Acta Scientiarum

http://www.uem.br/acta
ISSN printed: 1679-9291
ISSN on-line: 1807-8648
Doi: 10.4025/actascihealthsci.v39i1.31803

Aerobic capacity, physical activity and pain in adult victims of moderate to severe burns after discharge

Edna Yukimi Itakussu[1,2*], Paola Janeiro Valenciano[1], Dirce Shizuko Fujisawa[1], Elza Hiromi Tokushima Anami[2] and Celita Salmaso Trelha[1]

*[1]Programa de Pós-Graduação associado em Ciências da Reabilitação, Universidade Estadual de Londrina, Universidade Norte do Paraná, Rua Robert Koch, 60, 86038-350, Londrina, Paraná, Brazil. [2]Centro de Tratamento de Queimados, Hospital Universitário de Londrina, Londrina, Paraná, Brasil. *Author for correspondence. E-mail: yukimi@sercomtel.com.br*

ABSTRACT. Burns cause different impacts on the individual life. Many are the problems faced by survivors, such as hypermetabolism that may persist years after the event. The aim was to assess aerobic capacity, level of physical activity and pain in adult burn victims after hospital discharge. This is a descriptive, cross-sectional study. Participants (n = 60) were adult victims of moderate to severe burns, evaluated by six-minute walk test (6MWT), Pain Scale and International Physical Activity Questionnaire (IPAQ). We applied Student's t-test for independent samples and Mann-Whitney test for comparisons between medium and large burned; Chi-square test to compare the level of physical activity. Large burned (73%) patients prevailed among the 60 participants; there was a statistically significant trend in the distance predicted between groups (p = 0.066), with no change in performance of the aerobic capacity. 60% reported physical activity practice at least three times a week: walking, cycling and soccer. As for the level of pain, 40% reported moderate to severe persistent pain, even after complete healing of wounds. Most participants showed aerobic capacity within the normal range, despite the high body mass index reported, they reported doing physical activities of moderate intensity.

Keywords: physical therapy, walking, exercise test, assessment.

Capacidade aeróbica, atividade física e dor em adultos vítimas de queimaduras moderadas a graves após alta hospitalar

RESUMO. As queimaduras causam diversos impactos na vida do indivíduo. Inúmeros são os problemas enfrentados pelos sobreviventes, como o hipermetabolismo, que pode persistir por anos após o evento. O objetivo deste estudo foi avaliar a capacidade aeróbica, o nível de atividade física e a dor em adultos, vítimas de queimaduras após alta hospitalar. Neste estudo descritivo e transversal, participaram 60 adultos, vítimas de queimaduras moderadas a graves, avaliados pelo teste de caminhada de seis minutos (TC6min), pela Escala de Dor e pelo Questionário Internacional de Atividade Física (IPAQ). Utilizou-se Teste t Student independente e Mann-Whitney para comparações entre médios e grandes queimados; o Qui quadrado para comparação do nível de atividade física. Dos 60 pacientes, predominaram os grandes queimados (73%) e encontrou-se tendência estatística na distância predita entre os grupos (p = 0,066), sem alteração no desempenho da capacidade aeróbica. 60% referiram praticar atividade física pelo menos três vezes por semana: caminhadas, bicicleta e futebol. Quanto ao nível de dor, 40% dos avaliados mencionaram dores persistentes de moderadas a intensas, mesmo após a cicatrização total das feridas. A maioria dos adultos, vítimas de queimaduras moderadas a graves, encontra-se com a sua capacidade aeróbica dentro da normalidade e, apesar do elevado índice de massa corpórea, afirma realizar atividades físicas de moderada intensidade.

Palavras-chave: fisioterapia, caminhada, teste de esforço, avaliação.

Introduction

Every year, worldwide, about eleven million people are affected by severe burns requiring hospital admission (World Health Organization [WHO], 2008). In Brazil, this value is close to one million people, of these, 200,000 are treated in emergency services and 40,000 are hospitalized (Vale, 2005). Victims require intensified and specialized multidisciplinary care, usually long-lasting, which can cause strong economic impact (Silva, Almeida, Souza, & Costa, 2008).

With the advancement of medicine and more specialized centers for treatment of burn patients, the mortality of burn victims has decreased in recent decades (Brusselaers et al., 2005; Ullrich, Askay, & Patterson, 2009). Over the past 50 years, the team of

professionals has changed the focus of treatment, moving from survival to rehabilitation, in order to return the patients to society with functional capacity and quality of life (Mackey et al., 2009). These survivors are faced with a wide range of physical and psychosocial disadvantages, affecting all aspects of human life (Vale, 2005; Piccolo, 2002), requiring a careful process of rehabilitation to maximize recovery after hospital discharge (Farrell, Gamelli, Aleem, & Sinacore, 2008; Richard et al., 2009).

