subjects of both genders. The results showed that heart rate correlated with the intensity of effort, being related to fat percentage and BMI. Blood pressure (systolic and diastolic) showed good correlation with BMI for the female group. In the male group, WHR was the anthropometric indicator that showed a higher association with blood pressure. The double product had a higher correlation with BMI, indicating that this variable reflects the work of the myocardium.

As for noncommunicable chronic diseases, according to unpublished data from the National Health Survey (NHS) about 40% of the Brazilian adult population, the equivalent of 57.4

million people has at least one noncommunicable chronic disease. Hypertension, spine problems and high cholesterol are prevalent in the country, according to a survey by the Ministry of Health and IBGE. The survey, carried out by the Brazilian Ministry of Health in partnership with the Brazilian Institute of Geography and Statistics (BIGS), reveals that these diseases affect mainly females (44.5%). There are 34.4 million women and 23 million men (33.4%) suffering from chronic diseases [10].

[10] Noncommunicable chronic diseases account for more than 72% of deaths in Brazil. Hypertension, diabetes, chronic spinal disease, cholesterol (the main risk factor for cardiovascular diseases) and depression are the most prevalent in the country. The existence of these diseases is associated with risk factors such as smoking, abusive consumption of alcohol, overweightness, high cholesterol levels, low consumption of fruits and vegetables, and sedentary lifestyle. The study also classified the presence of chronic diseases by region, showing that the South and Southeast had the highest indexes – with 47.7% and 39.8%, respectively. In absolute numbers, this means 10.3 million people in the South and 25.4 million in the Southeast. The Midwest is the region with the third highest prevalence of noncommunicable chronic diseases– 4 million people (37.5%) – followed by the Northeast and the North, with 14 (36.3%) and 3.4 (32%) million people, respectively.

In 2013, physical inactivity in Brazil was responsible for 8.2% of the cases of heart disease, 10.1% of the cases of type 2 diabetes, 13.4% of the cases of breast cancer and 14.6% of the cases of colon cancer, while 11.4% of deaths were caused by sedentary lifestyle (the largest rate in Latin America). For the World Health Organization (WHO) a solution to lessen and even end physical inactivity is to practice at least 30 minutes of physical exercise per day. Inactivity is the fourth leading risk factor for mortality throughout the world, second only to diabetes, smoking and hypertension. Research also suggests that black women are even more sedentary lifestyle than white women [11].

The aim of this work was to study little active and sedentary women through physical assessments using anthropometric measurements and exercise testing using the Naughton and Bruce protocols.

Material and Method

Target Audience

Fifty three women attended the Postural Assessment Laboratory/ Electromyography of the School of Physical Education, University of Campinas, to participate in this study. After replying to a brief questionnaire and taken the measurements of height and weight, they were divided into two groups, namely:

Group 1 - comprised of 17 completely sedentary women, aged between 25 to 58 years, mean age 44.4 years;

Group 2 - comprised of 36 women who answered doing physical activities once or twice a week (low active), aged 28-54 years, mean age 39.5 years. We recorded in the average hours of this group, amounting 01:30 minutes of physical activity per week for each woman.

All participants are from administrative sectors of Unicamp.

Assessments Performed

Anthropometric measurements (weight and height) and ergometry were done on both groups. Group 1 ergometry was evaluated by the Naughton Protocol and Group 2 was evaluated by the Bruce Protocol. Noting that the Naughton Protocol is indicated for people completely sedentary, the elderly and cardiac patients, and the Bruce Protocol is designed for trained people, athletes and low physical condition people[12].

Table 1: Representative model of the Naughton Protocol Model I (Modified according to the specificities of the Integrated APEX TEB 2200 System) [12].

Phases	Mph	%inclination	VO2max	METs	mim
1	1.5	0	5.4	1.5	3
2	2.0	0	7.0	2.0	3
3	2.0	3.5	10.5	3.0	3
4	2.0	7.0	14.0	4.0	3
5	2.0	10.5	17.5	5.0	3
6	2.0	14.0	21.0	6.0	3
7	2.0	17.5	24.5	7.0	3

Table 2: Representative model of the Bruce Protocol [12].

