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Perfil da aptidão física de guarda-vidas militares

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Profile of physical fitness of military lifeguards

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Abstract

Introduction: During a lifeguard professional life span, regardless of age, the physical demands of performing a water rescue will probably remain constant. **Objectives:** To draw a physical fitness profile by age group of a sample composed of professional beach lifeguards engaged in the regular practice of physical activity. **Methods:** One-hundred and seventy-two lifeguards were initially recruited for this investigation. Data collected from 99 male lifeguards were provided for analysis. Anthropometric measurements were conducted upon first arrival, as well as lower limb power and handgrip measurements. Running tests were conducted on sand during a second visit. All testing procedures followed the same pre-defined order for all individuals. **Results:** A One-Way ANOVA with post-hoc Bonferroni was conducted or a Kruskal Wallis adjusted analysis was conducted to assess differences between age groups depending on the exact variable. Level of significance was set at $p \leq 0.05$. There were statistically significant differences in all power and velocity performance parameters as well as body fat percentage with better results found on the younger age categories (20-29;30-39) when compared to an older age group (40-49). However, there was no statistically significant differences between groups regarding handgrip strength. **Conclusions:** The results of the present investigation indicate significant differences in physical fitness among distinct age groups. The authors propose that the squat jump, countermovement jump, the 20-m linear sprint test, ZigZag Change-of-Direction Test, and the Running Anaerobic Sprint Test assessment should be implemented as a screening tool for readiness.

Keywords: physical functional performance; exercise; military personnel; occupational fitness; tactical personnel.

Resumo

Introdução: Durante a vida profissional de um guarda-vida, independentemente da idade, as exigências físicas impostas durante um salvamento provavelmente se manterão constantes. **Objetivos:** Desenhar um perfil de aptidão física de uma amostra composta por guarda-vidas profissionais praticantes regulares de atividade física. **Métodos:** Dados de 99 indivíduos foram utilizados para análise. Medidas antropométricas foram obtidas durante a primeira visita, assim como a análise da potência de membros inferiores e da força de preensão manual. Testes de velocidade e mudança de direção foram realizados na área em uma segunda visita. A testagem seguiu a mesma ordem pré-definida para todos os indivíduos. **Resultados:** Uma análise de variância com *post-hoc* de Bonferroni ou o teste de Kruskal-Wallis com comparações por pares ajustada foi utilizado para comparação entre grupos, a depender da variável. O nível de significância adotado foi $\leq$ 0,05. Foram observadas diferenças estatisticamente significativas entre as faixas etárias para todos os testes de potência e velocidade, bem como no percentual de gordura corporal, com melhores resultados encontrados nas faixas etárias mais jovens ("20-29" e "30-39" anos quando comparados ao grupo "40-49"). No entanto, não houve diferença estatisticamente significativa entre os grupos em relação à força de preensão manual. **Conclusões:** Os resultados indicam diferenças estatisticamente significativas na aptidão física de guarda-vidas entre as diferentes faixas etárias. É sugerido que o salto vertical, sem e com contramovimento, o teste de 20 metros, Running Anaerobic Sprint Test e Zig-Zag Test sejam implementados como ferramenta para triagem da aptidão física.

Palavras-chave: desempenho físico funcional; exercício físico; militares; saúde do trabalhador; profissionais de segurança pública.

INTRODUCTION

According to the characteristics of their occupational tasks, lifeguards may be subjected to periods of sedentary behavior combined with sudden outbursts of high-intensity physical demands which requires a high level of physical conditioning to correspond to the needs of a water rescue, for instance[1,2]. According to the World Health Organization, drowning is one of the major causes of death, which can be prevented by an early intervention of a lifeguard[3].

In this scenario, the physical readiness of lifeguards represents an important part of the rescue´s success. According to previous research, oxygen uptake, blood lactate, and heart rate values increase until near maximum values during a water rescue which highlights that power and aerobic capacity are fundamental to lifeguards[2]. During their professional life span, regardless of age, the physical demands of performing a water rescue will probably remain constant. Considering this premise, maintaining good to optimum level of physical readiness should be considered crucial in this population.

