REVIEW ARTICLE

Methods of assessing body composition in people with limb amputation

Métodos de avaliação da composição corporal em pessoas com amputação de membros

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ABSTRACT

Objective: Identify which methods of have been used to assess the body composition individuals with limb amputation from the literature review. **Method:** In order to reach the defined objective, the Pubmed and Scielo databases were used, through the descriptors (in combination with amputation) body composition, fat mass and lean mass from 1986 to 2019. **Results:** Found articles went through the inclusion and exclusion criteria and 17 articles were selected, all of them using anthropometric measures (body mass and stature), followed by bone densitometry (DXA) and thickness of skinfolds. It can also be observed that most of the studies are focused on the health aspect which focused on nutrition and risk factors. **Conclusion:** Through this review we observed that the anthropometric methods were mostly used to evaluate body composition in individuals with limb amputation followed by bone densitometry. However, the studies were scarce and many procedures were not so clear to make a more careful analysis unfeasible. In addition, there is a lack of longitudinal studies and especially in the area of sports performance in this population, indicating an important gap to be explored.

Keywords: Body composition, Anthropometric, Amputation

RESUMO

Objetivo: Identificar quais métodos foram utilizados para avaliar a composição corporal de indivíduos com amputação de membros a partir da revisão da literatura. **Método:** Para atingir o objetivo definido, utilizou-se as bases de dados Pubmed e Scielo, através dos descritores (em combinação com amputação) composição corporal, massa gorda e massa magra de 1986 a 2019. **Resultados:** Os artigos encontrados passaram pela inclusão e critérios de exclusão e 17 artigos, todos utilizando medidas antropométricas (massa corporal e estatura), seguidas de densitometria óssea (DXA) e espessura das dobras cutâneas. Pode-se observar, também, que a maioria dos estudos está focada no aspecto saúde, com foco em nutrição e fatores de risco. **Conclusão:** Através desta revisão, observou-se que os métodos antropométricos foram utilizados principalmente para avaliar a composição corporal em indivíduos com amputação de membros, seguida de densitometria óssea. No entanto, os estudos eram escassos e muitos procedimentos não eram tão claros para inviabilizar uma análise mais cuidadosa. Além disso, faltam estudos longitudinais e, principalmente, na área do desempenho esportivo nessa população, indicando uma lacuna importante a ser explorada.

Palavras-chave: Composição Corporal, Antropometria, Amputação

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Submitted: 12 January 2019
Accepted: 05 June 2019

How to cite
Silvestre OF, Buratti JR, Mattosinho RR, Borges M, Gorla JI. Methods of assessing body composition in people with limb amputation. Acta Fisiatr. 2018;25(4):200-204.

DOI: 10.11606/issn.2317-0190.v25i4a163850

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INTRODUCTION

The evaluation and monitoring of body composition has its relevance in both health and the individual's sporting performance.

Through direct methods (procedures that the evaluator obtains information in vitro), indirect methods (information obtained on physical and chemical domain variables) and double-indirect methods (which are involved in regression equations in order to predict variables associated with indirect procedures),[1] that is possible to identify the various components which make up our body of the study and by this will help to check the physical and nutritional status, health risks, set goals and monitor and plan subsequent work.

To define the methods of evaluation of body composition to be used, the main factors that must be observed are validity and degree of reliability. Following both criteria whatever the outcome of the evaluation or intervention will be more effective and safe.

Individuals with lower extremity amputation according to Rosemberg et al.[2] is predisposed to obesity, a fact that besides being harmful to health and also interferes in the mobility in use of the prosthesis.

In addition, the balance is also affected after the amputation and an adequate body composition contributes to the control and balance of the use of prosthesis.[3] Mozumdar & Roy[4] the assessment of body composition in this population should focus on nutritional status.

The most relevant study to evaluate the body composition in people with amputation named Osterkamp,[5] which was analyzing the previous studies done with cadavers and living people that was able to define a percentage by measuring of human body each participant. This finding was used as a reference until the present day to evaluate body composition of people with limb amputation.

Although many years of elapsing, the study of Osterkamp[5] mentioned it is not possible to verify the current scenario of the evaluation of body composition in this population, questions such as: which methods are most used? Are there double-validated methods validated for this population? They are needed to be answered.

Therefore, in view of the importance of the evaluation of body composition and of these questions were to be delineated by identifying through a literature review which methods of body composition assessment have been used for individuals with amputation as the purpose of this study.

OBJECTIVE

To identify which methods have been used to assess the body composition individuals with limb amputation.

METHODS

To carry out this review, a time line was defined between the years from 1986 to 2019. Reason for considering the year 1986 and onwards was that the first study has been found with the population involving the body composition.

The databases that have been used were Pubmed and Scielo, through the descriptors (in combination with amputation) body composition, fat mass and lean mass.

We included studies described in the English and Portuguese languages that having related research methods of evaluation of body composition in amputees.

We excluded review studies and articles that appeared in the descriptors which were not addressing methods of assessing body composition in people with amputation. Figure 1 shows the flow of articles.

