Effects of swimming and walking on aspects related to the health of police officers

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Abstract

The present study aimed to compare the effects of swimming and walking after 24 weeks of training on anthropometric indicators of obesity, physical activity, coronary risk and health-related quality of life among military police officers of the state of Santa Catarina, Brazil. The sample included 51 military police officers (male) whose ages ranged from 22 to 49 years, with a mean age of 35.53 ± 7.63 years, and who fulfilled the inclusion criteria of the study, which was conducted between the months of June and December 2012. The subjects were interviewed to collect demographic and occupational data as well as anthropometry, physical activity level and health. The volunteers were divided into the following three groups according to their preference: swimming experimental group (n = 24), walking experimental group (n = 24), and control group (n = 24). Statistical analyses were performed using descriptive analysis, one-way and two-way ANOVAs followed by Bonferroni’s post hoc test, Student’s t-test, the Kruskal-Wallis test and the Mann-Whitney U test followed by Bonferroni’s correction, the Wilcoxon test and Cohen’s d test. After 24 weeks of training, the waist circumference, conicity index, waist-to-height ratio, physical activity at work, vigorous activities and coronary risk were significantly different in the swimming group, and the percentages of fat, lean mass and fat mass were significantly different in the walking group. The swimming exercise program contributed to significant reductions in waist circumference, conicity index, the waist-to-height ratio and coronary risk and to increased levels of physical activity at work and vigorous activities. In addition, the walking exercise program contributed to significant reductions in relative body fat and fat mass and increased lean mass among military police officers.

Keywords: Police; Motor activity; Anthropometry; Health; Quality of life.

Introduction

Police officers are exposed to physical and psychological risks that significantly affect several aspects of their health. Studies have shown that police officers are more likely to be obese and to have higher mortality rates due to cardiovascular disease compared to the general population. Police officers also have higher depression and stress levels than other professional groups; these conditions adversely affect their quality of life.

Reports developed by health organizations recommend exercise for the general population based on physiological and psychological adaptations associated with better control of risk factors for cardiovascular disease, thus contributing to a healthier lifestyle and to improved quality of life. Although the benefits of regular physical activity are well documented in the literature, aspects related to the specificity of physical exercise targeted at the health of police officers need to be better investigated.

These gaps relate to specificities of the profession and the lifestyle adopted by police officers because they tend to exhibit low levels of sport...
and leisure physical activities, although they are considered more physically active than the general population. Therefore, strategies that enable cardiovascular disease prevention, professional technical improvement and health and quality of life enhancements in this population are relevant.

**Methods**

The quasi-experimental study was approved by the institution’s human research ethics committee (Protocol no. 174/2011/Comitê de Ética e Pesquisa em Seres Humanos - CEPSPH da Universidade do Estado de Santa Catarina - UDESC).

**Sample**

The sample consisted of male military police officers of various ranks who were aged 18 years or more, with an age range of 22 to 49 years and a mean age of 35.53 ± 7.63 years, who were able to practice physical activities as certified by a medical professional and who agreed to fully participate in the interventions. Individuals who had any type of cardiorespiratory impairment or musculoskeletal injury that could prevent the intervention protocol to be performed were excluded from this study.

Non-randomized selection was used because of the strict ethical standards, which, despite being focused on target variables, required subjects from the experimental group to be available to participate in training sessions without any interference from authorities in the chain of command that is present in the military police corporation. All military police officers who were interested or available had the same opportunities to participate in the study.

The sampling plan was developed based on criteria compatible with experimental health research; this plan established that at least 12 subjects per group were required. However, aiming to meet the adopted criteria and to account for the possibility of sample loss typical of experimental studies, the sample size was multiplied by two, totaling 72 subjects required for the study. Subject identification began with a collective presentation on the objectives and procedures to be adopted, in addition to the existing risks and ways to mitigate them, emphasizing the voluntary nature of participation regardless of the authority of the military chain of command. Subjects were selected only after informed consent form was obtained, thus respecting the existing national and international ethical guidelines.