Systemic metabolic response immediately after a burn leads to a state of hypermetabolism, which can persist for up to twelve months after the initial event (Hart et al., 2000). Changes such as muscle loss, weakness, contractures (Hart et al., 2000; Diego et al., 2013), decreased joint mobility, sensory changes, hypertrophic scarring (Ripper, Renneberg, Landmann, Weigel, & Germann, 2009), and psychological symptoms, stress, depression (Baur, Hardy, & Van Dorsten, 1998) lead to limitation of the functional and physical activities (Hart et al., 2000; Diego et al., 2013; Baur et al., 1998; Parry, Walker, Niszczak, Palmieri, & Greenhalgh, 2010). The benefits of physical activity in healthy subjects are numerous; for those who suffered burns, physical activity is essential at all stages of rehabilitation (Baldwin & Li, 2013). In a study conducted at Shiners Hospital, it was observed that the practice of supervised physical activity, in addition to improve lung function, contributed to the decrease of need for reconstructive surgeries (Celis, Suman, Huang, Yen, & Herndon, 2013).

Pain is another serious problem for the survivor, may persist for several months to years after the burn (Ullrich et al., 2009; Choinière, 1994). Lung function may also be impaired, resulting in decreased aerobic capacity remaining so for long periods (Grisbook et al., 2012). The impact on the cardiovascular system is known, with increase in cardiac output and the minute ventilation (Johnson, 1994); heart rate may be elevated for up to two years after the initial event (Jeschke et al., 2008).

The complete recovery of this individual is slow and there are important care that cannot be neglected so that they can return to their functional, physical and professional activities as early as possible (Farrell et al., 2008; Richard et al., 2009). Given the lack of studies on burns and the consequences in Brazil, as well as the high incidence of this event, worldwide, the study has scientific relevance, providing subsidies for the development of future population education policies aiming to prevent burns.

The aim of this study was to evaluate the aerobic capacity, the level of physical activity and pain in adult burn victims after hospital discharge, comparing the characteristics according to the severity of the injury.

Material and methods

Type of study

This is a descriptive, cross-sectional study with exploratory character and quantitative methodology approved by the Research Ethics Committee of the State University of Londrina (UEL), Londrina, state of Paraná (Opinion 104/2013).

Study location, period and population

The evaluations were performed at the outpatient clinic of the Center for Burn Treatment of University Hospital of Londrina (CTQ/HU/UEL), from October 2013 to July 2014. The CTQ/HU/UEL has twelve ward beds, six for intensive care, besides an operating room and a clinic for reassessment after discharge. It receives patients from the entire state of Paraná, cities near the border of the states of São Paulo and Santa Catarina and to the Paraguayan border. Because it is a Reference Center, only patients with moderate to severe burns are admitted to the hospital. Individuals with second-degree burn, 10 to 20% total burns surface area (TBSA), or with third-degree burn and up to 10% TBSA; severe or extensive burns were those above 20% TBSA with second degree burns or over 10% with deep third burn, as well as inhalation injuries and electrical burns, regardless of TBSA (Johnson, 1994). A convenience sample (n = 60) was obtained from the selection of adults (20-59 years), through the collection of data referring to patients admitted to the CTQ/HU/UEL diagnosed with burns, in the period from 01/10/2011 to 31/01/2014 and who attended the outpatient clinic return.

Inclusion and exclusion criteria

Participants were adults, victims of moderate to severe burns; with minimum of six months and a maximum of two years after hospital discharge; aged 20-59 years, of both sexes; who remained standing unassisted and understood simple verbal commands; who agreed to participate in and signed the free and informed consent. We excluded those who died.

Procedure for data collection

Sample characterization

We conducted a survey of the medical records and the database of the physical therapy team of CTQ/HU/UEL, including socioeconomic information (gender, age, education, social class); related to the burn (etiology, reason, site of occurrence, extent, depth and severity of the burn, inhalation injury) and data of hospital stay and the time after discharge. Information related to outpatient physical therapy and use of orthosis/garments after hospital discharge was collected on the assessment day.

Anthropometric data

Determination of anthropometric data and body mass index (BMI) was made with the aid of a biometric scale (*Balmak®, serial number 1.181.907-8, manufacture year 2005*) with the individual barefoot and wearing minimal clothing, in the upright position and head in the midline. Body mass was obtained in kilograms (kg) and height in meters (m). BMI resulted from the calculation of dividing body weight by height squared (Willett, 1998).

Six-minute walk test (6MWT)

Aerobic capacity was measured by the 6MWT and the participants performed two tests with an interval between them, according to the recommendations of the *American Thoracic Society* (ATS, 2002). The subjects walked for six minutes in a corridor of 30 meters and the starting and the end point was delimited by plastic cones; the examiner informed the participants the time to complete the six minutes and used standard incentive sentences (ATS, 2002) during the test. The examiners were previously trained physical therapists, the same examiner performed both tests and did not walk along with individuals.

The following variables were checked before and after the 6MWT: peripheral O_2 saturation (SpO_2) by pulse oximetry (*Pulse Oximeter More Fitness MF-415*), heart rate (HR), blood pressure (digital pressure meter OMRON), result of the modified Borg scale (Borg, 1982) for dyspnea and fatigue in the legs.