RESULTS

Through the first search in the databases, 59 articles were found. After reading the titles, 48 studies were selected. Titles and abstracts were read and the articles that did not meet the predefined criteria were excluded (n= 31), resulting in the number of 17 papers presented in Figure 1.

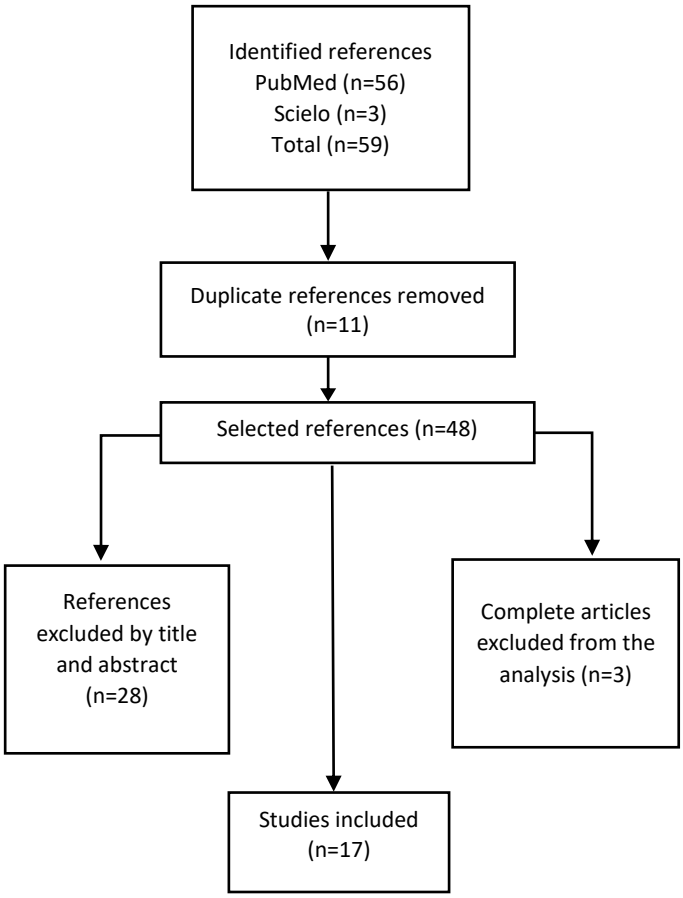

Figure 1. Flow of articles

The results above allow us to outline the research profile of body composition assessment in individuals with limb amputation. We listed the results in three broad areas. In health area, there are 10 articles, which focused on nutritional aspects and health risk factors.

Only two studies focused on the area of the physical exercise related to the profile and the physical performance of the individuals through the exercise and the validation area of methods, which sought to validate indirect measures for this population.

Specifically, in 17 selected articles we can observe that all of them used anthropometric measures such as body mass and height, either with the purpose of characterizing the sample or even validating them.

Among these studies, only five studies performed a corrected body mass calculation, and some studies did not clarify the procedures performed to measure them.

Regarding BMI, five studies[7,8,16,19,20] applied the corrected BMI calculation and one study[13] used a nomogram, the others did not specify the procedures.

Studies that analyzed body composition mostly used bone densitometry, followed by regression equations through skinfold thickness and computed tomography.

Chart 1. Main methodological characteristics of selected papers

Study	N	Mean Age (years)	Level of Amputation	Method of Evaluation of body composition
Innocencio et al.[6] (2006)	15	32.3±6.3	Transtibial (1); Transfemoral (12)	Anthropometry: BM, H, CIRC e SFT
Andrews et al.[7] (2016)	10	26.1 ± 3.6	Transtibial Unilateral (7); Transfemural Unilateral (1); Transradial Unilateral (1); Transumeral unilateral (1)	DXA; Anthropometry: BM corrected, H and BMI corrected
Frost et al.[8] (2017)	38	40.0 ± 12.5	Hip disarticulation / Hemipelvectomy, Transfemoral, Transtibial and / or through the ankle joint (Symes)	DXA; Anthropometry: BM corrected, H and BMI corrected
Littman et al.[9] (2019)	11	56	Transtibial	DXA; Anthropometry: BM corrected, H and BMI corrected e CIRC
Quintana & Neiva[10] (2008)	27	33,11±7,56	Not identified	Anthropometry: BM, H, CIRC and SFT
Simin et al.[11] (2013)	12	29,3 ± 8,6	Not identified	Anthropometry: BM, H, CIRC and SFT
Tzamaloukas et al.[12] (1994)	23	Not identified	Unilateral leg amputation and multiple amputations	Correction proposal BMI amputation
Midha et al.[13] (1999)	12	48	Transfemoral bilateral (1)	Anthropometry: BM, H, CIRC and SFT
Kurdibaylo[14] (1996)	68	20-49 years	Transtibial (30);Transfemoral (25); Transtibial + Transfemoral bilateral (7);Transfemoral bilateral (6)	Anthropometry: BM, H, CIRC and SFT
Tzamaloukas et al.[15] (1994)	14	43-78 years	Transtibial unilateral (12); Transtibial below the knee (2)	Anthropometry: BM and H
Eckard et al.[16] (2015)	31	> 18 years	Unilateral and bilateral amputation of lower limbs	DXA. Anthropometry: BM, H and BMI
Sherk et al.[3] (2010)	24	18-64 years	Transfemoral unilateral (5); Transtibial (7)	DXA. CT. Anthropometry: BM and H
Rose et al.[17] (1986)	31	36 ± 1	Transfemoral bilateral (19); Transradial (12)	DXA. Anthropometry: BM, H, CIRC and SFT
Guchan et al.[18] (2017)	24	26,67 ± 7,7 athletes, 33 ± 6,7 sedentary	Transtibial unilateral (24)	Anthropometry: BM, H, BMI and SFT
Howell et al.[19] (2015)	100	27,3 years (± 5,3)	Unilateral and bilateral transfemoral; Transtibial unilateral and bilateral	DXA. Anthropometry: BM corrected, H and BMI corrected
Andrews et al.[20] (2011)	1	35 years	Transtibial (1)	DXA. Anthropometry: BM, H, BMI corrected and BSA
Kim et al.[21] (2018)	167	63,1 (sarcopenia), 60,5 (without sarcopenia)	Amputation of lower limbs	CT. Anthropometry: BM, H, and BMI