The period for participant recruitment was June 20 to June 30, 2012. The volunteers were divided into the following three groups according to their preference: a) swimming experimental group (SEG; n = 24), b) walking experimental group (WEG; n = 24) and c) control group (CG; n = 24).

After allocation to the three groups, the subjects were individually scheduled for evaluations that would be performed at the Santa Catarina State University and Center for Health Sciences and Sports.

**Analyzed Variables**

Subjects were interviewed to collect demographic and occupational data (age, rank, activities, work shift and years of service) and anthropometric indices (weight, height, waist circumference, relative body fat, lean mass and fat mass). The anthropometric assessment adopted the protocol of Lohman, Roche and Martorell, and the variables allowed the conicity index (CI) and the waist-to-height ratio (WHtR) to be calculated.

The subjects also completed the following three questionnaires: a) the International Physical Activity Questionnaire long version (IPAQ); b) the Short Form Health Survey (SF-36) and c) the Coronary Risk Inventory, created by the Michigan Heart Association.

**Physical Exercise Protocol**

Swimming (SEG) was performed in a 25-meter semi-Olympic swimming pool with a constant temperature of 26°C; the protocol for walking (WEG) was performed on a 5,700-meter course. Everyday occupational, recreational and sport-related activities were not limited, but volunteers were requested not to alter their usual routines. All of the above assessments were performed before (week zero) and after (week 24) the training period.
The SEG and WEG activity programs were prepared as recommended by the American College of Sports Medicine.33 The programs included three 60-minute sessions per week for 24 weeks. The CG did not participate in any type of intervention, but evaluations were performed at weeks zero and 24.

The exercise intensity prescription was based on the Heart Rate Reserve (HRreserve).33 The Tanaka equation34 was used to determine the maximum heart rate (HRmax). The exercise intensity in each training session was monitored individually and continuously using digital heart rate (HR) monitors (Polar® FT1) and the Borg scale of perceived exertion, which ranges from zero (none) to 10 (maximum) points.35

All exercise sessions were standardized and divided into five parts: 1) initial assessment - before exercise, with blood pressure (BP) and HR assessments; 2) preparation - composed predominantly of warm-up and stretching exercises; 3) training - swimming (SEG) or walking (WEG) activities; 4) cool down or return to rest - low-intensity aerobic activities, relaxation or muscle stretching activities and 5) final evaluation - after exercise sessions, with BP and HR assessments.

In the SEG, the exercises performed during the first two weeks (adaptation) were conducted at intensities between 40 and 50% of the HRreserve and consisted of breathing, floating, swimming, immersion and displacement technical skills without previous guidance. During weeks three and seven (development/stabilization phase), activities to develop the front crawl, breaststroke and backstroke swimming techniques were performed at intensities between 60 and 80% of the HRreserve. During the third phase (stabilization), weeks 13-24, the intensity was maintained between 75 and 85% of the HRreserve with BP, HR and perceived exertion control rate monitored.

Statistical Analysis

The statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 20.0.

According to the recommendations of Bland and Altman36, quantitative data were treated using parametric statistics, and discrete data were treated using non-parametric statistics.

For the descriptive analysis, means, standard deviations, medians, absolute and relative frequencies were used.

The anthropometric indicators of obesity were analyzed by one-way analysis of variance (ANOVA) followed by Bonferroni’s post hoc test before and after interventions and by two-way ANOVA followed by Bonferroni’s post hoc test. Student’s t-test for paired samples was used to compare the participants in each exercise program. Effect measures were calculated using Cohen’s d test (d) adopting the following classification: small (d = 0.2), medium (d = 0.5) and large (d = 0.8) for quantitative data. The r test was used for categorical data with the formula \( r = \frac{z}{\sqrt{N}}, \) where r is the effect size, z is the value of the statistic, and N is the sample size.