Body composition is widely used as a health and fitness parameter[4], also, different fitness components such as power, and agility have already been associated with performance in military populations like firefighters[5] and police cadets[4]. While data on the level of physical fitness of police officers and other military forces emerge in the scientific literature, the same scenario has not been displayed regarding profiling the physical fitness of lifeguards. Previously research with other corporations showed an association between functional performance and their professional tasks[4,6]. Thus, it seems interesting to draw a profile on these subjects aiming to open paths for future research that may establish normative values for this specific population, and establish which characteristics can explain the physical fitness of lifeguards and the success of maritime rescue.

Also, previous research has raised the importance of training lifeguards in more specific ways based on good physical and technical training allowing the professionals to perform a faster and more effective intervention in case of a possible drowning situation[7]. The lack of information regarding the physical profile of professional beach lifeguards makes it difficult to develop adequate test batteries and training regimens aiming to recognize candidates who are more suitable for the job and improve performance during life rescues, respectively, as well as return to active-duty guidelines. Therefore, the purpose of this study was to draw a physical fitness profile by age group of a sample composed of professional military beach lifeguards.

METHODS

One-hundred and seventy-two military lifeguards from the city of Rio de Janeiro (Rio de Janeiro, Brazil) were initially recruited for this investigation. Seventy-three individuals did not complete all the proposed evaluations due to time constrains or job demands. Six individuals were excluded due to the use of anabolic substances, fifteen were excluded because they were unable to perform all testing procedures due to reasons unrelated to the study, and 44 individuals were excluded for performing regular physical activity outside the battalion. Data collected from 99 male lifeguards were provided for analysis. All testing procedures occurred during summer season. Familiarization about all testing procedures were conducted verbally a week before the begging of data collection. Anthropometric measurements were conducted upon first arrival, as well as lower limb power and handgrip measurements. Running tests were conducted on sand during a second visit. All testing procedures followed the same pre-defined order for all individuals.

Prior to data collection, an approval from the University Review Board was obtained Sample size calculation was conducted considering an error of 0.05, a presumed prevalence of 0.25, and a 95% confidence interval, reaching a total of 97 individuals.

Inclusion criteria consisted of a) be an active-duty military lifeguard; b) abstain from alcohol, caffeine, and any anti-inflammatory drug 72 hours prior to testing, and throughout the experiment design; c) do not perform any physical training besides the one traditionally proposed by the battalion. Exclusion criteria consisted of (a) any kind of musculoskeletal injury during the last month prior to data collection (b) use of anabolic steroids, and (c) a previous history of cardiovascular complications. Subjects were categorized in three distinct age groups: 20-29 (n = 34), 30-39 (n = 49), and 40-49 (n = 16). The sample´s characteristics are displayed on Table 1.

Table 1. Mean and standard deviation for age, body mass, height, military service time, BMI, and BF

	age (years)	body mass (kg)	height (m)	military service time (years)	BMI (Kg/m²)	BF (%)
20-29	26.32 ± 2.23	80.51 ± 11.10	1.76 ± .07	6 ± 2.21	25.71 ± 3.08	13.61 ± 5.56
30-39	34.04 ± 2.64	81.64 ± 10.53	1.76 ± .06	9.90 ± 4.43	26.08 ± 3.08	15.01 ± 4.80
40-49	44.06 ± 3.69	86.36 ± 10.99	1.76 ± .05	19.81 ± 5.44	27.55 ± 3.27	21.69 ± 13.41

BMI: body mass index; BF: body fat

Anthropometry

Height was measured through a stadiometer attached to the scale with a maximum height of 200 cm. Individuals positioned themselves with their body weight uniformly distributed in hip-width stance, at rest, forming a perpendicular angle of 90º with the vertical shaft of the stadiometer[8]. Weight was measured using a mechanical scale (Filizola®, São Paulo, São Paulo - Brazil) with a maximum capacity of 150 kg and a 100 g precision. Body fat (BF) percentage was calculated using a scientific adipometer (CESCORF®, Porto Alegre, Rio Grande do Sul - Brazil) with a 0.01mm precision, following Pollock´s three skinfold protocol. Each skinfold was measured twice, and the mean value was used for analysis. Body mass index was also calculated. To reduce the margin of error in testing, an experienced evaluator was responsible for all measurements.

