

ORIGINAL ARTICLE

Health outcomes in Colombian older adult population with amputations: a secondary analysis of the SABE survey**Desenlaces en salud en población adulta mayor colombiana con amputaciones: un análisis secundario de la encuesta SABE****Thalía Pinilla-Aldana¹, Tatiana Agudelo-Henao¹, Daniel Cortes-Sarmiento^{1,3}, Carlos Cano-Gutierrez^{1,2,4}, Diego Chavarro-Carvajal^{1,2,4}**¹Seedbed of neurosciences and aging of the Faculty of Medicine of the Pontificia Universidad Javeriana, Bogota, Colombia.²Institute on Aging of the School of Medicine of the Pontificia Universidad Javeriana, Bogota, Colombia.³Orthopedics and traumatology, Universidad El Bosque, Bogota, Colombia.⁴Geriatric Unit of the Hospital Universitario San Ignacio, Bogota, Colombia.**Resumen**

Objective: to describe the factors associated with amputations in the Colombian elderly population (>60 years) as evaluated in the 2015 SABE Survey with its possible adverse health related outcomes. **Materials and methods:** cross-sectional, retrospective and analytical study consisting of a secondary analysis of the SABE (Health, Well-being and Aging) Colombia 2015 survey. Excluding factors were people who required a substitute informant during the interview, people without amputations and those with upper and lower limb amputations simultaneously. The dependent variables were the adverse health outcomes in older people with amputations (depressive symptoms, mobility problems, poor self-perception of health, disability discrimination, falls in the last year, whether or not help was needed in the last fall, and hospitalizations in the last year). Both descriptive and bivariate analysis as well as multivariate logistic regression were performed. **Results:** the sample was of 278 elderly, 77.34% were men, with a mean age of 70 ± 11 years. Variables such as male sex (OR 3.62 95%CI 1.82-7.19, $p < 0.001$) and arterial hypertension (OR 3.45 95%CI 1.77-6.71, $p < 0.001$), were positively associated with upper limb amputations. Likewise, for lower limb amputations, a positive association was found with diabetes (OR 7.78 95%CI 3.78-16.02, $p < 0.001$). However, there was a negative association with male sex (OR 0.27 95%CI 0.14-0.55, $p < 0.001$) and arterial hypertension (OR 0.29 95%CI 0.15-0.56, $p < 0.001$). **Conclusion:** in people over 60 years of age, factors such as being a man and having high blood pressure are associated with upper limb amputations; counterwise, diabetes is associated with lower limb amputations.

Palabras clave: aged, amputation, measures of association (Source: MeSH BIREME).

Resumen

Objetivo. Describir los factores asociados a las amputaciones en la población colombiana adulta mayor de 60 años evaluados en la Encuesta SABE 2015, frente a posibles desenlaces adversos en salud. **Materiales y métodos.** Estudio transversal, retrospectivo y analítico consistente en un análisis secundario de la encuesta SABE (Salud, Bienestar y Envejecimiento) Colombia 2015. Para este trabajo, se excluyeron a las personas que requirieron de un informante sustituto durante la entrevista, personas sin amputaciones o con amputaciones de miembro superior e inferior simultáneamente. La variable dependiente fueron los desenlaces adversos en salud en personas mayores con amputaciones (síntomas depresivos, problemas de movilidad, mala autopercepción de salud, discriminación por discapacidad, caídas en el último año, si en la última caída necesito o no ayuda y hospitalizaciones en el último año). Se realizó análisis descriptivo, bivariado y regresión logística multivariada. **Resultados.** De las 278 personas identificadas con amputaciones, el 77.34% fueron hombres, con edad promedio de 70 ± 11 años. Se encontró que variables como sexo masculino (OR 3.62 IC95%1.82-7.19, $p < 0.001$) e hipertensión arterial (OR 3.45 IC 95%1.77-6.71, $p < 0.001$), se asocian positivamente con amputaciones de miembro superior. Asimismo, para amputaciones de miembro inferior, se encontró asociación positiva con diabetes (OR 7.78 IC95%3.78-16.02, $p < 0.001$), y asociación negativa frente a sexo masculino (OR 0.27 IC95%0.14-0.55, $p < 0.001$) e hipertensión arterial (OR 0.29 IC95%0.15-0.56, $p < 0.001$). **Conclusión.** En personas mayores de 60 años, factores como ser hombre y tener hipertensión arterial se asocian con amputaciones en miembro superior; por otro lado, la diabetes se asocia con amputaciones en miembro inferior.