Because quality of life, coronary risk and physical activity level are non-parametric, the intergroup comparison was tested using the Kruskal-Wallis test and the Mann-Whitney U test followed by Bonferroni’s correction. The Wilcoxon test was applied for comparisons among the participants. The significance level used in the analyses was set at \( p \leq 0.05. \)

Results

During the study, the 24 subjects were allocated to each of the three groups as follows: 14 subjects in the SEG, 16 subjects in the WEG and 21 subjects in the CG. Thus, during the proposed period, 51 individuals participated in the study (n = 51).
The 51 police officers who participated in the study had ages ranging from 22 to 49 years, with a mean age of 35.53 ± 7.63 years, and worked an average of approximately 4 ± 0.97 days and 698.82 ± 336.39 minutes daily. TABLE 1 shows the characteristics of the subjects relative to rank and function as well as years of service and classification of physical activity level and coronary risk, analyzed by group.

### TABLE 1 - Characteristics of the subjects relative to rank and function as well as years of service and classification of the physical activity level and coronary risk, analyzed by group.

<table>
<thead>
<tr>
<th>Variable</th>
<th>SEG (n = 14)</th>
<th>WEG (n = 16)</th>
<th>CG (n = 21)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Rank</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soldier</td>
<td>8</td>
<td>57.1</td>
<td>10</td>
</tr>
<tr>
<td>Corporal</td>
<td>1</td>
<td>7.1</td>
<td>1</td>
</tr>
<tr>
<td>Sergeant</td>
<td>1</td>
<td>7.1</td>
<td>5</td>
</tr>
<tr>
<td>Lieutenant</td>
<td>3</td>
<td>21.4</td>
<td>0</td>
</tr>
<tr>
<td>Major</td>
<td>1</td>
<td>7.1</td>
<td>0</td>
</tr>
<tr>
<td>Function</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predominantly administrative</td>
<td>6</td>
<td>42.9</td>
<td>4</td>
</tr>
<tr>
<td>Predominantly operational</td>
<td>8</td>
<td>57.1</td>
<td>12</td>
</tr>
<tr>
<td>Years of service</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-10 years</td>
<td>6</td>
<td>42.9</td>
<td>5</td>
</tr>
<tr>
<td>11-20 years</td>
<td>5</td>
<td>35.7</td>
<td>4</td>
</tr>
<tr>
<td>21-30 years</td>
<td>3</td>
<td>21.4</td>
<td>7</td>
</tr>
<tr>
<td>Physical activity level classification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insufficiently active</td>
<td>1</td>
<td>7.1</td>
<td>0</td>
</tr>
<tr>
<td>Little active</td>
<td>4</td>
<td>28.6</td>
<td>6</td>
</tr>
<tr>
<td>Active</td>
<td>4</td>
<td>28.6</td>
<td>3</td>
</tr>
<tr>
<td>Very active</td>
<td>5</td>
<td>35.7</td>
<td>7</td>
</tr>
<tr>
<td>Coronary risk classification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well below average risk</td>
<td>1</td>
<td>7.1</td>
<td>0</td>
</tr>
<tr>
<td>Below average risk</td>
<td>5</td>
<td>35.7</td>
<td>5</td>
</tr>
<tr>
<td>Medium risk</td>
<td>8</td>
<td>57.1</td>
<td>8</td>
</tr>
<tr>
<td>Moderate risk</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

The analyses conducted before the experimental period did not indicate significant differences between the groups for any of the variables, i.e., the subjects were in the same conditions regarding age of the subject, years of service, minutes of work per day, days of work per week, and classification of physical activity level and coronary risk. The comparison of anthropometric indicators of obesity after the interventions showed significant differences in the means between groups for relative body fat (F(1,50) = 4.69, p = 0.014), and the differences found between the walking and swimming groups (p = 0.014) were in favor of the WEG. Significant differences were also observed for relative body fat before and after the interventions (TABLE 2).

