DOI: 10.1590/1809-2950/16775424042017

ORIGINAL RESEARCH

Anthropometric characteristics, functional capacity of exercise, and physical activity of children who suffered burns

Características antropométricas, capacidade funcional de exercício e atividade física de crianças vítimas de queimaduras

Características antropométricas, capacidad funcional de ejercicio y actividad física de niños víctimas de quemaduras

Paola Janeiro Valenciano[1], Edna Yukimi Itakussu[2], Celita Salmaso Trelha[3], Dirce Shizuko Fujisawa[4]

ABSTRACT | This study aimed to analyze the anthropometric characteristics, functional capacity of exercise, and physical activity of children who suffered burns. It also aimed to verify whether there is association between the anthropometric and physical activity variables and the severity of the burns, after hospital discharge. Nutritional status, regular physical activity, and functional capacity of exercise were evaluated by z-score, "Physical Activity Questionnaire for Older Children," and six-minute walk test (6MWT), respectively. Shapiro-Wilk test was used to verify the normality of the data. Fisher's exact test was used to study the association among the qualitative variables. A statistical significance of 5% was adopted. The mean age was 10.0±2.7 years old, and most participants were classified as greatly burned. After 12.7±5.5 months of hospital discharge, 13 (61.9%) participants were eutrophic and 7 (33.3%) were shorter than expected. Regarding physical activity, 11 (52.3%) were classified as active, and the mean distance traveled in the 6MWT was 564.7±70.6 m. There was no significant difference in the association between the variables eutrophic or overweight and active or sedentary (p=0.65) nor between moderately or greatly burned and active or sedentary (p=0.31). The findings showed no association of children classified as greatly burned or overweight/obese with sedentary lifestyle. There was also no reduction of functional capacity of exercise, even with some participants presenting changes in anthropometric data and being sedentary.

Keywords | Burns; Child; Walking; Exercise Tolerance; Body Weight.

RESUMO | O objetivo do estudo foi analisar as características antropométricas, capacidade funcional do exercício e atividade física, bem como verificar se há associação entre as variáveis antropométricas e de atividade física com a gravidade da queimadura em crianças após a alta hospitalar. O estado nutricional foi estabelecido pelo escore z, a atividade física regular foi avaliada por meio do questionário *Physical Activity Questionnaire for Older Children* (PAQ-C), e a capacidade funcional de exercício pelo teste de caminhada de seis minutos (TC6). O teste Shapiro-Wilk foi utilizado para verificar a normalidade dos dados. Para análise de associação entre as variáveis qualitativas foi utilizado o teste exato de Fisher. A significância foi estabelecida em 5%. A idade foi de 10,0±2,7 anos, e a maioria dos participantes foi classificada como grande queimado. Após 12,7±5,5 meses da alta hospitalar, 13 (61,9%) participantes encontravam-se eutróficos e 7 (33,3%) com a estatura abaixo do esperado. Em relação à atividade física, 11 (52,3%) foram classificados como ativos, e a distância percorrida no TC6 foi de 564,7±70,6. Na

[1]Physical therapist, master in Rehabilitation Sciences. Research fellow of Demanda Social/Capes/Fundação Araucária – Londrina (PR), Brazil.
[2]Physical therapist at the Hospital Universitário de Londrina, master in Rehabilitation Sciences – Londrina (PR), Brazil.
[3]Physical therapist, professor of the Department of Physical Therapy of Universidade Estadual de Londrina (UEL), PhD in Health Sciences – Londrina (PR), Brazil.
[4]Physical therapist, professor of the Department of Physical Therapy of Universidade Estadual de Londrina (UEL), PhD in Education, Productivity research fellow of Fundação Araucária – Londrina (PR), Brazil.