Keywords: adulto mayor, amputación, medidas de asociación (Fuente: DeCS BIREME).

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Introduction

Over the years, multiple definitions have emerged regarding the term amputation. According to the dictionary of the Real Academia Española (RAE), amputation corresponds to "the action and effect of cutting and completely separating a limb or portion of it from the body"⁽¹⁾. It has also been defined as a reconstructive procedure designed to help the patient form a new relationship with the world and resume their life after the loss of a body segment⁽²⁾. Regardless of the proposed definition, amputations have both physical and psychosocial implications that alter the person's functional capacity and impact their role in society, making them more prone to adverse health outcomes and disability. The World Health Organization (WHO) states that disability "results from the interaction between persons with impairments and attitudinal and environmental barriers that hinders their full and effective participation in society on an equal basis with others"⁽³⁻⁴⁾.

Statistically, it is believed that 0.5% of the world's population requires prostheses or orthoses, which suggests a need for 47,000 to 53,000 devices worldwide. In the United States, approximately 185,000 amputations occur each year⁽⁵⁾. Likewise, in Colombia, according to the Colombian Association of Physical Medicine and Rehabilitation, the incidence of amputation is 200 to 300 people per 100,000 inhabitants⁽⁶⁾. Regarding etiologies, there are multiple factors that contribute to the disability condition, with one of the most important being cardiovascular diseases, such as peripheral artery disease, deep vein thrombosis, and embolisms, diabetes mellitus (6-25%), cancer, occupational injuries, or armed conflict⁽⁷⁾. In recent decades, Colombia's history has been marked by the presence of armed conflict. According to the Antipersonnel Mine Observatory (MAP) of the Presidency of the Republic, up to 2022, 12,209 victims have been registered due to antipersonnel mines and unexploded ordnance, which has caused injuries in 81% of the victims and deaths in 19%, with predominance of affection in older adult men (65.59%)⁽⁸⁾.

Amputations have an economic impact, with medical assistance costs estimated to range from 272 USD to 15,882 USD⁽⁹⁾. However, it is not only the cost of having the prosthesis that impacts, but also receiving it promptly, as it has been shown that early receipt of a prosthesis is associated with a reduction in spending in the 12 months following amputation of approximately 25,000 USD⁽¹⁰⁾. It is essential to consider the disability of amputated individuals as an interaction between health status and environmental factors in order to assess appropriate interventions to reduce it^(11,12).

At the social level, relational and occupational competencies are affected, mainly in lower limb amputations. They require greater self-care, hinder mobility, affect the ability to maintain social relationships, participate in leisure activities, be active members of the community, and return to work and maintain it⁽¹³⁾.

According to the SABE survey - 2015, 2.2% of older adults presented an amputation, with a higher proportion among those aged 70 to 74 years⁽¹⁴⁾. It is essential to consider the challenges faced by older amputees in their rehabilitation, as this is affected by aging processes such as loss of muscle mass, decreased lung reserve, accompanying comorbidities, and immunosenescence, among others, conditions that ultimately impact the rehabilitation process and quality of life after injury, increasing susceptibility to health problems.

The objective of this article is to define the associations between upper and lower limb amputation in the Colombian population aged 60 years and older, living in the community evaluated in the Health, Well-being, and Aging Survey (SABE) 2015, in relation to possible adverse health outcomes, such as depression, self-perceived lower health quality, increased number of falls, discrimination, and higher number of hospitalizations.

Materials and methods

Study design. This was a cross-sectional, retrospective, analytical study.

Study population. The study population was composed of data obtained from the SABE Colombia survey, which was conducted between April and September 2015 and was representative of all regions (including rural and urban areas) and included a total of 23,694 responses from older adults (aged 60 years and above)⁽¹⁵⁻¹⁶⁾.

Sampling. The sample was taken through non-probabilistic and intentional sampling, as it excluded individuals who required an informant or substitute during the interview, those without any amputations, and those who reported simultaneous upper and lower limb amputations.

Variables. The health outcomes evaluated as dependent variables were: depressive symptoms, mobility problems, poor self-perceived health, disability discrimination, falls in the last year, whether or not help was needed in the last fall, and hospitalizations in the last year.

Depressive symptoms were evaluated using the Yesavage geriatric depression scale, using a cutoff point of 6 or more to assess depressive symptoms. Mobility problems were assessed through specific aspects of the Barthel

index (bed-chair transfer, ambulation, and stair climbing), which indicates functional dependence for scores equal to or less than 5. Self-perceived health was also evaluated through the question: "Compared to other people your age, would you say your health is better, the same, or worse?" Poor self-perceived health was defined as those who reported a worse self-perception.