The longest distance was considered for the analysis. For calculating the predicted distance, we used the following formula according to Britto et al. (2013).

$$6MWDpred = 890.46 - (6.11 \times age) + (0.0345 \times age^2) + (48.87 \times gender) - (4.87 \times BMI)$$

Physical Activity Questionnaire (IPAQ short form)

The IPAQ short form, originally presented in several languages, including in Portuguese, dismissing translation (Craig et al., 2003), was validated in Brazil by Pardine et al. (2001). It was applied on the assessment day and aimed to measure the level of physical activity of the participants, in the previous two weeks, through the investigation on the practice of sports and games, activities at home, at work and in leisure time, including time in sedentary activities like watching television (Pardine et al., 2001). For data analysis, we used the consensus between the Center for Physical Fitness Laboratory Studies of São Caetano do Sul and the Center for Disease Control (CDC, 2002), in Atlanta, classifying them into four categories: very active, active, irregularly active and sedentary (Pardine et al., 2001).

Pain assessment

The Visual Analogue Scale (VAS) associated with Visual Numerical Scale (EVN), consists of a visual analogue line, 100 mm in length, which represents the painful experience of the patient at the time of evaluation, in which the higher the value the greater the intensity of pain (Collins, Moore, & McQuay, 1997), zero being the absence of pain, from one to three, mild pain, four to seven, moderate pain, eight to nine, severe pain and 10, excruciating pain (Hospital Israelita Albert Einstein, 2010). This scale was applied on the assessment day, the subject was asked about the presence or absence of pain, and if positive, pointed in the scale the intensity level of the pain and the affected region.

Statistical analysis

The statistical analysis was performed using GraphPad Prism 6.0. Data normality was checked by the Shapiro-Wilk test. Data were expressed as median and interquartile range (25 - 75%) for data without normal distribution, and as mean and standard deviation for data with normal distribution. We used the Mann-Whitney test and Student's t-test for independent samples to compare groups according to the severity of the injury. The Chi-square test with Yates correction was used to compare the level of physical activity between medium and large-burned groups. The power of the sample was calculated using the Power and Sample Size program, considering $\alpha = 0.05$, $n = 16$, $m = 2.75$, $\sigma = 49.71$, $\delta = 34$. The significance level was 5 %.

Results

During the study period, 288 adult burn victims were hospitalized. Among them, 49 died, 27 were not included, 10 refused to participate in and 104 by loss of contact (no return for evaluation and/or unsuccessful telephone contact). In this way, 60 patients were evaluated, as can be seen in Figure 1.

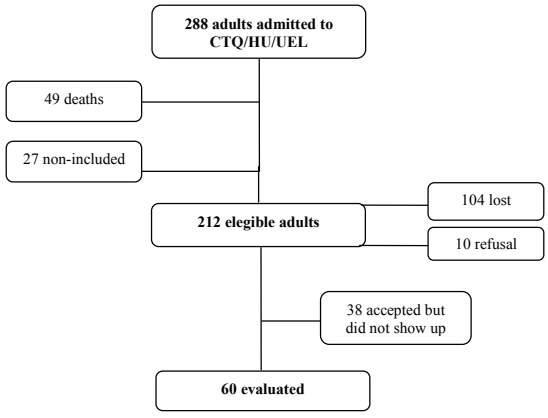

Figure 1. Participant selection process.

Individuals were assessed about nine months after hospital discharge, ranging from the minimum of six months up to 24 months; period in which most of the metabolic changes return to normal. There was a predominance of men (60%); 34 subjects (57%) were overweight, with a mean BMI of 26.5 ± 5.1 kg m^{-2}; large burned represented the most evaluated individuals with 44 (73%) patients and medium burned were represented by 16 (27%) individuals. The length of stay ranged from two to 134 days with a median of 24 days (14-39). Fire was the main etiological agent, independent of the severity of the injuries; the events that caused the burn mostly were domestic accident followed by work accidents (Table 1).

As for the need for mechanical ventilation, only 20% of those evaluated needed this life support during the hospital stay; and only 3 (5%) were diagnosed with inhalation injury. With respect to care after hospital discharge, such as outpatient physical therapy and the use of compression garment, the vast majority of participants followed the guidelines recommended by the team.

The most affected areas were the upper limbs (82%) followed by the head, face and/or neck. With regard to pain, 31 (52%) participants reported pain, 28 were large burned and only three, medium burned. Fourteen (45%) reported the pain caused limitations of functional activities. The location of the pain, prevailed pain in the upper limbs (69%), followed by the lower limbs (42%) (Table 2).

Table 1. Characteristics of the study population according to the injury severity. Londrina, state of Paraná, 2014.

Variable	Total	Medium burned	Large burned
	n= 60	n= 16	n= 44
Gender			
Female	24 (40%)	06 (37.5%)	18 (41%)
Male	36 (60%)	10 (62.5%)	26 (59%)
Age group			
20 – 30 years	17 (28%)	05 (31.25%)	12 (28%)
31 – 40 years	12 (20%)	04 (25%)	08 (18%)
41 – 50	21 (35%)	05 (31.25%)	16 (36%)
Above 51	10 (17%)	02 (12.5%)	08 (18%)
BMI			
Low weight	02 (3.0%)	02 (12.5%)	-
Normal weight	24 (40%)	05 (31.25%)	19 (43%)
Overweight	19 (32%)	05 (31.25%)	14 (32%)
Class I Obesity	10 (17%)	-	10 (23%)
Class II Obesity	05 (8.0%)	04 (25%)	01 (2%)
TBSA (%)			
Up to 10%	23 (39%)	12 (75%)	11 (25%)
11 - 20%	20 (33%)	04 (25%)	16 (36%)
Above 21%	17 (28%)	-	17 (39%)
Etiology			
Fire / Flame	29 (48%)	07 (44%)	22 (50%)
Scald	10 (17.5%)	05 (31%)	05 (11%)
Electrical	07 (11.5%)	-	07 (16%)
Explosion	07 (11.5%)	01 (6.0%)	06 (14%)
Others	07 (11.5%)	03 (19%)	04 (9.0%)
Reason			
Domestic accident	29 (48%)	11 (69%)	18 (41%)
Work	20 (33.5%)	04 (25%)	16 (36%)
Murder	06 (10%)	-	06 (14%)
Self-extermination	03 (5.0%)	-	03 (7.0%)
Others	02 (3.5%)	01 (6.0%)	01 (2.0%)