Corresponding address: Paola Janeiro Valenciano – Rua Chile, 185, ap. 704B – Londrina (PR) – Brazil – Zip Code: 86010-220 – Telephone: (43) 996525542 – Email: paola_jv3@hotmail.com – Finance Source: Capes/Fundação Araucária – Conflict of interesting: Nothing to declare – Presentation: 08 Oct. 2016– Accepted for publication: 14 Nov. 2017 – Approved by the Research Ethics Committee Opinion no. 138/2013.

análise de associação, não houve diferença significante entre as variáveis eutróficos ou sobrepeso com ativos ou sedentários (p=0,65); e entre médio ou grande queimados com ativos ou sedentários (p=0,31). Os achados mostraram que não houve associação entre as crianças consideradas grande queimado ou sobrepeso/obesas com o sedentarismo, também não houve redução da capacidade funcional do exercício, mesmo com parte dos participantes apresentando alteração nos dados antropométricos e sendo sedentários.

Descritores | Queimaduras; Criança; Caminhada; Tolerância ao Exercício; Peso Corporal.

RESUMEN | El objetivo de este estudio ha sido analizar las características antropométricas, capacidad funcional de ejercicio y actividad física, así como verificar si hay asociación entre las variables antropométricas y de actividad física con la gravedad de la quemadura en niños después del alta hospitalaria. El estado nutricional ha sido establecido por la puntuación Z, se evaluó la actividad física a través cuestionario *Physical Activity Questionnaire for Older Children* (PAQ-C), y la capacidad funcional de ejercicio por la prueba de marcha de seis minutos (TM6M). Se utilizó la prueba de Shapiro-Wilk para verificar la normalidad de los datos. Para el análisis de asociación entre las variables cualitativas se utilizó la prueba exacta de Fisher. Se estableció una significancia a 5%. La edad fue de 10.0±2.7 años, la mayoría de los participantes fue clasificada como quemadura grave. Después de 12.7±5.5 meses del alta hospitalaria, 13 (61.9%) participantes se encontraban eutróficos y 7 (33.3%) con la estatura inferior a la esperada. Con relación a la actividad física, 11 (52.3%) participantes fueron clasificados como activos, y la distancia recorrida en el TM6M fue de 564.7±70.6 metros. En el análisis de asociación, no hubo diferencia significante entre las variables eutróficos o sobrepeso con activos o sedentarios (p=0.65); y entre quemadura mediana o grave con activos o sedentarios (p=0.31). Los hallazgos mostraron que no hubo asociación entre los niños considerados quemados graves o sobrepeso/obesas con el sedentarismo, tampoco hubo reducción de la capacidad funcional de ejercicio, aunque parte de los participantes demuestre alteración en los datos antropométricos y sedentarismo.

Palabras clave | Quemaduras; Niño; Caminata; Tolerancia al Ejercicio; Peso Corporal.

INTRODUCTION

Burns are considered a public health problem, especially in low- and middle-income countries, where the mortality rate because of them is higher[1]. Children often suffer burns[1,2], and the most common causes are accidents by contact with overheated fluids/surfaces and fire, but they also can occur by contact with other agents, such as chemical, electrical, or radioactive substances[3]. Most hospitalizations occur because of more severe burns, such as second and third degree burns[4], and the latter causes more functional and aesthetic sequelae[5].

The improvement in the outcomes of burns can be attributed to specialized centers, which cover the wound, treat infections, and control hypermetabolic responses[6,7]. Professionals must be prepared to manage post-traumatic responses, which persist after the period of discharge and may lead to catabolism and marked and prolonged musculoskeletal weakness[8]. The wound healing process can last up to two years, a critical period to the formation of keloids and hypertrophic scars[9] and installation of musculoskeletal changes, which affect the individual's quality of life[10].

It is known that the experience of physical or emotional stress, as occurs in children who suffer burns, can exacerbate several psychological and somatic conditions, including anxiety disorders, depression, obesity, and metabolic syndrome[11]. Another important point to be noted is the participation in physical and/or recreation activities after the discharge of burned children[12]. According to Grice et al.[12], the patients tend to perform activities or games preferably indoors. The authors point out that health professionals must develop appropriate interventions, considering enjoyable activities to improve social adjustment and quality of life.