Disability discrimination, presence of falls in the last year, need for help, and number of hospitalizations in the last year were obtained through questions.

The sociodemographic variables included were: gender (male or female), age, location (urban or rural), and marital status. Additionally, it was taken into account whether the patient had been diagnosed with any non-communicable chronic diseases such as: hypertension, type 2 diabetes mellitus, cancer, chronic obstructive pulmonary disease (COPD), cardiovascular disease, stroke, joint pathology, osteoporosis, or psychiatric pathology, through the question: "Has a doctor or nurse told you that you have (the condition)?"

Procedures. The SABE survey was created by the Pan American Health Organization (PAHO) for seven Latin American capital cities, and was adapted and adjusted to the population characteristics and Colombian context. The methodology used for the development of the survey is published in other works⁽¹⁵⁾. The database is under the custody of the Ministry of Health of Colombia, and a formal request for access to the data was made for the realization of the studies and secondary analyses. For these analyses, a research protocol was developed, presented and approved by the institutional ethics committee, and subsequently, the analysis phase was initiated, according to the inclusion and exclusion criteria and the objectives of the study.

Statistical analysis. A descriptive analysis was performed with the information of the variables of interest, using measures of central tendency and dispersion. Subsequently, bivariate models were performed to identify the prevalences and associations of the variables mentioned in relation to having an upper limb amputation or a lower limb amputation. The initial associations were made using chi-square tests with sample weighting according to each subpopulation, in this way the variables that presented a statistically significant association, with a p value less than 0.05, were found. Subsequently, a multivariate logistic regression analysis was performed to identify the factors associated with the dependent variables of interest, obtaining odds ratios (OR) with 95% CI. The data were analyzed using Stata version 16.

Ethical aspects. The application of this instrument complied with the ethical principles set out in the Helsinki Declaration. The survey was approved by an ethics committee, and the secondary analysis of the data was approved by the Institutional Research and Ethics Committee of the Faculty of Medicine of the Pontificia Universidad Javeriana and the San Ignacio University Hospital.

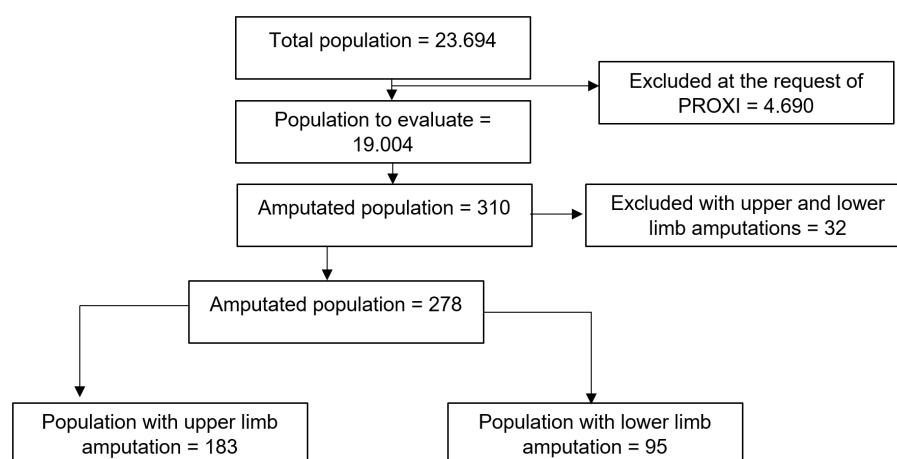


Figure 1. Included and excluded population

Results

Of the 23,694 older adults included in the SABE survey, 278 people reported some type of upper or lower limb amputation (Figure 1), of which 77.34% were men, with an average age of 70 ± 11 years and mostly located in the urban center. Regarding the descriptive analysis of the level of amputation (Table 1), 65.83% corresponded to upper limb amputations, with 84.7% being men, with a median age of 69 years, predominantly located in the urban center (75.9%), and with comorbidities such as hypertension and depressive symptoms, in 51.37% and 57.92%, respectively. On the other hand, people with lower limb amputation accounted for 34.17% of the surveyed population, mostly men (63.16%), with a median age of 70 years, and with comorbidities such as hypertension (44.21%) and diabetes mellitus (45.26%), in addition to reporting depressive symptoms in 60%. Additionally, no participant with upper limb amputation reported mobility problems compared to participants with lower limb amputation who did report them (8.42%).