Body fat percentage was calculated through the following formula[8]:

$$\text{body density of males} = 1.1093800 - 0.0008267\,(\Sigma 3M) + 0.0000016\,(\Sigma 3M)2 - 0.0002574\,(\text{age y})$$

$$\%BF = [(4.95 / \text{Body Density}) - 4.5] \times 100$$

Squat Jump (SJ) and Countermovement Jump (CMJ)

Warm up consisted of lower limb dynamic stretching, ten calf raises, five SJ´s, and five CMJ´s[9,10]. During the SJ performance, individuals would start in a half isometric (six seconds) squatting position (90º knee position), on the other hand, when performing the CMJ, individuals should start in a standing, neutral position. In both testing procedures, individuals would maintain their arms akimbo to avoid contribution of the upper limbs. Five attempts with a three second rest interval between them were performed in each test. The highest jump (in centimeters) was used for statistical analysis. Testing was conducted on a force platform (Force Plate SV – CEFISE® Nova Odessa, São Paulo - Brazil).

Handgrip

Warm up consisted of ten wrist flexion as well as 10 wrist flexion using a bat, ten light grips and one submaximal grasp on a Jamar handgrip dynamometer (Jamar® Dynamometers, Fabrication Enterprises, New York - USA) used in the second handle position[11]. Subjects remained seated with their shoulders adducted, and neutrally rotated, with elbows flexed at 90º. Individuals performed three trials with a 15 second rest interval between them holding their maximal voluntary contraction for five seconds. The highest value of their dominant limb was used for statistical analysis.

Linear sprint test (20-m), ZigZag Change of Direction (COD) Test, and Running Anaerobic Sprint Test (RAST)

Warm up consisted of five minutes of submaximal running in a self-selected pace with two short duration sprints in the end of the third and fifth minute[12]. Submaximal attempts were conducted aiming to minimize the learning effect. Performance on the linear sprint test was evaluated using three photocells (CEFISE®, Nova Odessa, São Paulo - Brazil) which were positioned at 0, and 20 meters. Starting point was positioned 30 meters behind the starting line and two attempts were conducted with a five-minute rest interval between them with the fastest trial being registered for statistical analysis[13]. The Zig Zag COD test consisted of four 5-m sections (a total of a 20-m linear sprint). Sections were marked with cones set at

100º angles. Two attempts were conducted with a five-minute rest interval between them. Subjects positioned themselves 30 meters behind the first pair of photocells (CEFISE®, Nova Odessa, São Paulo – Brazil) Participants were asked to complete the test as quickly as possible until crossing the second pair of photocells. The fastest time was used for statistical analysis[14]. RAST evaluation consists of six 35-meter sprints performed as fast as possible with a 10-second rest interval between each sprint[15]. A pair of photocells (CEFISE® Nova Odessa, São Paulo - Brazil) recorded total test time in seconds and hundredths of seconds. Verbal encouragement in a standardized manner was given throughout all tests.

Statistical analyses

Statistical analyses were conducted on software SPSS v. 20.0 (IBM Corp., Chicago, IL, USA). Data distribution was assessed through the Shapiro-Wilk test, kurtosis and skewness analyses, and graphical observation. When the normality of the data was rejected, a Kruskal Wallis adjusted analysis was conducted to assess differences between age groups. When data normality was not rejected, a One-Way ANOVA with post-hoc Bonferroni was conducted observing the homogeneity of variances. Level of significance was set at $p = 0.05$. Data is reported as mean and standard deviation for parametric analyses and as median and interquartile range for non-parametric analyses[16]. Correlations between RAST, CMJ, and SJ were also conducted. values > 0.7 may be regarded as “strong” correlation, values between 0.50 and 0.70 may be interpreted as “good” correlation, between 0.3 and 0.5 may be treated as “fair” or “moderate” correlation, and any value < 0.30 would be poor correlation[17]. A One-sample T-test will be conducted when needed aiming to compare the present sample with available data.