BMI: Body Mass Index; TBSA: Total Burns Surface Area

Table 2. Pain characteristics of adults treated at CTQ/HU/UEL, according to the burn injury severity, after hospital discharge. Londrina, state of Paraná, 2014.

Variable	Total	Medium burned	Large burned
	n-=60	n=16	n=44
Location of the burning			
Head, face, neck	44 (74%)	11 (69%)	33 (75%)
Upper limbs	49 (82%)	09 (56%)	40 (91%)
Lower limbs	30 (50%)	03 (19%)	27 (61%)
Anterior/posterior trunk	38(63%)	10 (63%)	28 (64%)
VAS			
No pain	29 (48%)	13 (81%)	16 (36%)
Slight pain	07 (12%)	-	07 (16%)
Moderate pain	17 (28%)	03 (19%)	14 (32%)
Severe pain	07 (12%)	-	07 (16%)
Location of the pain	n = 31	n = 03	n = 28
Face, neck	04 (13%)	01 (33,3%)	03 (11%)
Upper limbs	19 (61%)	-	19 (68%)
Lower limbs	13 (42%)	01 (33,3%)	12 (43%)
Anterior/posterior trunk	11 (35%)	01 (33,3%)	10 (23%)
Limiting pain	n = 31	n = 03	n = 28
Yes	14 (45%)	03 (100%)	11 (39%)
No	17 (55%)	-	17 (61%)
Work before the burn injury	n = 60	n = 16	n = 44
Yes	52 (87%)	15 (25%)	37 (61%)
No	08 (13%)	01 (2%)	07 (12%)
Return to work			
Yes	36 (69%)	15 (94%)	21 (48%)
No	16 (31%)	-	16 (36%)

VAS: Visual Analogue Scale

Considering the intensity of pain, a statistically significant difference (p = 0.007) was detected between the groups. Before the burning, 52 worked, of these 36 (69%) were able to return to work activities, but 16 (31%) patients were unable to return until the assessment day. All those who could not return to work were large burned.

As to the level of physical activity, most participants were performing physical activities in the last two weeks, 36 lay in the range of active and/or very active (60%). As for the time of the activities, the median of walk was 100 minutes, 120 minutes for moderate activity and for more vigorous activities, zero (0-45) minutes (Table 3). Although they are performing physical activities, it is noteworthy that 57% of the individuals were classified between overweight and class I and II obesity.

Table 4 shows the values of the 6MWT variables; all participants tolerated the test and none of them interrupted the test before completing the six minutes. The average distance of the 6MWT was 548 ± 60 m; only four participants did not reach 80%, three large burned and one medium burned. There was a statistical trend in the performance of the 6MWT between groups (p = 0.066) with an average of 573 ± 50 m traveled to the medium burned group and 539 ± 75 m for the large burned group (Table 4).

Discussion

This study evaluated the aerobic capacity, the level of physical activity and pain after discharge comparing the performance according to the injury severity. There was no difference between groups in the level of physical activity, or the time of activity performed weekly. There was a statistical trend (p = 0.066) for 6MWT, only four participants did not reach the 80% the predicted distance. As for the level of pain, 40% reported moderate to severe persistent pain, even after complete healing of wounds.

Although the epidemiological data of burn victims vary greatly from one country to another, some data in this study are similar to the national and international literature, such as male predominance (Gawryszewski et al., 2012; Van Loey et al., 2011; Vendrusculo, Balieiro, Echevarría-Guanilo, Farina Junior & Rossi, 2010), aged between 20 and 40 years (Dyster-Aas, Kildal, & Willebrand, 2007; Jarrett, McMahon, & Stiller, 2008; Theodorou, Xu, Weinand, Perbix, & Maegele, 2013), low level of education (Gawryszewski et al., 2012; Ringo & Chilonga, 2014), fire as the main etiological agent (Jarrett et al., 2008; Ricci et al., 2014), the home and the workplace as the places of higher frequency of occurrence (Ricci et al., 2014; Papp & Haythornthwaite, 2014; Elsherbiny, Salem, El-Sabbagh, Elhadidy, & Eldeen, 2011).

Table 3. Level of physical activity and pain in large and medium burned patients after hospital discharge treated at CTQ/HU/UEL. Londrina, state of Paraná, 2014.