Table 1. Characterization of the population of people with some type of upper or lower limb amputation

Item	General amputations n=278	Upper limbs n= 183 (65.83%)	Valor p	Lower limbs n= 95 (34.17%)	Values p
Male	215 (77.34%)	155 (84.70%)	0.00	60 (63.16%)	0.00
Age (median, IQR)	70 (11)	69 (11)	0.87	70 (12)	0.87
Urban center	211 (75.90%)	138 (75.41%)	0.79	73 (76.84%)	0.79
Marital status (single)	29 (10.43%)	21 (11.48%)	0.48	8 (8.42%)	0.48
Arterial hypertension	136 (48.92%)	94 (51.37%)	0.25	42 (44.21%)	0.25
Diabetes	66 (23.74%)	23 (12.57%)	0.00	43 (45.26%)	0.00
Cancer	17 (6.12%)	9 (4.92%)	0.25	8 (8.42%)	0.25
COPD	30 (10.79%)	20 (10.93%)	0.92	10 (10.53%)	0.92
Cardiovascular disorders	27 (9.71%)	19 (10.38%)	0.60	8 (8.42%)	0.60
Stroke	12 (4.32%)	7 (3.83%)	0.58	5 (5.26%)	0.58
Joint pathology	53 (19.06%)	32 (17.49%)	0.35	21 (22.11%)	0.35
Osteoporosis	21 (7.55%)	14 (7.65%)	0.38	7 (7.37%)	0.38
Psychiatric disorders	22 (7.91%)	14 (7.65%)	0.75	8 (8.42%)	0.75
Outcomes					
Depressive symptoms	163 (58.63%)	106 (57.92%)	0.74	57 (60%)	0.74
Problems with mobility	8 (2.88%)	0 (0%)	0.00	8 (8.42%)	0.00
Worse self-perception of comparative health	30 (10.79%)	14 (7.65%)	0.03	16 (16.84%)	0.03
Disability discrimination	30 (10.79%)	18 (9.84%)	0.38	12 (12.63%)	0.38
Falls over the last year	82 (29.50%)	51 (27.87%)	0.41	31 (32.63%)	0.41
Last fall needed help	45 (16.19%)	26 (14.21%)	0.46	19 (20%)	0.46
Hospitalizations in the last year	44 (15.83%)	23 (12.57%)	0.03	21 (22.11%)	0.03

IQR: interquartile range.

Regarding the bivariate analysis, it was found that upper limb amputations were positively associated with male sex (OR 3.23 $p<0.05$). On the other hand, age (OR 0.99 $p<0.05$), diabetes (OR 0.17 $p<0.05$), worse self-perceived health (OR 0.41 $p<0.05$), and having been hospitalized in the last year (OR 0.51 $p<0.05$) were negatively associated. In the multivariate logistic regression analysis for upper limb amputations, adjusted for confounding variables, a statistically significant association was found with male sex (OR 3.62 $p<0.05$) and arterial hypertension (OR 3.45 $p<0.05$) (Table 2).

When applying bivariate analysis to the data obtained from participants with lower limb amputations, variables such as diabetes (OR 5.75 $p<0.05$), worse self-perceived health (OR 2.44 $p<0.05$), and hospitalizations in the last year (OR 1.97 $p<0.05$) were positively associated, while male sex (OR 0.31 $p<0.05$) was negatively associated. In multivariate logistic regression, a statistically significant association was found between lower limb amputations and diabetes (OR 7.78 $p<0.05$), male sex (OR 0.27 $p<0.05$), and hypertension (OR 0.29 $p<0.05$) (Table 3).

Table 2. Multivariate logistic regression in people with upper limb amputations with independent variables

Variable	OR not adjusted (CI 95%)	p	OR adjusted (IC 95%)	p
Male	3.23 (1.80-5.77)	0.00	3.62 (1.82-7.19)	0.00
Age	0.99 (0.96-1.03)	0.03	0.99 (0.96-1.03)	0.80
Urban center	0.92 (0.51-1.65)	0.79	1.11 (0.57-2.18)	0.75
Arterial hypertension	1.33 (0.81-2.19)	0.26	3.45 (1.77-6.71)	0.00
Diabetes	0.17 (0.09-0.31)	0.00	0.13 (0.06-0.26)	0.00
Depressive symptoms	0.92 (0.55-1.52)	0.74	1.1 (0.61-1.97)	0.76
Worse self-perception of comparative health	0.41 (0.19-0.88)	0.02	0.47 (0.19-1.14)	0.09
Falls over the last year	0.80 (0.47-1.36)	0.41	1.13 (0.6-2.13)	0.71
Hospitalizations in the last year	0.51 (0.26-0.97)	0.04	0.79 (0.35-1.8)	0.57