RESULTS

There were no statistically significant differences in body mass index (BMI) between groups. However, a statistically significant difference was found for BF percentage between age groups “20-29” and “40-49” as well as between groups “30-39” and “40-49”.

Data regarding vertical jump performance and differences between the distinct age groups are displayed on Table 2. Handgrip performances and differences between groups are exhibited on Table 3. Finally, performance on velocity-based tests and their respective differences between age groups are displayed on Table 4.

Nonparametric Spearman correlations displayed a negative correlation between RAST and CMJ, and between RAST and SJ performance (Table 5).

Table 2. Performance on the SJ and the CMJ divided by age group and presented as mean and standard deviation

Age group	SJ (cm)	CMJ (cm)
20-29 (n = 34)	24.52 (2.90)	27.19 (3.22)
30-39 (n = 49)	24.50 (3.33)	27.45 (4.32)
40-49 (n = 16)	20.68 (3.53) *	23.49 (4.47) *

SJ: squat jump; CMJ: countermovement; *significant differences between age groups

Table 3. Performance on the handgrip divided by age group and presented as mean and standard deviation

Age group	Handgrip (kg.F)
20-29 (n = 34)	58.18 (7.72)
30-39 (n = 49)	60.20 (7.71)
40-49 (n = 16)	59.88 (8.64)

Table 4. Performance on the velocity tests divided by age group and presented as mean and standard deviation

Age group	ZigZag COD (sec)	20-m sprint (sec)	RAST (sec)
20-29 (n = 34)	5.66 (0.35)	3.48 (0.21)	39.32 (2.66)
30-39 (n = 49)	5.58 (0.32)	3.48 (0.21)	40.57 (3.45) *
40-49 (n = 16)	5.92 (0.38) *	3.67 (0.31) *	43.84 (5.15) *

COD: Change-of-Direction; RAST: Running Anaerobic Sprint Test; *Significant differences between age group

Table 5. Correlations between RAST, CMJ, and SJ performance

	RAST			
	R	Classification	*p-value*	r^2
CMJ	- .473	moderate	.000	0.22
SJ	- .433	moderate	.000	0.18

RAST: Running Anaerobic Sprint Test; CMJ: Countermovement Jump; SJ: Squat Jump

DISCUSSION

The purpose of this study was to draw a scenario regarding the level of physical fitness by age group in a sample composed exclusively of professional beach lifeguards. There were statistically significant differences in all power and velocity performance parameters as well as body fat percentage with better results found on the younger age categories (20-29;30-39) when compared to an older age group (40-49). However, there was no statistically significant differences between groups regarding handgrip strength. A considerable change in body fat through the years is closely associated to changes in body weight across middle-aged individuals in general population[18]. A trend that was not observed in the present data. While body fat percentage may generally increase with age, this increase may not be so significant as to markedly provide a change in body weight in a sample that probably has a high rate of energy expenditure, considering its daily demands[7,19].

Considering that during the summer season there may be a spike in the number of water rescues, the ability to perform maximal sprints of short durations may be needed. In this sense, the performance on the running-based anaerobic sprint test (RAST) may be an important screening tool for readiness. Apparently, the age-associated decline in men´s anaerobic power is steeper than that of aerobic power[20] which was partially corroborated by the results of this analysis. The association between RAST and vertical jump has been observed in a sample composed of teenage futsal athletes[21]. This may be the reason why lower limb power also displayed a decline with age in the present sample. A possible association between RAST and vertical jump performance in a sample composed of professional beach lifeguards may permit that CMJ and SJ tests can be used as an alternative testing tool. Power testing may also be an option when investigating one´s ability to accelerate since covering a distance in a short amount of time relies heavily on power performance[22]. This can also be observed in the results of the present study as the older age group (40-49) presented worst performance on the 20-m sprint test.