According to the World Health Organization, physical activity is any body movement produced by skeletal muscles that requires energy expenditure, such as walking, cycling, and playing sports, and physical inactivity is identified as the fourth risk factor for global mortality[13]. Physical inactivity in schoolchildren is a determining factor for overweight; thus, access to physical activity is regarded as a health strategy to control obesity, which is currently considered a global public health problem[14,15]. The most active children improve their cardiorespiratory and muscle strength capacity and reduce symptoms of anxiety and depression[16].

Given the frequency of accidents with burns involving children and their possible sequelae, this study aimed to analyze the anthropometric characteristics, functional capacity of exercise, and physical activity and to verify whether there is association of the anthropometric and physical activity variables with the severity of the burn. The first hypothesis tested was that most children hospitalized in the Burn Treatment Center (CTQ – *Centro de Tratamento de Queimados*) would be classified as greatly burned and would need physical therapy during hospitalization, and that, because of the repercussions of the burn, they would be subjected, up to two years after discharge, to the experience of physical and emotional stress, which could negatively affect the risk of obesity, sedentary lifestyle, and functional capacity of exercise. The second hypothesis tested was that there would be association of children considered greatly burned with obesity and/or sedentary lifestyle. This study also aims to increase knowledge on this topic, and thus collaborate with clinical practice, given the lack of studies in this field of research.

METHODOLOGY

Study design

This is a cross-sectional study with convenience sample. All patients who returned to the outpatient clinic of the CTQ were included during the period of data collection. The study was approved by the Research Ethics Committee (no. 138/2013).

Participants

The non-probability sample was formed by children who suffered burns in the period between October 2013 and July 2014. Inclusion criteria were: age between six and 14 years old; time after discharge from hospital between six months and two years; and signing of the informed consent form by the participants, along with their parents or legal guardians. Exclusion criteria were: difficulty in understanding the guidelines and questions; presence of chronic or acute diseases affecting the musculoskeletal system or preventing them from attending school a week before the interview. All patients who returned to the outpatient clinic of the CTQ during the period of data collection and who met the inclusion criteria were evaluated.

Outcome measures and data collection procedures

Information were collected by medical records and interviews with the children and their parents or guardians. The following data were obtained: personal data, information about the accident and burn, and treatment performed.

Regular physical activity was assessed by the "Physical Activity Questionnaire for Older Children" (PAQ-C), created by Crocker et al.[17], and translated and modified to the Brazilian population[18]. The PAQ-C allows one to classify individuals as active or sedentary, and it has been used in several studies[19,20]. The questionnaire was answered by the children. Data regarding height (m) and body mass (kg) were collected for later calculation of nutritional status with the z-score obtained, using WHO AnthroPlus, version 1.0.4, a free software developed by the World Health Organization[21].

The functional capacity of exercise was measured by the six-minute walk test (6MWT), according to the American Thoracic Society[22]. The reference values used were those established by Priesnitz et al.[23] for children and adolescents. The following equipment were needed to perform the test: stopwatch, cones for delimitation of the circuit, sphygmomanometer, stethoscope, and pulse oximeter[24]. Heart rate, systolic and diastolic blood pressure in millimeters of mercury (mmHg), peripheral oxygen saturation (pulse oximeter), and rating of perceived exertion (Borg scale) were measured before and after the test. Two tests were performed with a 30-minute rest interval, and the longest distance traveled was considered.

Data analysis

The data were analyzed in GraphPad Prism 6. Shapiro-Wilk test was used to evaluate whether the data were normally distributed, and the values were presented in mean and standard deviation or median and interquartile ranges [25-75]. Fisher's exact test was used to analyze the association among the qualitative or dichotomized variables. A statistical significance of 5% was adopted.

RESULTS

Twenty-one children who suffered burns – 16 (76.2%) male and five (23.8%) female –, with mean age

of 10±2.7 years, were evaluated. The mean time after hospital discharge was 12.7±5.5 months. The mean time of hospitalization was 14 [9.5-16.5] days, and the burned body area was 8 [4-12.5]%. Most (17 – 81%) participants were classified as greatly burned (Table 1). All the children performed physical therapy during the hospital stay, but after hospital discharge only 6 (28.5%) children reported performing physical therapy.