Phases	Mph	%inclination	VO2max	METs	mim
1	1.7	10	15	4	1
2	2.5	12	25	7	3
3	3.4	14	35	10	3
4	4.2	16	45	13	3
5	5.0	18	55	16	3
6	5.5	20	65	19	3
7	6.0	22	75	22	3

Material Used

We used the Ergometry-TEB System, which is formed by an Ergometer APEX 2200 Treadmill, two monitors, configured for 06 protocols and others that meet the limits of speed and tilt of the system. The system is prepared to act in either automatic, semi-automatic or emergency stop. It is a system made up of 13 simultaneous channels and allows the performance of exercise tests with the classic configuration of the three leads MV5, D2M and V2M, which is the configuration used. This System starts with the speed of 1.5 mph containing 07 stages.
For anthropometric measurements we used a Welmy scale, with toesa, with capacity of up to 150 Kg.

Data Collection

During the assessments, the women were wearing Bra and Shorts to facilitate the placement of the electrodes according to the selected derivations. The electrodes used were from the brand 3M (Electrode for cardiac monitoring) Ag/AgCl, with adhesive

ge. All participants signed the Free Informed Consent prior to the start of the testings. The project was approved by the Ethics Committee of UNICAMP No. 431/2007

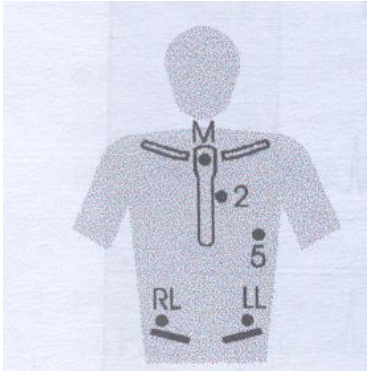

Figure 1: Representative model of electrode placement.

The women were instructed to be at the site of evaluations (Postural Assessment Laboratory and Electromyography of the School of Physical Education, University of Campinas) one hour before the start of evaluations.

They also received a week in advance from the laboratory a folder with the following guidelines:
Eat up to two hours before the start of the Protocol;

a) Avoid any kind of physical activity the day before the Protocol;
b) Bring appropriate attire for the realization of the Protocol (shorts, two piece swimsuit and sneakers);
c) Avoid abuses and excesses the night before;
d) Sleep from 6 to 8 hours the day before the exam;
e) Avoid using sedatives; and communicate any changes in their health status in the past 24 hours.

Presentation of Results

For purposes of data, we collected data related to: age, weight and height extracted for the BMI. Regarding the variables, we

studied resting heart rate, systolic blood pressure, diastolic blood pressure and double product during the stages of the protocols and in the recovery phase. We also obtained the maximal and submaximal heart rate. Therefore, for the purposes of statistical analysis between populations and protocols used, we have considered up to stage 4 for both groups.
The results were statistically analyzed by Student's t test, two-tailed, with a significance level of 5%.

The hypotheses tested were:

H_0: $M_1 = M_2$

H_1: $M_1 \neq M_2$

Table 3: Overall Average of the variables related to anthropometric measurements, age, BMI and Heart Rate, Systolic Blood Pressure, Diastolic Blood Pressure and Double Product of Group 1 - Naughton Protocol.

AGE	43.4	SBPrest	121.9	DBP6	89.7
WEIGHT	73.4	SBP1	127.2	DBP7	92.7
HEIGHT	160.6	SBP2	134.1	DBPrec1	90
BMI	28.6	SBP3	140.6	DBPrec2	87.8
HRmax	176.6	SBP4	145.6	DBPrec3	84.4
HRsubm	149.5	SBP5	152.8	DBPrec4	81.9
HRrest	72.7	SBP6	164.7	DPrest	92.6
HR1	94.3	SBP7	177.3	DP1	12030
HR2	110.1	SBPrec1	168.8	DP2	14833
HR3	112.5	SBPrec2	159.1	DP3	15710
HR4	120.5	SBPrec3	145.3	DP4	17667
HR5	125.3	SBPrec4	135.4	DP5	19234
HR6	137.7	DBPrest	79.7	DP6	22665
HR7	152	DBP1	82.2	DP7	26932
HRrec1	117.9	DBP2	84.1	DPrec1	19980
HRrec2	111.9	DBP3	85.6	DPrec2	17910
DPrec3	108.4	DBP4	86.9	DPrec3	16113
HRrec4	106.8	DBP5	89.4	DPrec4	14467