Variables	Total	Medium burned	Large burned	*p*
	n = 60	n = 16	n = 44	
IPAQ (AT/SD)	36/ 24 60% / 40%	08 / 08 50% / 50%	28 / 16 64% / 36%	0.512
Weekly walking time (min)**	100 (10 – 360)	110 (5 – 870)	95 (10 – 330)	0.897
Weekly moderate activity time **	120 (60 – 345)	120 (17.5 – 315)	120 (60 – 390)	0.294
Weekly vigorous activity time **	0 (0 – 45)	0 (0 – 60)	0 (0 – 22.5)	0.388
Visual Analogue Scale	1 (0 – 6)	0 (0 – 0)	4 (0 – 6)	0.007*

IPAQ: physical activity questionnaire; AT: active and very active; SD: sedentary and irregularly active. Values expressed in** median and interquartile range (25 – 75%); * comparison between medium and large burned (p < 0.05).

Table 4. Comparative data for Six-Minute Walk Test (6MWT) according to the burn injury severity in adults after hospital discharge treated at CTQ/HU. Londrina, state of Paraná, 2014.

Variables	Total Initial	Medium burned Initial	Large burned Initial	*p**	Total Final	Medium burned Final	Large burned Final	*p**
SpO_2, %**	98 (97 – 99)	98 (96 – 99)	98 (97 – 99)	0.348	98 (97 – 99)	97 (96 – 98)	99 (98 – 99)	0.0001*
ΔSpO_2, %	-	-	-	-	0 (-1 – 1)	-0.5 (-1 – 0)	0 (0 - 1)	0.061
HR, bpm⌘	76 ± 11	76.5 ± 11.08	76.42± 13.39	0.982	88 ± 16	92.44 ± 15.28	89.47± 19.85	0.590
ΔHR, bpm**	-	-	-	-	10 (5 – 21)	15.5 (7.5 – 26.75)	10 (4 – 21)	0.159
Borg scale for dyspnea**	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0.532	0(0 – 2)	0.5 (0 - 2)	0.5 (0– 3)	0.670
Δ Borg dyspnea	-	-	-	-	0 (0 – 2)	0.25 (0 – 1.75)	0.5 (0 – 2)	0.521
Borg scale for fatigue**	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0.409	0.5 (0 – 3)	1.25 (0 – 3)	1.25 (0 – 3)	0.828
Δ Borg fatigue	-	-	-	-	0.5 (0 – 2)	0.25 (0 – 2.75)	0.5 (0 – 2)	0.749
Systolic BP, mmHg⌘	127 ± 15	121 ± 15	127± 14	0.105	134 ± 16	126 ± 14	136 ± 16	0.038*
Systolic Δ BP, mmHg⌘	-	-	-	-	8 (-1 – 16)	4 (0 – 10)	10 (-3 – 17)	0.261
Diastolic BP, mmHg⌘	79 ± 9	73 ± 9	80 ± 9	0.018*	81 ± 11	74 ± 9	83 ±12	0.011*
Diastolic Δ BP, mmHg⌘	-	-	-	-	3 (-2 – 8)	0 (-2.75 – 7.25)	4 (-2 – 8)	0.246
6MWD maximum, m⌘	-	-	-	-	548±63	573 ± 50	539± 65	0.066
% predicted distance⌘	-	-	-	-	91 ± 11	93 ± 10	91 ± 12	0.447

SpO_2: peripheral oxygen saturation; HR: heart rate; BP: blood pressure; 6MWD: 6 minutes walking distance. Values expressed in ⌘ mean and standard deviation;** median and interquartile range (25 – 75%); * comparison between medium and large burned groups (p < 0.05).

The TBSA < 10% was the most prevalent and for the burned areas, Peck (2012) points out that the upper body is more susceptible and upper limbs are the most affected (Jarrett et al., 2008; Ringo & Chilonga, 2014). On electrical burns, Sun et al. (2012) revealed that 75% point of entry of the burn was the upper limbs. The small number of inhalation injury in the study population can be explained by the difficulty in diagnosing the inhalation injury at the study center, which has only a single bronchoscope for the whole hospital, hindering the examination by the team of thoracic surgery; beyond the small sample size.

The average hospital stay worldwide ranged from 21.6 (Van Loey et al., 2011) to 89.0 (Brych et al., 2001) days and can be attributed to extension of burns (Ricci et al., 2014). Sierra-Zúñiga, Castro-Delgado, Caicedo-Caicedo, Merchán-Galvis and Delgado-Noguera (2013) report that the stay time is directly associated with the depth and severity of burns; besides depending on the etiological agent, for example, electrical burns require longer hospital stay due to greater complexity. The median found was 24 (14-39) days, with a minimum of two and a maximum of 134 days, similarly to that registered by Smailes, Engelsman and Dziewulski (2013).

As in previous studies (Brych et al., 2001; Esselman et al., 2007), most of the patients who were working before the burning event returned to work successfully, as in the present study, where 69% returned to work. Esselman et al. (2007) found that the barriers to return to work are diverse, resulting not only from burns, but also from physical and psychological limitations. Mackey et al. (2009) report that the pain is a major reason for not returning to work. In addition to pain, the authors also cite the severity of burns, amputation of toes and upper limbs, and hypertrophic scarring that limit the movements. The 16 individuals who were unable to return to work had severe burns, referred pain and were still in the rehabilitation process.