Table 2 shows the data regarding aspects after hospital discharge, such as the nutritional classification and the anthropometric and physical activity characterization. Concerning the functional capacity of exercise, the children traveled an average distance of 564.7±70.6 m, representing 101.1±11.7% of what was predicted for the 6MWT. The test was performed 12.7±5.5 months after discharge. Table 3 shows the values of pretest and posttest.

Table 1. Characterization of children and adolescents who suffered burns (during hospital stay)

	Participants (N=21)
Greatly burned	17 (81.0)
Moderately burned	4 (19.0)
Second degree burn	12 (57.1)
Third degree burn	9 (42.8)
Face and/or cervical burn	12 (57.1)
Anterior torso burn	11 (52.3)
Posterior torso burn	5 (23.8)
UL burn	13 (61.9)
LL burn	9 (42.8)

The values are presented in absolute and relative frequency (%). Abbreviations: UL – upper limbs; LL – lower limbs

Table 2. Anthropometric and physical activity characterization of children and adolescents who suffered burns (after hospital discharge)

	Participants (N = 21)
Eutrophic	13 (61.9)
Overweight or obese	8 (38.1)
Height within the expected	14 (66.7)
Height lower than expected	7 (33.3)
Active	11 (52.3)
Sedentary	10 (47.6)
More active – Perception of participants	7 (33.3)
Equally active – Perception of participants	7 (33.3)
Less active – Perception of participants	7 (33.3)
More fit – Perception of participants	6 (28.7)
Equally fit – Perception of participants	11 (51.4)
Unfit – Perception of participants	4 (19.0)
Television time, hours/day	2.4±1.5

The values are presented in absolute and relative frequency (%) and mean±standard deviation

Table 3. Functional capacity of exercise evaluated by the six-minute walk test in children who suffered burns (after hospital discharge)

	Participants (N = 21)
Pretest values	
Heart rate before, beats/min	84.1±12.3
Oxygen saturation before, %	98 [98-99]
Systolic blood pressure before, mmHg	107.0±10.7
Diastolic blood pressure before, mmHg	62.1±9.2
Dyspnea before, points (Borg scale)	0 [0-0.5]
Fatigue before, points (Borg scale)	0 [0-0]
Posttest values	
Heart rate after, beats/min	102.7±19
Oxygen saturation after, %	98 [97-99]
Systolic blood pressure after, mmHg	112.9±13.2
Diastolic blood pressure after, mmHg	66.2±8.4
Dyspnea after, points (Borg scale)	0.5 (0-2.0)
Fatigue after, points (Borg scale)	0.5 (0-2.0)

* median [25-75]% or mean±standard deviation

Regarding the association analysis, no significant difference was found between the variables eutrophic or overweight and active or sedentary (p=0.65) and between moderately or greatly burned and active or sedentary (p=0.31).

DISCUSSION

This study investigated the anthropometric characteristics, functional capacity of exercise, and physical activity of children who suffered burns, from six months to two years after hospital discharge, a period characterized by post-traumatic responses and wound healing[8,9]. This is a critical period for the return to school and community activities, because of their vulnerability to exclusion and stigma[25]. Our findings showed that most participants had severe burns and needed physical therapy during the hospital stay. Physical therapy is essential since the first day of hospitalization until the stage after hospital discharge, to avoid or minimize possible sequelae[26,27]; however, although all patients performed physical therapy during the hospital stay, only 28.5% remained doing it after hospital discharge.

We observed that 61.9% participants were eutrophic and 66.7% had a height within the normality parameters for their age. However, 38.1% were classified as overweight or obese and 33.3% had a height below the percentile. Studies show that severe burns in the

pediatric population can cause problems such as delayed bone growth; premature fusion of the epiphyseal plate, which may lead to deformities; and reduced bone mineral density, which can be noticed in children with a BBS higher than 15%[10]. The bone demineralization in the postburn period and the difficulty of children who suffered burns in gaining bone mass during growth periods increase the risk of fractures[28]. Therefore, one must consider the clinical follow-up during the growth phase of children with burns[10].