OR: odds ratio; CI: confidence Interval

Table 3. Multivariate logistic regression in people with lower limb amputations with independent variables

Variable	OR raw (IC 95%)	p	OR tight (IC 95%)	Valor p
Male	0.31 (0.17-0.55)	0.00	0.27 (0.14-0.55)	0.00
Urban center	1.08 (0.60-1.94)	0.79	0.91 (0.47-1.77)	0.77
Arterial hypertension	0.75 (0.46-1.23)	0.26	0.29 (0.15-0.56)	0.00
Diabetes	5.75 (3.17-10.40)	0.00	7.78 (3.78-16.02)	0.00
Worse self-perception of comparative health	2.44 (1.14-5.26)	0.02	2.11 (0.87-5.14)	0.09
Falls over the last year	1.25 (0.73-2.14)	0.41	0.88 (0.47-1.66)	0.70
Hospitalizations in the last year	1.97 (1.03-0.97)	0.04	1.24 (0.55-2.30)	0.60

OR: odds ratio; CI: confidence Interval

Discusión

This study focused on describing the factors in the Colombian elderly population aged 60 years and over with amputations, which were evaluated in the SABE 2015 survey, in relation to various adverse health outcomes. The first hypothesis was that upper limb amputation was associated with joint pathology, mobility problems, worse self-perception of health, and greater discrimination. With regard to lower limb amputations, a high prevalence of diabetes was expected, and as an outcome associated with amputation, a higher number of falls per year, greater mobility impairment, and worse self-perception of health were expected.

It was found that a man is 3.23 times more likely to present with upper limb amputation, consistent with findings from a study conducted by the National Rehabilitation Institute in Peru that included 1,290 participants with amputations, where the main etiology was trauma in 59.2%, 8.4% of amputations were due to work accidents, and 98.2% of participants were men. On the other hand, the most frequent level of amputation due to work accident was below the knee with 27.3%, followed by finger amputation with 22.2%⁽¹⁷⁾.

Diabetic patients constitute a high-risk population for amputations, and it is estimated that around 100,000 amputations per year occur in 60% of people who have suffered from a foot ulcer, representing an increased risk compared to the general population. This is relevant due to the social and economic impact, due to disability and high health costs, respectively⁽¹⁸⁾. In our study population, having diabetes increases the risk of lower limb amputation by 7.78 times, demonstrating an important relationship between these two factors. On the other hand, diabetes has a negative association with upper limb amputation.

Peripheral arterial disease (PAD) along with diabetic foot are diseases with the highest rate of major and minor amputations⁽¹⁹⁾. It is a disorder that mainly affects the arteries of the upper and lower limbs, which arises as a consequence of progressive stenosis of these arteries, usually secondary to atherosclerosis that progresses to complete arterial occlusion. It has several risk factors, with smoking being the most important, followed by diabetes and hypertension. According to the literature, PAD affects 7% of the general population and up to 15-20% of those over 70 years old, and hypertensive patients are considered to have double the risk of suffering from PAD compared to the general population^(20,21). It is estimated that there are 200 million people with PAD in the world, and approximately 16 million amputations are performed annually⁽¹⁹⁾. The results of our study showed a positive association 1.33 times more regarding upper limb amputation, while for lower limb amputations, it was negatively associated.

Regarding health outcomes, it was found that upper limb amputation is not associated with mobility problems, a higher number of hospitalizations, or worse self-perceived health compared to the general population. On the other hand, for lower limb amputation, it was found that there is a 2.44 times greater risk of having a worse self-perceived health, a 1.25 times greater risk of falls requiring assistance, a 1.32 times greater risk of experiencing discrimination due to disability, and a greater association (1.97 times) with hospitalization. This is believed to be because amputation, as the cause of permanent disability, compromises a person's quality of life and functionality. It has been found that they can present a degree of disability between 21 and 60%. Furthermore, more than 50% of the population is left with an annulled occupation or family role, depending on the affected segment. Lower limb amputation involving the knee, followed by finger and below-elbow amputation, produce the highest number of potential productive life years lost, ultimately compromising self-perceived health⁽¹⁷⁾.