Legend: BM: body mass, H: Height; CIRC: Circumference; SFT: Skin old thickness; BMI: body mass index; DXA: Dual energy X-ray; BSA: Body Surface Area; CT: Computed Tomography

DISCUSSION

The purpose of this study was to verify the methods that were used to evaluate body composition in individuals with lim amputation.

In this way, it was found that the anthropometric methods of body mass, height and thickness of skinfolds were the most used followed by bone densitometry. The greater use of the anthropometric measures seen in this review may be directly related to the practicality as low cost and easy applicability of these measures in large populations. Among the studies that used corrected body mass, all of them performed the following calculation: current body mass (without the prosthesis) / (1-P), where P is the body weight ratio of the absent limb.

The values of body weight ratios used in the studies of Andrews et al.[7] and Frost et al.[8] were proposed by Osterkamp.[5] The studies of Andrews et al.[20] and Kim et al.[21] used the proposed body proportion values of Mozumdar & Royt[4] and in the study by Eckard et al.[16] were determined according to the study of Himes.[22]

In their study, Mozumdar & Roy[4] emphasized the importance of estimating corrected body mass as well as the corrected BMI in this population, so that there are no underestimates or overestimations of these measures which has a close relationship with the balance for the use of the prosthesis. Increased BMI will be indicating the nutritional status, disease risk, human growth factors, among others.[2]

The studies that used skin fold thickness measurements were seven, four of them related to health[6,10,14,18] and three to the physical exercise of individuals with amputation.[11,13,19] Among these studies, some authors have used the thickness of the skin folds together with other anthropometric indicators to characterize the sample, as in the Quintana & Neiva[10], Gomes et al.[6], Midha et al.[13] and Simin et al.[11]

A study of Kurdibaylo[14] aimed to relate the anthropometric profile to the levels of amputation, and inferred that the greater amount of fat in the body mass was noticed in the subjects with bilateral transfemoral amputation (above the knee) than the transtibial amputation (below the knee) . Since body fat is being increased mainly in subcutaneous fat layers.

Guchan et al.[18] found first to relate the anthropometric profile of amputees to amputees, the result showed that the percentage of body fat of the amputees was significantly lower than the amputee sedentary.

Regarding the use of DXA, the reliability and validity of this method to assess body composition is in the most diverse populations, especially as a measure of bone mineral density is already well referenced in the literature. The main advantage of DXA is the evaluation of the body composition in a segmental way, favoring an accurate analysis for amputees.

The studies found in this review in which DXA was used only two studies that had the objective of validating the methods. In the Frost et al.[8] study, the goal was to validate BMI. In the study by Howell et al.[19], the aim was to validate an indirect method for the evaluation of caloric expenditure.

This perspective is a worrisome factor considering in this review that the studies point to doubly indirect methods validated, studies in this sense are older and do not allow us to infer something definitive and as being ideal for the most different levels of amputation.

CONCLUSION

Through this review, we could observe that the anthropometric methods are mostly used to evaluate body composition in individuals with limb amputation followed by bone densitometry. However, studies are scarce and many procedures are not clear.

It is also possible to identify a gap regarding validation of methods since the studies referenced with this perspective are old and the focus is on corrected body mass and corrected BMI variables.

There are few discussions about the use of other indirect and double indirect methods which is relevant given the numerous changes in body composition that occurred after limb loss. In addition, there is a lack of longitudinal studies mainly in the area of sports performance in this population and being the major focus in the health area.

Acknowledgments

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) Finance Code 001. Thank you Udara Liyanaarachchi for your support.

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