Proper nutrition is crucial to supply the required energy for wound recovery and attenuation of the hypermetabolism and protein catabolism that occur in individuals who suffered severe burns[29]. The data were positive given that no child was classified as undernourished and most were eutrophic, but one should clinically consider those classified as overweight or obese, since childhood obesity is regarded as a public health problem not only in Brazil, but around the world[13,30,31]. Although we found no significant difference between the variables eutrophic or overweight and active or sedentary, Carissimi et al.[32] argue that obese children often avoid taking part in physical activity because they feel unfit for it, which leads them to a vicious circle of physical inactivity and obesity.

In the 6MWT, which is considered a submaximal test of tolerance to physical exercise, all the children obtained values of distance traveled within the predicted for the Brazilian child population, which shows no limitation in the functional capacity of physical exertion[23]. Regarding physical activity, 57.1% were classified as active and 42.9% as sedentary, and, among the latter, 33.3% considered themselves as less active and 19% as unfit compared to the others. The average number of hours watching television was 2.4 h/day, which can be considered positive, since Silva and Malina[18], in a study with adolescents with a mean age of 15 years, from Rio de Janeiro, found a higher average, between 4.4 h and 4.9 h/day; also, added to this, more than half of that sample showed a low degree of physical activity.

Children are naturally active, thus, one must encourage them to participate in age-appropriate activities that are enjoyable and varied, which is fundamental to their motor and skill development, especially for those with motor dysfunctions or difficulties, because they are, for the most part, less active compared to those without these limitations. Therefore, health professionals must understand and provide appropriate types and amounts of specific activities for each individual[16]. Suman and Herdon[33] found that the benefits of a structured and supervised exercise program can be effective with children who suffered burns, even after a three-month follow up, and stressed that future studies should include the best way to evaluate eating habits and spontaneous physical activities. Disseldorp et al.[34] emphasized the importance and need to research physical activity and fitness in children and adolescents who suffered burns, to contribute to a better understanding of their long-term consequences and guide the rehabilitation process.

The following clinical implications stand out: monitoring children who suffered burns – to identify whether they are within the established anthropometric parameters for their age; physical therapy follow-up after hospital discharge, with specific goals for each child, also for promoting reinsertion in the school and community; encouraging the practice of physical activity, both by sports and play, given the incidence of physical inactivity in the population evaluated. Although the functional capacity of exercise was appropriate based on the predicted values, it can underestimate the possible limitations caused by the severity of the burn and/or sedentary lifestyle, as it is a submaximal test. Thus, a specialized multidisciplinary team must follow up the patients, helping with the multiple aspects involved in their rehabilitation[35].

The limitations of this study were the reduced sample (even though it was held with all pediatric patients who returned to the CTQ in the period) and the use of a questionnaire for the classification of physical activity. Thus, researches using tools such as pedometers and accelerometers to classify physical activity are recommended.

CONCLUSION

Our findings showed that most children hospitalized in the CTQ were classified as greatly burned and that they performed physical therapy during the hospital stay. In the interval between six months and two years after hospital discharge, we found no association of children classified as greatly burned or overweight/obese with sedentary lifestyle. There was also no reduction of functional capacity of exercise, even with some participants being overweight and sedentary. Concerning the anthropometric data, we identified children with height below the expected for the age, but no participants underweight, which could occur

because of the burn. From the results of this study, we recommend that the multidisciplinary team emphasize the need for the maintenance of physical therapy, encourage the patients to carry out physical activities, and monitor their growth. These outcomes contribute with knowledge on this topic and, thus, with clinical practice, but further research in this field is still needed.