Pain is another problem that accompanies the survivor even after complete healing of wounds (Ullrich, 2009); studies (Choinière, 1994; Dauber, Osgood, Breslau, Vernon & Carr, 2002) indicate that the pain can persist for years after the burning event. Dauber et al. (2002) report that the pain can interfere with functional activities in almost half of the survivors; similarly to the findings of this survey, in which 45% of subjects with pain had limitations in their lives.

Moreover, the physical deconditioning caused by the combination of different factorsm such as changes in metabolism, long bedridden period, frequent surgeries, medications and psychological problems (Esselman et al., 2007; Disseldorp, Nieuwenhuis, Van Baar, & Mouton, 2011). Baldwin and Li (2013) argue that walking is the most frequently performed activities, as a form of affordable and practical aerobic activity.

The systemic metabolic response immediately after the burning that leads to hypermetabolism impacts on the cardiovascular system (Johnson, 1994; Ogunbileje et al., 2016; Benjamin, Andersen, Herndon, & Suman, 2015), and it may persist for up to twelve months after the initial event (Hart et al., 2000). Furthermore, there is evidence that heart rate can remain elevated for two years post-burn (Jeschke et al., 2008).

In the present study, we observed changes in diastolic and systolic pressures after the 6MWT, with statistically significant differences between the medium and larged burned groups, but we cannot affirm that this variation is due to the severity of the injury.

In relation to the assessment of the aerobic capacity, the 6MWT is used mainly in patients with chronic lung disease and the test was chosen based on qualities as simplicity, practicality, easy to perform and highly reproducible in clinical practice (Vilaró, Resqueti, & Fregonezi, 2012). In this study, the vast majority of participants reached the predicted distance, i.e, they have aerobic conditioning within the normal range, according to Holland et al. (2014). Similarly, Stockton, Davis, Brown, Boots, & Paratz (2012) verified that most subjects evaluated reached normal response. There was a statistical trend as for the distance traveled (6MWD) between medium and large burned groups ($p = 0.066$), a result that can be explained by the power of the sample of 63%.

Still, there was a high rate of overweight and class I and II obesity, after hospital discharge, with mean BMI of 26.5 ± 5.1 kg m^{-2}, as noticed by Theodorou et al. (2013). The only study available comparing functional results in obese and non-obese individuals shows that BMI can contribute to the lower functional scores (Farrell et al., 2008), but there is a need for studies that explain the reasons that lead to weight gain in patients after a burn.

Limitations of this study relate to sample size and subjective evaluation of physical activity by the IPAQ questionnaire. It is suggested a multicenter study, with objective assessment of physical activity in the future.

Conclusion

After hospital discharge, most participants adult victims of moderate to severe burns show aerobic capacity for exercise practice within the normal range, performing activities such as walking and have significant pain, some impairing the execution of daily tasks.

References

American Thoracic Society (ATS). (2002). Committee on proficiency standards for clinical pulmonary function laboratories. ATS statement: guidelines for the six-minute walk test. *American Journal of Respiratory and Critical Care Medicine, 166*(1), 111-117.

Baldwin, J., & Li, F. (2013). Exercise behaviors and barriers to exercise in adult burn survivors: a questionnaire survey. *Burns & Trauma, 1*(3), 134-139.

Baur, K. M., Hardy, P. E., & Van Dorsten, B. (1998). Post-traumatic stress disorder in burn populations: a critical review of the literature. *The Journal of Burn Care & Rehabilitation, 19*(3), 230-240.

Benjamin, N. C., Andersen, C. R., Herndon, D. N., & Suman, O. E. (2015). The effect of lower body burns on physical function. *Burns, 41*(8), 1653-1659.

Borg, G. A. (1982) Psychophysical bases of perceived exertion. *Medicine and Science in Sports & Exercice, 14*(5), 377-381.

Britto, R. R., Probst, V. S., Dornelas de Andrade, A. F., Samora, G. A. R., Hernandes, N. A., Marinho, P. E. M., … Parreira, V. F. (2013). Reference equations for the six-minute walk distance based on a Brazilian multicenter study. *Brazilian Journal of Physical Therapy, 17*(6), 556-563.

Brusselaers, N., Hoste, E. A., Monstrey, S., Colpaert, K., De Waele, J., Vandewoude, K., & Blot, S. (2005). Outcome and changes over time in survival following severe burns from 1985 to 2004. *Intensive Care Medicine, 31*(12), 1648-1653.

Brych, S. B., Engrav, L. H., Rivara, F. P., Ptacek, J. T., Lezotte, D. C., Esselman, P. C., … Gibran, N. S. (2001). Time off work and return to work rates after burns: systematic review of the literature and a large two-center series. *The Journal of Burn Care & Rehabilitation, 22*(6), 401-405.

Celis, M. M., Suman, O. E., Huang, T. T., Yen, P., & Herndon, D. N. (2003) Effect of a supervised exercise and physiotherapy program on surgical interventions in children with thermal injury. *The Journal of Burn Care & Rehabilitation, 24*(1), 57-61

Centers for Disease Control and Prevention (CDC). (2002). *Physical activity levels among children aged 9-13 years: United States, 2002*. Atlanta, GE. *CDC, 52*(33), 785-788.