The intragroup comparisons showed significant differences in the means of the waist circumference (t(50) = 4.33, p = 0.001), CI (t(50) = 3.28, p = 0.006) and WHtR (t(50) = 3.68, p = 0.003) in the SEG and in the means of the fat percentage (t(50) = 2.45, p = 0.027), lean mass (t(50) = -2.96, p = 0.01) and fat mass (t(50) = 2.06, p = 0.05) in the WEG (TABLE 2).
The absolute delta and percentage delta variation, which is the variation between the two assessments, revealed that waist circumference, CI, WHtR, relative body fat and fat mass decreased and lean mass increased after the swimming and walking exercises. The \( d' \) statistics showed that the magnitudes of the effects ranged from 0.26 to 0.52 for measures relative to swimming and from 0.39 to 0.59 for measures relative to walking, which according to Cohen’s convention, suggests small and medium effects, respectively, on these variables (TABLE 3).

The comparison of the health-related quality of life components and physical activity domains between groups after the interventions revealed significant differences for the mind component (\( K = 6.70, p = 0.035 \)). The SEG and CG differed from each other (\( U = 72.5, p = 0.011 \)), in favor of the SEG.

No significant differences in the health-related quality of life components were found between participants in the experimental groups. Regarding physical activity domains, significant differences were found between participants from the SEG for metabolic equivalents (METs) at work (\( Z = -2.073, p = 0.038 \)) and for vigorous activities (\( Z = -2.143, p = 0.032 \)). A significant difference was also noted in the overall coronary risk score (\( Z = -1.97, p = 0.038 \)) in the SEG (TABLE 4).

TABLE 4 shows the absolute delta and percentage delta variation. The results indicate that most domains related to physical activity increased and the overall coronary risk score decreased after swimming and walking activities. The \( r \) statistics revealed that the effect magnitudes ranged from 0.52 to 0.57 in measures associated with swimming, suggesting large effects on these variables (TABLE 5).
TABLE 4 - Comparisons between the medians of physical activity domains and the overall coronary risk score in pre- and post-experimental periods.

<table>
<thead>
<tr>
<th>Variable</th>
<th>SEG</th>
<th>WEG</th>
<th>CG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PA domains (METs)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work</td>
<td>0</td>
<td>449.5*</td>
<td>0</td>
</tr>
<tr>
<td>Transportation</td>
<td>16.5</td>
<td>1440</td>
<td>16.5</td>
</tr>
<tr>
<td>Household chores</td>
<td>440</td>
<td>865.5</td>
<td>720</td>
</tr>
<tr>
<td>Leisure</td>
<td>608.5</td>
<td>594</td>
<td>240</td>
</tr>
<tr>
<td>Mild activities</td>
<td>445.5</td>
<td>371.25</td>
<td>2240</td>
</tr>
<tr>
<td>Moderate activities</td>
<td>1160</td>
<td>1440</td>
<td>720</td>
</tr>
<tr>
<td>Vigorous activities</td>
<td>480</td>
<td>1440</td>
<td>0</td>
</tr>
<tr>
<td><strong>Coronary risk</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall score</td>
<td>18.5</td>
<td>16*</td>
<td>21.5</td>
</tr>
</tbody>
</table>

The values are the medians; PA, physical activity; SEG, swimming experimental group; WEG, walking experimental group; CG, control group.
* Significant intragroup difference (p ≤ 0.05) – Wilcoxon test.
Source: Produced by the author.

TABLE 5 - Absolute delta (Δ), percentage delta (Δ%) and effect magnitude (r) values.

<table>
<thead>
<tr>
<th>Variables</th>
<th>SEG</th>
<th>WEG</th>
<th>CG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PA domains (METs)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work</td>
<td>449.5</td>
<td>115.5</td>
<td>-</td>
</tr>
<tr>
<td>Transportation</td>
<td>106.5</td>
<td>772.73</td>
<td>-</td>
</tr>
<tr>
<td>Household chores</td>
<td>-20</td>
<td>-14.50</td>
<td>240</td>
</tr>
<tr>
<td>Leisure</td>
<td>490.5</td>
<td>503.37</td>
<td>288</td>
</tr>
<tr>
<td>Mild activities</td>
<td>17.5</td>
<td>181.5</td>
<td>91.67</td>
</tr>
<tr>
<td>Moderate activities</td>
<td>440</td>
<td>520</td>
<td>72.22</td>
</tr>
<tr>
<td>Vigorous activities</td>
<td>600</td>
<td>480</td>
<td>48</td>
</tr>
</tbody>
</table>

**Coronary risk**

| Overall score              | -2.50 | -16.28 |

Discussion

The main results of this study provide evidence that an exercise program of swimming or walking with moderate intensity three times per week reduced anthropometric indicators of obesity and coronary risk. In addition, the levels of physical activity at work and during vigorous activities of military police officers increased.