Physically demanding occupations also require an optimum amount of change of direction (COD) ability which relies on several components such as technique, sprinting speed, strength, and power[23]. It is important to emphasize that COD testing, as well as the 20-m and RAST testing procedures, were carried out at the beach with the purpose of respecting their daily work specificity. This does not represent a limitation since according to previous studies, activities that involve COD ability performed on the sand require a different motor/biomechanical strategy compared to flat surfaces[24]. Also, on sand surfaces it´s possible to perform sprint activities at maximum speed with greater energy expenditure with less joint impact. Additionally, in COD-type activities it´s possible to reach higher values during the deceleration phase.

As expected, the older age group presented worst results on the ZigZag COD test that may result from the decrease in power and strength resulting from the aging process that incipiently occur from middle-age[25]. Still, this decline is not so abrupt[25] which may also be observed by the mean values presented in this sample. This natural decline in performance resulting from the aging process does not necessarily represent an inability to perform their labor activities, since this population probably has levels higher levels of physical readiness than the general population. This is hypothesized since lifeguards must undergo specific physical fitness testing batteries as a pre-requirement for job admission.

When comparing the results of the present to other military samples, it´s possible to observe a similar trend in variables such as the vertical jump performance. A one-sample t-test was conducted by the authors aiming to compare the present data with the results presented on the study of Perroni et al.[6]. It was possible to observe that young military firefighters exhibited a significantly better performance ($p < 0.001$) compared to the military lifeguards, this could be justified by the use of older individuals in the present sample, since our age group encompassed individuals between 20 and 29 years of age while Perroni et al.[6] had a younger sample composed of individuals between 20 and 22 years old. However, when comparing older age groups there is no statistically significant difference between the studies' samples (p = 0.067). This can suggest that a trend regarding loss of performance exists regardless of the specificity of the military function.

When considering the process of evaluating quantitatively large groups, instruments or tests that allow the measurement to be obtained in a simple and quick manner are extremely useful. In this context, a clear example would be the use of the BMI to classify obesity in epidemiological studies in detriment of methods which are capable to assess body composition[26,27]. Although in the present sample all groups had BMI values above normality, being classified as overweight individuals, it is possible to emphasize that these values are not in accordance with the data provided by Perroni et al.[6]. After a one-sample t-test, statistically significant differences were observed between all categories. It is also necessary to highlight that BMI is strongly influenced by high values of fat-free mass, however data referring to fat-free mass or body fat percentage were not provided by Perroni et al.[6] which limited comparisons.

The use of the handgrip as a marker of muscle strength may be a feasible option. Handgrip strength has been associated with task performance in a sample composed of police students[28]. According to the authors, recruits who had lower scores on grip strength seemed to be more susceptible to failing specific occupational task assessments. Despite investigating a different sample, both populations present similar occupational demands since they both need to perform dynamic tasks such as pushing, grabbing, lifting, and carrying. In the present investigating, it was possible to observe that there were no statistically significant differences in grip strength between groups. Still, even without statistically significant differences in handgrip performance, the complete characterization of the strength profile of and individual needs both lower and upper limb testing[29]. Also, it should be noted that isometric handgrip strength is just one of the different types of strength required during their professional activity. The present study was not limited to this type of strength and also investigated lifeguards´ power performance which is an important manifestation of dynamic strength associated with performance[30].

The current study had a few limitations such as sample differences between age groups. This can be partially attributed to the fact that older lifeguards may be assigned to roles that do not directly involve the water rescue. Also, authors weren´t able to control the individuals' specific physical demands since they rely on mischance. The authors would like to highlight the study´s limitation regarding data collection on the use of anabolic steroids since no urine or blood samples were collected to control for the limitations imposed by using an anamnesis as a way of collecting data on the use of performance enhancing substances. In addition, considering the possibility that the individual´s performance may oscillate throughout the seasons, any bias regarding this matter was controlled as the data collection occurred in a single season of the year.

CONCLUSIONS

In summary, the results of the present investigation indicate significant differences in physical fitness, except for handgrip performance, among different age groups in a sample composed of beach lifeguards. Therefore, the authors propose that the squat jump, countermovement jump, the 20-m linear sprint test, ZigZag COD Test, and the RAST assessment should be implemented as a screening tool for readiness. Also, it´s suggested that, considering the natural process of aging, complementary individualized training programs should be implemented in order to mitigate this natural decline in physical aptitude.

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