Choinière, M. (1994). Pain of burns. In P. D. Wall, & R. Melzack (Eds.). *Textbook of pain* (3rd ed., p. 523-537). New York, US: Churchill Livingstone.

Collins, S., Moore, R. A., & McQuay, H. J. (1997).The visual analogue pain intensity scale: What is moderate pain in millimetres? *Pain Medicine, 72*(1-2), 95-97.

Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., … Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine and Science in Sports & Exercice, 35*(8), 1381-1395.

Dauber, A., Osgood, P. F., Breslau, A. J., Vernon, H. L., & Carr, D. B. (2002). Chronic persistent pain after severe burns: A survey of 358 burn survivors. *Pain Medicine, 3*(1), 6-17.

Diego, A. M., Serghiou, M., Padmanabha, A., Porro, L. J., Herndon, D. N., & Suman, O. E. (2013). Exercise training after burn injury: A survey of practice. *Journal of Burn Care Research, 34*(6), 311-317.

Disseldorp, L. M., Nieuwenhuis, M. K., Van Baar, M. E., & Mouton, L. J. (2011). Physical fitness in people after burn injury: a systematic review. *Archives of Physical Medicine and Rehabilitation, 92*(9), 1501-1510.

Dyster-Aas, J., Kildal, M., & Willebrand, M. (2007). Return to work and health-related quality of life after burn injury. *Journal of Rehabilitation Medicine, 39*(1), 49-55.

Elsherbiny, O. E., Salem, M. A., El-Sabbagh, A. H., Elhadidy, M. R., & Eldeen S. M. (2011). Quality of life of adult patients with severe burns. *Burns, 37*(5), 776-789.

Esselman, P. C., Wiechman, A. S., Carrougher, G. J., Lezotte, D. C., Holavanahalli, R. K., Magyar-Russell, G., … Engrav, L. H. (2007). Barriers to return to work after burn injuries. *Archives of Physical Medicine and Rehabilitation, 88*(12), S50-56.

Farrell, R. T., Gamelli, R. L., Aleem, R. F., & Sinacore, J. M. (2008). The relationship of body mass index and functional outcomes in patients with acute burns. *Journal of Burn Care Research, 29*(1), 102-108.

Gawryszewski, V. P., Bernal, R. T. I., Silva, N. N., Morais Neto, O. L., Silva, M. M. A., Mascarenhas, M. D. M., ... Malta, D. C. (2012). Atendimentos decorrentes de queimaduras em serviços públicos de emergência no Brasil, 2009. *Cadernos de Saúde Pública, 28*(4), 629-640.

Grisbook, T. L., Wallman, K. E., Elliott, C. M., Wood, F. M., Edgar, D. W., & Reid, S. L. (2012). The effect of exercise training on pulmonary function and aerobic capacity in adults with burns. *Burns, 38*(4), 607-613.

Hart, D. W., Wolf, S. E., Mlcak, R., Ramzy, P. I., Obeng, M. K., & Herndon, D. N. (2000). Persistence of muscle catabolism after severe burn. *Surgery, 128*(2), 312-319.

Holland, A. E., Spruit, M. A., Troosters, T., Puhan, M. A., Pepin, V., Saey, D., ... Sally, J. (2014). An official european respiratory society / American Thoracic Society Technical Standard: field walking tests in chronic respiratory disease. *European Respiratory Journal, 44*(6), 1428-1446.

Hospital Israelita Albert Einstein (2010). *Gerenciamento da dor na SBIBHHAE.* Recovered from http://medsvl.einstein.br/diretrizes/tratamento_dor/Gerenciamento%20da%20dor%20na%20SBIBHAE.pdf

Jarrett, M., McMahon, M., & Stiller, K. (2008). Physical outcomes of patients with burn injuries - a 12 month follow-up. *Journal of Burn Care Research, 29*(6), 975-984.

Jeschke, M. G., Chinkes, D. L., Finnerty, C. C., Kulp, G., Suman. O. E., Norbury, W. B., … Herndon, D. N. (2008). Pathophysiologic response to severe burn injury. *Annals of Surgery, 248*(3), 387-401.

Johnson, C. (1994). Pathologic manifestations of burn injury. In R. L. Richard, & M. J. Stanley (Eds.). *Burn care and rehabilitation: principles and practice* (p. 29-48). Philadelphia, PA: F.A.Davis Company.

Mackey, S. P., Diba, R., McKeown, D., Wallace, C., Booth, S., Gilbert, P. M., & Dheansa, B. S. (2009). Return to work after burns: a qualitative research study. *Burns, 35*(3), 338-342.

Ogunbileje, J. O., Porter, C., Herndon, D. N., Chao, T., Abdelrahman, D. R., Papadimitriou, A., … Sidossis L. S. (2016). Hypermetabolism and hypercatabolism of skeletal muscle accompany mithocondrial stress following severe burn trauma. *American Journal of Physiology Endocrinology and Metabolism, 311*(2), 436-448.

Papp, A., & Haythornthwaite, J. (2014). Ethnicity and etiology in burn trauma. *Journal of Burn Care Research, 35*(2), 99-105.