Of the 72 police officers interested in participating in the study, only 51 participated until the end of the program. The main reasons for dropout reported by the subjects were work shift and double shift schedules. The police officers in this study worked approximately four days per week and 12 hours per day. In addition, an individual's rank and function may interfere with adherence to exercise programs; due to the occupational requirements of a police officer, these professionals are more willing to engage in physical exercises to better perform their duties. In this study, 60.8% of the officers were soldiers who had predominantly operational functions. This type of professional work demands a high level of physical condition due to the demands of the primary function of ostensible policing. Adequate physical condition can contribute to not only individual health protection of the police involved but also public health. This contribution may occur because most effective actions against crimes can affect the quality of public security and, consequently, the care of the community.
The low number of military police officers in the city of Florianópolis may also interfere with regular physical exercise practice. Data from the State Department of Public Safety indicate that the state of Santa Catarina has 11,400 military police officers; the city of Florianópolis has one military police officer for every 1,000 inhabitants, whereas the United Nations (UN) recommends one officer for every 250 inhabitants\(^8\), a shortfall that results in exhausting workloads. Some studies involving police officers showed that a supervised exercise program could increase the adherence of these professionals to exercise\(^13, 25, 38-39\), which is corroborated by the results of this study. This increase may occur because supervised programs permit physical training control and maximize their results, which can increase motivation for physical exercise practice. Furthermore, offering these programs makes the most efficient use of the officers’ free time, which is not abundant among military police due to being overworked and having long work hours and varying work schedules.

Another important factor that must be considered is the mean risk of developing coronary heart disease in most police officers the present study. According to Ramey, Downing and Franke\(^8\), police officers have a 1.7-fold greater risk of developing cardiovascular disease compared to the general population. In the study by Franke, Ramey and Shelley\(^8\), predictors for cardiovascular disease in police officers included years of service as well as perceived stress and hypertension. In the study by Silva et al.\(^41\), the CI and relative body fat as well as years of service, minutes of work per day and level of physical activity during leisure time were identified as risk factors for coronary risk in 165 military police officers studied. Similarly, the daily rhythm of work and responsibility to society can result in stressful situations, which, combined with a poor diet and physical inactivity, may promote the development of metabolic complications and cardiovascular disease.\(^42\) Regarding the physical activity level, although most subjects were classified as very physically active, when the categories of insufficiently active and slightly physically active were added, 22 subjects were included in these classifications, which could also explain the medium risk of cardiovascular disease development.

Additionally, the medium risk of developing cardiovascular disease for police officers in the present study may be because 20 police officers had waist circumferences greater than 90 cm, as the accumulation of adipose tissue in the abdominal region greatly increases the risk for developing insulin resistance, dyslipidemia and hypertension.\(^43\) A meta-analysis conducted by Koning et al.\(^42\) found that an increase of 1 cm in waist circumference may increase the risk for cardiovascular disease by 2%. In a cohort study by Sorensen et al.\(^25\), conducted among Finnish police officers, 64% had waist circumferences greater than 94 cm and 38% had waist circumferences greater than 102 cm. When combined, these data suggest that this simple and inexpensive assessment should be considered for this population because the literature reports high values of this indicator in association with cardiometabolic complications.

Despite the cardiovascular disease risk, most police officers exhibited an active physical activity level, which corroborates data from the study conducted by Minayo, Assis and Oliveira\(^44\), in which 13.1% of military police officers interviewed reported exercising four or more times per week and 38.3% reported exercising at least once a week.