REFERENCES

1. World Health Organization (WHO). A WHO plan for burn prevention and care. Geneva; 2008. [cited 2016 Jan 15]. Available from: https://goo.gl/hhLNtX
2. Stubbs TK, James LE, Daugherty MB, Epperson K, Barajaz KA, Meyer WJ 3rd, et al. Psychosocial impact of childhood face burns: a multicenter, prospective, longitudinal study of 390 children and adolescents. Burns. 2011;37(3):387-94. doi: 10.1016/j.burns. 2010.12.013
3. Malta DC, Mascarenhas MDM, Neves ACM, Silva MA. Atendimentos por acidentes e violências na infância em serviços de emergências públicas. Cad Saúde Pública [online]. 2015;31(5):1095-105. doi: 10.1590/0102-311X00068814
4. Dassie LTD, Alves EONM. Centro de tratamento de queimados: perfil epidemiológico de crianças internadas em um hospital escola. Rev Bras Queimaduras. 2011;10(1):10-4.
5. Albuquerque MLL, Silva GPF, Diniz DMSM, Figueiredo AMF, Câmara TMS, Bastos VPD. Análise dos pacientes queimados com sequelas motoras em um hospital de referência na cidade de Fortaleza-CE. Rev Bras Queimaduras. 2010;9(3):89-94.
6. Krishnamoorthy V, Ramaiah R, Bhananker SM. Pediatric burn injuries. Int J Crit Illn Inj Sci. 2012;2(3):128-34. doi: 10.4103/2229-5151.100889
7. Jeschke MG, Herndon DN. Burns in children standard and new treatments. Lancet. 2014;383(9923):1168-78. doi: 10.1016/S0140-6736(13)61093-4
8. Porter C, Tompkins RG, Finnerty CC, Sidossis LS, Suman OE, Herndon DN. The metabolic stress response to burn trauma: current understanding and therapies. Lancet. 2016;388(10052):1417-26. doi: 10.1016/S0140-6736(16)31469-6
9. Berman B, Viera MH, Armini S, Huo R, Jones BS. Prevention and management of hypertrophic scars and keloids after burns in children. J Craniofac Surg. 2008:19(4):989-1006. doi: 10.1097/SCS.0b013e318175f3a7
10. Schneider JC, Qu HD. Neurologic and musculoskeletal complications of burn injuries. Phys Med Rehabil Clin N Am. 2011;22(2):262-75. doi: 10.1016/j.pmr.2011.01.003
11. Pervanidou P, Chrousos GP. Metabolic consequences of stress during childhood and adolescence. Metabolism. 2012;61(5):611-9. doi: 10.1016/j.metabol.2011.10.005
12. Grice KO, Barnes KJ, Vogel KA. Influence of burn injury on activity participation of children. J Burn Care Res. 2015;36(3):414-20. doi: 10.1097/BCR.0000000000000105
13. World Health Organization (WHO). Physical activity. Geneva; 2016. [cited 2016 Jan 15]. Available from: https://goo.gl/NhGtP
14. Guilherme FR, Molena-Fernades CA, Guilherme VR, Fávero MTM, Reis EJB, Rinaldi W. Inatividade física e medidas antropométricas em escolares de Paranavaí, Paraná, Brasil. Rev Paul Pediatr. 2015;33(1):50-5. dpo: 10.1016/j.rpped.2014.11.009
15. Beja A, Ferrinho P, Craveiro I. Evolução da prevenção e combate à obesidade de crianças e jovens em Portugal ao nível do planejamento estratégico. Rev Port Sau Pub. 2014;32(1):10-7.
16. US Department of health and human services. Physical activity guidelines for Americans. Rockville, MD: Office of Disease Prevention and Health Promotion; 2008. [cited 2016 Jan 19]. Available from: http://health.gov/paguidelines/
17. Crocker PR, Bailey DA, Faulkner RA, Kowalski KC, McGrath R. Measuring general levels of physical activity: preliminary evidence for the Physical Activity Questionnaire for Older Children. Med Sci Sports Exerc. 1997;29(10):1344-9.
18. Silva RCR, Malina RM. Nível de atividade física em adolescentes do Município de Niterói, Rio de Janeiro, Brasil. Cad Saúde Pública. 2000;16(4):1091-97. doi: 10.1590/S0102-311X2000000400027
19. Alves JGB, Siqueira PP, Figueiroa JN. Excesso de peso e inatividade física em crianças moradoras de favelas na região metropolitana do Recife, PE. J Pediatria. 2009;85(1):67-71. doi: 10.2223/JPED.1862
20. Rivera IR, Silva MAM, Silva RDATA, Oliveira BAV, Carvalho ACC. Atividade física, horas de assistência à TV e composição corporal em crianças e adolescentes. Arq Bras Cardiol. 2010;95(2):159-65. doi: 10.1590/S0066-782X2010005000065
21. World Health Organization (WHO). Grouth Reference data for 5-19 years: WHO reference 2007. Geneva; 2007. [cited 2016 Jan 19]. Available from: https://goo.gl/DSuS8
22. ATS statement: guidelines for the six-minute walk test. Am J Respir Crit Care Med. 2002;166(1):111-7. doi: 10.1164/ajrccm.166.1.at1102
23. Priesnitz CV, Rodrigues GH, Stumpf CDAS, Viapiana G, Cabral CP, Stein RT, et al. Reference values for the 6-min walk test in healthy children aged 6-12 years. Pediatr Pulmonol. 2009;44(12):1174-9. doi: 10.1002/ppul.21062
24. Britto RR, Souza LAP. Teste de caminhada de seis minutos uma normatização brasileira. Fisioter Mov. 2006;19(4):49-54.
25. Peck M, Molnar J, Swart D. A global plan for burn prevention and care. Bull Word Health Organ. 2009;87(10):802-3. doi: 10.2471/BLT.08.059733
26. Takino MA, Valenciano PJ, Itakussu EY, Kakitsuka EE, Hoshimo AA, Trelha CS, et al. Perfil epidemiológico de crianças e adolescentes vítimas de queimaduras admitidos em centro de tratamento de queimados. Rev Bras Queimaduras. 2016;15(2):74-9.
27. Serghiou M, Cowan A, Whitehead C. Rehabilitation after a burn injury. Clin Plastic Surg. 2009;36:675-86. doi: 10.1016/j.cps.2009.05.008