Pardine, R., Matsudo, S., Araújo, T., Matsudo, V., Andrade, E., Braggion, G., ... Raso, V. (2001). Validação do questionário internacional de nível de atividade física (IPAQ – versão 6): estudo piloto em adultos jovens brasileiros. *Revista Brasisleira de Ciência e Movimento, 9*(3), 45-51.

Parry, I., Walker, K., Niszczak, J., Palmieri, T., & Greenhalgh, D. (2010). Methods and tools used for the measurement of burn scar contracture. *Journal of Burn Care Research, 31*(6), 888-903.

Peck, M. D. (2012). Epidemiology of burns throughout the world. Part II: Intentional burns in adults. *Burns, 38*(5), 630-637.

Piccolo, N. S., Correa, M. D., Amaral, C. R., Leonardi, D. F., Novaes, F. N., Prestes, M. A., ... Piccolo, M. T. (2002). *Queimaduras*. São Paulo, SP: Projeto Diretrizes, Sociedade Brasileira de Cirurgia Plástica.

Ricci, H., Gonçalves, N., Gallani, M. C., Ciol, M. A., Dantas, R. A. S., & Rossi, L. A. (2014). Assessment of the health status in Brazilian burn victims five to seven months after hospital discharge. *Burns, 40*(4), 616-623.

Richard, R., Baryza, M. J., Carr, J. A., Dewey, W. S., Dougherty, M. E., Forbes-Duchart, L., … Young, A. (2009). Burn rehabilitation and research: proceedings of a Consensus Summit. *Journal of Burn Care Research, 30*(4), 543-573.

Ringo, Y., & Chilonga, K. (2014). Burns at KCMC: epidemiology, presentation, management and treatment outcome. *Burns, 40*(5), 1024-1029.

Ripper, S., Renneberg, B., Landmann, C., Weigel, G., & Germann, G. (2009). Adherence to pressure garmet therapy in adult burn patients. *Burns, 35*(5), 657-664.

Sierra-Zúñiga, M. F., Castro-Delgado, O. E., Caicedo-Caicedo, J. C., Merchán-Galvis, A. M., & Delgado-Noguera, M. (2013). Epidemiological profile of minor and moderate burn victims at the University Hospital San José, Popayán, Colombia, 2000–2010. *Burns, 39*(5), 1012-1017.

Silva, H. T. S., Almeida, J. S., Souza, S. I. F., & Costa, I. M. P. (2008). Queimaduras: um estudo de caso na unidade de tratamento de queimados do hospital público do oeste, em Barreiras-BA. *Revista Digital de Pesquisa Conquer da Faculdade São Francisco de Barreiras*. Recovered from http://www.fasb.edu.br/revistaindex.php/conquer/article/viewFile/84/61

Smailes, S. T., Engelsman, K., & Dziewulski, P. (2013) Physical functional outcome assessment of patients with major burns admitted to a UK Burn Intensive Care Unit. *Burns, 39*(1), 37-43.

Stockton, K. A., Davis, M. J., Brown, M. G., Boots, R., & Paratz, J. D. (2012). Physiological responses to maximal exercise testing and the modified incremental shuttle walk test in adults after thermal injury: a pilot study. *Journal of Burn Care Research, 33*(2), 252-258.

Sun, C. F., Lv, X. X., Li, Y. J., Li, W. Z., Jiang, L., Li, J., … Li, X. Y. (2012). Epidemiological studies of electrical injuries in Shaanxi Province of China: a retrospective report of 383 cases. *Burns, 38*(4), 568-572.

Theodorou, P., Xu, W., Weinand, C., Perbix, W., & Maegele, M. (2013). Incidence and treatment of burns: A twenty-year experience from a single center in Germany. *Burns, 39*(1), 49-54.

Ullrich, P. M., Askay, S. W., & Patterson, D. R. (2009). Pain, depression, and physical functioning following burn injury. *Rehabilitation Psychology, 54*(2), 211-216.

Vale, E. C. S. (2005). Primeiro atendimento em queimaduras: a abordagem do dermatologista. *Anais Brasileiros de Dermatologia, 80*(1), 9-19.

Van Loey, N. E., Shoot, R. V., Gerdin, B., Faber, A. W., Sjo¨berg, F., & Willebrand, M. (2011). The Burn Specific Health Scale-Brief: measurement invariant across European countries. *Journal of Trauma and Acute Care Surgery, 74*(5), 1321-1326.

Vendrusculo, T. M., Balieiro, C. R. B., Echevarría-Guanilo, M. E. , Farina Junior, J. A., & Rossi, L. A. (2010) Burns in the domestic environment: characteristics and circumstances of accidents. *Revista Latino-America de Enfermargem, 18*(3), 444-451.

Vilaró, J., Resqueti, V. R., & Fregonezi, G. A. F. (2012). Clinical assessment of exercise capacity in patients with chronic obstructive pulmonary disease. *Revista Brasileira de Fisioterapia, 12*(4), 249-259.

World Health Organization [WHO]. (2008). *A WHO plan for Burn Prevention and Care*. Geneva, SW: WHO

Willett, W. (1998). *Nutritional epidemiology* (2th ed.). Oxford, UK: Oxford University Press.

Received on May 1, 2016.
Accepted on September 15, 2016.