Table 4: Overall Average of the variables related to anthropometric measurements, age, BMI and Heart Rate, Systolic Blood Pressure, Diastolic Blood Pressure and Double Product of Group 2 - Bruce Protocol.

age	39.51	HRrec4	102.59	DBP4	79.35
weight	62	SBPrest	111.21	DBPrec1	80.13
height	163	SBP1	124.86	DBPrec2	77.83
BMI	23.2	SBP2	134.05	DBPrec3	75
MHR	180.48	SBP3	145.81	DBPrec4	74.86
HRsubm	153	SBP4	150.8	DPrest	80.61
HRrest	71.69	SBPrec1	156.75	DP1	12075
HR1	97.02	SBPrec2	144.72	DP2	14629
HR2	109.16	SBPrec3	132.43	DP3	18932
HR3	130.87	SBPrec3	123.51	DP4	21594
HR4	142	DBPrest	73.51	DPrec1	18732
HRrec1	121.24	DBP1	75.67	DPrec2	15156
HRrec2	105.91	DBP2	77.56	DPrec3	13186
HRrec3	100.56	DBP3	79.05	DPrec4	12629

The results presented in Tables 1 and 2 represent the overall averages of variables studied without statistical treatment. We found that the levels of the events of the cardiac cycle shown during exercise are within acceptable standards for both populations. We highlight the differences listed in the Tables regarding the number of stages completed by groups 1 and 2, namely: Group 1 completed the test on the 7th stage of the Naughton protocol and group 2 completed the test in the 4th stage of the Bruce protocol.

Table 5: Results of the anthropometric variables related to age, BMI and Heart Rate (maximal, submaximal and resting) in groups 1 and 2 studied statistically through the Student's t-test, two tailed.

VARIABLES	P-value	Significance of t-test	Conclusion
age	0.0736	ns	EQUAL
weight	0.0032	**	DIFFERENT
height	0.0441	*	DIFFERENT
BMI	0.0001	**	DIFFERENT
MHR	0.0762	ns	EQUAL
HRsubm	0.0551	ns	EQUAL
HRrest	0.6120	ns	EQUAL

Ns = non-significant t-test.
* = t-test significant at 5% level.
** = t-test significant at 1% level.

The results shown in Table 03 indicate that groups 1 and 2 were different in terms of weight, height and BMI. The variables weight and BMI were significant p> 0.05 at 1% level (**) and height at 5% level (*). Regarding the variables Maximum Heart Rate (MHR), Submaximal Heart Rate (HRsubm) and resting heart rate (HRrest), both groups showed no difference between the protocols used nor between the sedentary and little active populations.

Table 6: Results of variables (heart rate, systolic blood pressure, diastolic blood pressure and double product) of Groups 1 and 2 evaluated by the Naughton and Bruce protocols studied statistically by the Student's t-test, two-tailed.

Variables	P-value	Significance of the test	Conclusion	Variables	P-value	Significance of the test	Conclusion
HR1	0.5841	ns	equal	DBPrest	0.1355	ns	equal
HR2	0.9876	ns	equal	DBP1	0.1616	ns	equal
HR3	0.0010	**	different	DBP2	0.1222	ns	equal
HR4	0.0153	*	different	DBP3	0.1293	ns	equal
HR5	-		-	DBP4	0.0371	*	different
HR6	-		-	DBP5	-		-
HR7	-		-	DBP6	-		-
HRrec1	0.3978	ns	equal	DBP7	-		-
HRrec2	0.3917	ns	equal	DBPrec1	0.0198	*	different
DPrec3	0.1348	ns	equal	DBPrec2	0.0045	**	different
HRrec4	0.3762	ns	equal	DBPrec3	0.0041	**	different
SBPrest	0.0128	*	different	DBPrec4	0.0373	*	different
SBP1	0.7447	ns	equal	DPrest	0.2145	ns	equal
SBP2	0.9515	ns	equal	DP1	0.2958	ns	equal
SBP3	0.4628	ns	equal	DP2	0.9843	ns	equal
SBP4	0.4524	ns	equal	DP3	0.0210	*	different
SBP5	-		-	DP4	0.0460	*	different
SBP6	-		-	DP5	-		-
SBP7	-		-	DP6	-		-
SBPrec1	0.1540	ns	equal	DP7	-		-
SBPrec2	0.0382	*	different	DPrec1	0.4230	ns	equal
SBPrec3	0.0428	*	different	DPrec2	0.0243	*	different
SBPrec4	0.1634	ns	equal	DPrec3	0.0148	*	different
				DPrec4	0.0379	*	different