28. Mayes T, Gottschlich MM, Khoury J, Kagan RJ. Investigation of bone health subsequent to vitamin D supplementation in children following burn injury. Nutr Clin Pract. 2015;30(6):830-7. doi: 10.1177/0884533615587720

29. Bakhtyar N, Sivayoganathan T, Jeschke MG. Therapeutic approaches to combatting hypermetabolism in severe burn injuries. J Intens Crit Care. 2015;1(1):1-6. doi: 10.21767/2471-8505.10006

30. Wijnhoven TM, van Raaij JM, Sjöberg A. WHO European Childhood Obesity Surveillance Initiative: school nutrition environment and body mass index in primary schools. Int J Environ Res Public Health. 2014;11(11):11261-85. doi: 10.3390/ijerph111111261

31. Zhang Y, Zhao J, Chu Z, Zhou J. Increasing prevalence of childhood overweight and obesity in a coastal province in China. Pediatr Obes. 2016;11(6):e22-e26. doi: 10.1111/ijpo.12070

32. Carissimi A, Adan A, Tonetti L, Fabbri M, Hidalgo MP, Levandovski R, et al. Physical self-efficacy is associated to body mass indexin schoolchildren. J Pediatr. 2017;93(1):64-9. doi: 10.1016/j.jped.2016.04.011

33. Suman OE, Herndon DN. Effects of cessation of a structured and supervised exercise conditioning program on lean mass and muscle strenght in severely burned children. Arch Phys Med Rehabil. 2007;88(12 Suppl 2):S24-9. doi: 10.1016/j.apmr.2007.09.002

34. Disseldorp LM, Mouton LJ, Van Brussel M, Beerthuizen GIJM, Van der Woude LHV, Nieuwenhuis M. Design of a cross-sectional study on physical fitness and physical activity in children and adolescents after burn injury. BMC Pediatr. 2012;12:195. doi: 10.1186/1471-2431-12-195

35. Dematte MF, Gemperli R, Salles AG, Dolhmikoff M, Lanças T, Saldiva PHN, Ferreira MC. Mechanical evaluation of the resistance and elastance of post-burn scars after topical treatment with tretinoin. Clinics. 2011;66(11):1949-54. doi: 10.1590/S1807-59322011001100016