Regarding mobility, which is the ability to move autonomously or with external help⁽²²⁾, it is compromised mainly in patients with lower limb amputations, where gait is altered, and the energy cost of walking increases due to decreased gait efficiency, reduced physical activity, lower ambulation capacity, and low prosthetic use, which ultimately increases the risk of disability for basic activities of daily living⁽²³⁾. Klute et al. propose that amputee patients should walk between 1,100 and 1,450 steps daily to lead an independent life and have a social role⁽²⁴⁾. Similarly, Geertzen et al. propose that the ability to walk 500 m or more allows independent activities of daily living, with the precision that this capacity decreases with age and the more proximal the amputation level is, and is even more compromised when the amputation is of vascular origin or due to diabetes mellitus⁽²⁵⁾. However, although multiple tools exist to evaluate mobility, there is no consensus on the most appropriate and efficient scales to assess mobility in amputee patients⁽²³⁾.

Based on our data, it was found that people with lower limb amputation have a 1.09 times greater chance of presenting depressive symptoms, while in the case of upper limb amputations, there is a negative association. The literature presents two different positions: the first refers to the idea that minor or major limb amputation is considered a risk factor for the development of depression and anxiety symptoms and favors social and work discrimination of the affected person, where higher levels of anxiety are shown in relation to the amputation surgery⁽²⁶⁾. Additionally, it was evidenced that individuals once recovered from lower limb amputation surgery have problems returning to work or even have to change jobs⁽²⁷⁾.

The second position favors the hypothesis that amputation has no influence on the development of depressive or anxiety symptoms, or on the contrary, it reduces the prevalence of these factors, indicating that older adults adapt quickly to living with an amputation. This can be explained due to the disability paradox, which consists of the fact that before amputation, most individuals experienced pain, insomnia, anxiety, depression, and other symptoms related to the affected limb, negative symptoms that improve after the loss of the limb, improving their quality of life⁽²⁸⁾. Evidence has been reported in which amputations in severely ill patients with metastatic musculoskeletal disease improved their ability to perform daily activities, relieved pain, and improved their life emotionally, sexually, and socially⁽²⁹⁾.

Regarding multivariate analysis, it was evident that male sex and arterial hypertension are significantly associated with upper limb amputations. Similarly, diabetes remains the most important risk factor for lower limb amputations, as well as increasing the risk of worse self-perception of health and hospitalizations.

The weaknesses of the study mainly consist of selection bias and information bias, since the data is extracted from the survey. Additionally, being a cross-sectional study, it is not possible to talk about causality, but rather to determine whether there is or not a positive association with the variable. Among the strengths, it is found that the results were obtained based on a validated survey such as the SABE survey, and that this article allows obtaining a general view of older adults with amputations in Colombia, since the current availability in the country regarding this problem is low.

Conclusions

In conclusion, limb amputation in the older adult population has an impact on autonomy compromise and

deterioration of self-perception of health status. In people over 60 years of age, factors such as being male and having arterial hypertension are associated with upper limb amputations; on the other hand, diabetes is associated with lower limb amputations; and outcomes such as depressive symptoms, disability discrimination, and falls in the last year are not associated. Taking this into account, new studies with broader perspectives should be conducted to determine other conditions associated with limb amputation in older adults, as well as to emphasize prevention and interventions such as adequate control of chronic diseases.

Authors' contributions

1. Conceived the idea of the manuscript: Thalia Pinilla-Aldana, Tatiana Agudelo-Henao, Daniel Cortes-Sarmiento, Carlos Cano-Gutierrez, Diego Chavarro-Carvajal.
2. Data collection: Thalia Pinilla-Aldana, Tatiana Agudelo-Henao, Daniel Cortes-Sarmiento, Carlos Cano-Gutierrez, Diego Chavarro-Carvajal.
3. Conducted the study analysis: Thalia Pinilla-Aldana, Daniel Cortes-Sarmiento, Diego Chavarro-Carvajal.
4. Drafted the first version of the article: Thalia Pinilla-Aldana, Tatiana Agudelo-Henao, Daniel Cortes-Sarmiento.
5. Critically revised the article: Carlos Cano-Gutierrez, Diego Chavarro-Carvajal.
6. Approved the final content of the article: Thalia Pinilla-Aldana, Tatiana Agudelo-Henao, Daniel Cortes-Sarmiento, Carlos Cano-Gutierrez, Diego Chavarro-Carvajal.
7. Approved the version for publication: Thalia Pinilla-Aldana, Tatiana Agudelo-Henao, Daniel Cortes-Sarmiento, Carlos Cano-Gutierrez, Diego Chavarro-Carvajal.

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