Ns = non-significant t-test. * = t-test significant at 5% level. ** = t-test significant at 1% level.

Discussion

The qualities of "sedentary and little active" physical fitness seem to go together, specifically in relation to the events of the cardiac cycle (heart rate, systolic and diastolic blood pressure); however, group 2 is at an advantage compared to group 1 because they practice physical activities, thus influencing the quality of life. The amount of hours and the number of times per week that group 2 practices physical activities showed to not be sufficient to differentiate the results from group 1, who are completely sedentary, although group 2 has completed the exercise testing using the Bruce protocol, on the 4th stage, considered a good result.

[5,13] Studied the events of the cardiac cycle in men and women through the ergometry system before and after initiating a physical activity program for six months. The results showed: at rest, regarding gender, heart rate showed no significant difference between the assessment and reassessment. Regarding SBP and DBP, there were differences between assessment and reassessment only for men. In the recovery period: heart rate showed no difference for both groups (male and female). As for PAS, for both groups, there were differences regarding the assessment of the reassessment from the first minute up to the 6th minute. As for DBP, there was no difference in the first minute.

Regarding age, we can see that the two groups studied do not differ much in relation to average age (43.4 years for G1 and 39.5 for G2) and both groups develop administrative work at the University of Campinas.

Table 1 shows the results of the variables studied related to the overall averages without statistical treatment. We can observe that group 1 has a greater weight, lower height and greater BMI. According to WHO recommendations, this group is overweight, while group 1 is considered to have a BMI within the limits recommended by the WHO for healthy individuals.

Regarding the levels of Maximum Heart Rate, both groups are at levels recommended for adults aged 20 to 55 years considered exhaustive, i.e., above 175 bpm (Tables 1 and 2).

Studies on the desired levels of heart rate extrapolate several decades; for example, [14] reported that a greater physical work capacity, kept a metabolic balance, could be achieved with a maximum limit of 170 beats per minute.

According [15] stress heart rate must be within a range of 135 and 174 bpm, i.e., exercise should have an intensity that can increase HR above 135 bpm, however, cannot exceed 174 bpm.

The results presented in Tables 3 and 4 show that there was little significant difference between groups 1 and 2 in relation to the protocols used, as well as the physical fitness levels of both groups. The results analyzed statistically in relation to the variable Heart Rate (maximal, submaximal and resting) in the 1st and 2nd stages and in the recovery period showed no significant differences between the two groups. In the 3^{rd} stage, the difference was statistically significant at the 1% level ($p = 0.0010$) and in the 4^{th} and 5^{th} stages at the 5% level, with $p = 0.0153$ and $p = 0.0226$ respectively.

According [16], double product (DP) is a measure estimating cardiac stress and myocardial oxygen consumption and its value is determined by multiplying heart rate (measured in bpm) by systolic blood pressure (measured in mmHg). The double product showed significant differences at the 5% level in the stages 3 ($p=0.0210$) and 4 ($p=0.0460$) and also in the recovery phase in the stages 2 ($p=0.0243$), 3 ($p=0.0148$) and 4 ($p=0.0379$).

The DP can estimate the myocardial O2 consumption (MVO2) and is its best indirect predictor [17,18,19,20]. The correlation between DP and MVO2 is stronger ($r = 0.92$) than between MVO2 and HR ($r = 0.88$), [21]. There is also a linear relation between MVO2/DP and blood flow in coronary arteries. Typical values for Double Product range from 6,000 at rest (HR=50 beats/min, SBP=120 mm Hg) to 40,000 during intense exercise

(HR=200 beats/min, SBP=200 mm Hg). Changes in heart rate and blood pressure equally contribute to a change in DP [22].