In this study, significant differences in waist circumference, CI, WHtR, physical activity level at work, vigorous activities and coronary risk were observed after a swimming exercise program. During swimming, several muscle groups are used; therefore, energy consumption and oxygen uptake are increased because of the mechanical conditions of breathing, which may be related to decreased indicators of abdominal adiposity, thus favoring coronary risk reduction and improved performance during the practice of occupational and vigorous activities. Physical exercise practice is currently encouraged as a prophylactic and therapeutic measure for all risk factors for coronary artery disease\(^45\) because weight reduction as a result of exercising contributes to lower cardiovascular morbidity and mortality.\(^46-48\)

Significant differences in the percentages of fat, lean mass and fat mass were found in the WEG. The 16.4% variation in relative body fat was due to the type of exercise performed. Similar observations were made by Savage et al.\(^49\). When applying a physical training program that involved 60 to 90-min walks for four months, five to seven times per week, with 50 to 60% VO\(_2\) max (maximal oxygen consumption) in overweight coronary disease patients, these authors measured an effective reduction in relative body fat (-2.9%). Therefore, walking can be an alternative to physical exercise practice, as it has low economic cost and has a high applicability level. However, although
walking may be an interesting alternative activity, it should not be considered the only alternative because the demands of policing action require intense physical training.

The present study had some limitations. The IPAQ instrument, which is used to assess physical activity level, has memory and recollection as bias factors. For some variables, information was obtained only by participant reports, which may have caused a small degree of information bias. The exercise program was conducted only among a battalion of the Military Police of Santa Catarina, and two moderate-intensity aerobic modalities were used. In addition, the straps from the heart rate monitors are not coded to reduce interference between heart rate monitors.

Despite these limitations, this study provided important information on the effects of exercise programs for police officers. In this study, all exercise sessions were supervised, ensuring that subjects actually performed the prescribed exercises. Thus, we can conclude that a swimming exercise program contributed to significant reductions in waist circumference, CI, WHtR and coronary risk and to increased levels of physical activity at work and vigorous activities. In addition, a walking exercise program contributed to significant reductions in relative body fat and fat mass and increased lean mass among military police officers.

Competing Interests

The authors declare that no competing interests exist.

Acknowledgements

We would like to acknowledge the Military Police of Santa Catarina, the Coordination of Improvement of Higher Education Personnel – CAPES and the Foundation for Research and Innovation in the State of Santa Catarina (FAPESC).

Resumo

Efeitos da natação e caminhada nos aspectos relacionados à saúde de policiais

O presente estudo teve como objetivo comparar os efeitos da natação e caminhada após 24 semanas de treinamento sobre os indicadores antropométricos de obesidade, atividade física, risco coronariano e com qualidade de vida relacionada à saúde entre os policiais militares do estado de Santa Catarina, Brasil. A amostra incluiu 51 policiais militares (sexo masculino) que tinham média de idade de 35,53 ± 7,63 anos, com amplitude de 22 a 49 anos, e que preencheram os critérios de inclusão do estudo realizado entre os meses de junho-dezembro de 2012. Os sujeitos foram entrevistados e coletados os dados demográficos e ocupacionais, antropometria, nível de atividade física e saúde. Os voluntários foram divididos em três grupos de acordo com a sua preferência: Grupo Experimental de Natação (n = 24); Grupo Experimental de Caminhada (n = 24); e Grupo Controle (n = 24). As análises estatísticas foram realizadas utilizando análise descritiva e Anova One-Way e Anova Two-Way seguido pelo post hoc de Bonferroni, teste t de Student, teste de Kruskal-Wallis e o teste U de Mann-Whitney seguido pela correção de Bonferroni, o teste de Wilcoxon, e teste d de Cohen. Houve uma diferença significativa na perimétria da cintura, índice de concicidade e relação cintura-estatura, atividade física no trabalho, atividades vigorosas e risco coronariano no grupo natação e no grupo caminhada, houve uma diferença significativa no percentual de gordura, massa magra e massa gorda após 24 semanas de treinamento. O programa de natação contribuiu para reduções significativas na circunferência da perimétria da cintura, índice de concicidade e relação cintura-estatura e risco coronariano e no aumento dos níveis de atividade física no trabalho.
References