The DP is a hemodynamic parameter that sets high correlation with MVO2, determined in stress ergometry, although the prediction is not possible in exercises against resistance. Even so, the DP can be used as an evaluation index of cardiac stress in RE (resistance exercise), thus being recommended by the American College of Sports Medicine [21].

Regarding the systolic and diastolic blood pressure variables, the literature reports that, during exercise and physical activities, SBP and DBP tend to increase causing a significant increase also in mean arterial pressure, even if for a short period of time. Separately, SBP and DBP show different behaviors during exercise. In ongoing activities of progressive intensity, SBP increases in direct proportion to the intensity of the exercise, due to the increase in cardiac output [23,24].

We can see in Tables 1 and 2, from the resting phase until the 7th stage for group 1 and up to the 4th stage for group 2, a gradual increase in systolic and diastolic blood pressure according to the increase of stress in the test. In the recovery phase, they decrease gradually. It is interesting to follow in the Tables 1 and 2 the behavior of the double product, taking into account that its value is determined by multiplying heart rate (measured in bpm) by the systolic blood pressure (measured in mmHg).

Diastolic pressure varies little during aerobic exercise when compared to SBP and HR, as the systemic pressure during cardiac diastole tends to stay in rest levels. In activities with strong static component, due to the capillary constriction by active muscles, coupled with the increase in cardiac output, a significant elevation in DBP 25 can occur [25,26].

Resting systolic blood pressure showed a result statistically different at the 5% level ($p=0.0128$). In the recovery stages, groups 1 and 2 showed significant differences at the 5% level in the 2nd and 3rd stages, with $p=0.0382$ and $p=0.0428$,

respectively. As for diastolic blood pressure, we detected a difference at the 5% level in stage 4 (p=0.0371) and also in the recovery phase in stages 1-4 of the protocols used. In the stages 1 (p=0.0198) and 4 (p=0.0373) there was significant difference at the 5% level, and in the stages 2 (p=0.0045) and 3 (p=0.043) at the 1% level.

The research studies and discussion about the benefits of exercise and physical activity are old considering the scientific publications [27], who describes that aerobic exercises (low intensity and long duration) are excellent for improving physical fitness and reducing body fat, reducing the risks of cardiovascular diseases.

It was evident that group 2 needs to practice physical activities with greater intensity and higher weekly frequency so that changes and improvements can occur in the events of the cardiac cycles (HR, SBP and DBP). As for group 1, taking into account the results presented, they are able to enter and start physical activities to improve the levels found, specifically weight, BMI, HR, SBP and DBP.

[28,29] Postulate that every adult individual should accumulate at least 30 minutes of physical activity at least 5 days a week, or if possible the entire week, of moderate intensity, which can be performed continuously or accumulated. However, the group of women considered little active completed the stress test by the Bruce protocol in the 4th stage with the following specifications: 4.2 mph, 16% incline, VO_2Max 45, 13 METs and already amounted 10 minutes of test performance, which can be considered good for a exercise testing, considering the physical fitness of the "little active" women.

The women in group 1 that "self-declared" completely sedentary, completed the exercise testing by the Naughton protocol on stage 7 with the following specifications: 02 Mph, 17.5% incline, VO_2Max 24.5, 7 METs and already amounted 21 minutes of test performance and yet, for the variables of the events of the cardiac cycle in accordance with the statistical analysis, the

results were not different between groups 1 and 2 in most of the variables, as shown in Table 2.

Conclusions

- Participants from group 1 are able to join physical activity programs from the results presented, specifically due to weight, BMI, heart rate and blood pressure;
- Participants from group 2 require more days of practice of physical activities and longer hours to improve the levels of heart rate and blood pressure;
- For heart rate, the significant differences occurred in the 3rd and 4th stages;
- For systolic blood pressure, significant differences were observed in the resting phase and during the recovery phase in the 2nd and 3rd stages;
- For diastolic blood pressure, significant differences were observed in the 4th stage and in the recovery phase from the 1st to the 4th stage;
- For double product, significant differences were observed in the 3rd and 4th stages and in the recovery phase in the 2nd, 3rd and 4th stages.

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