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Percentile ranges for the physical condition assessment of children in the city of Barranquilla - Colombia

Rangos percentiles para la valoración condición física de niños de la ciudad de Barranquilla - Colombia

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ABSTRACT

Introduction: physical fitness in children is closely related to health, physical activity, sports practice, and depends on multiple multisystem attributes. The evaluation of the physical condition is essential for the identification of the physical health situation and the tests that allow its evaluation classify the children according to international reference values that differ from the anthropometric, biological and sociocultural characteristics of the different nations and regions. **Objective:** build the first percentile charts of four tests that reflect components of physical condition in children from 6 to 10 years of age in the city of Barranquilla. **Method:** it is presented as a descriptive cross-sectional study, carried out in children aged 6 to 10 years. Anthropometric characteristics were evaluated, and 4 specific fitness tests were performed for muscular strength, agility, and cardiorespiratory fitness. **Results:** 1,432 (42.96%) girls and 1,901 (57.04%) boys were evaluated. The overall mean weight was 30.17 ± 8.24 kg and 1.3021 ± 0.10 m for height. **Conclusions:** the findings made it possible to consolidate the first percentile normative tables for the classification of the physical condition of children residing in the Colombian Caribbean.

Keywords: Physical fitness; Exercise; Child development; Muscle strength; Cardiorespiratory fitness.

RESUMEN

Introducción: la condición física en los niños está relacionada estrechamente con la salud, con la actividad física, la práctica de deportes y depende de múltiples atributos multisistémicos. La evaluación de la condición física es esencial para la identificación de la situación de salud física y las pruebas que permiten su evaluación clasifican los niños de acuerdo con valores de referencia internacionales que difieren de las características antropométricas, biológicas y socioculturales de las diferentes naciones y regiones. **Objetivo:** construir las primeras cartas percentílicas de cuatro pruebas que reflejan componentes de la condición física en niños de 6 a 10 años de la ciudad de Barranquilla. **Método:** se presenta como un estudio descriptivo de corte transversal, realizado en niños con edades comprendidas desde los 6 a 10 años. Se evaluaron las características antropométricas y se realizaron 4 pruebas de condición física específicas para la fuerza muscular, agilidad y la aptitud cardiorrespiratoria. **Resultados:** 1432 (42,96%) niñas y 1901 (57,04%) niños fueron evaluados, la media general del peso fue de 30,17±8,24 kg y de 1,3021±0,10 m para la talla. **Conclusiones:** los hallazgos permitieron consolidar las primeras tablas normativas percentílicas para la clasificación de la condición física de niños residentes en el caribe colombiano.

Palabras claves: Aptitud Física; ejercicio físico; desarrollo infantil; fuerza muscular; capacidad cardiovascular.

INTRODUCTION

To consider a child physically active, the World Health Organization has proposed in its global recommendations for physical activity (PA) the performance of a minimum of 60 minutes a day in activities of moderate to vigorous intensity, mainly of an aerobic type, in addition to including in at least three times a week muscle-strengthening activities. The activities can be based on games, recreational activities, physical education, and sports practice[1].

According to different guidelines from educational organizations, the practice of sports in childhood is associated with the enhancement of cognitive flexibility and memory, as well as the development of motor skills and socio-affective strategies that are important to confront the challenges that may arise for a long time of life[2]. Likewise, satisfactory performance of PA plays an essential role in controlling obesity because it alters the balance between caloric intake and expenditure in children. Various reports show that sports that include PA of moderate to vigorous intensity promote a lower prevalence of childhood obesity and a reduction in the time spent on screens, which leads to a healthier lifestyle[2,3].

During the last decades, the PA levels of children have changed meaningfully; playing and practicing sports in the open air has been increasingly replaced by sedentary activities indoors[1]. However, the global COVID-19 pandemic has been an aggravating factor in the deterioration of the active behaviors of the youngest people; several reports expose that, in comparison with the measures prior to the pandemic, the performance of sufficient physical activity, sleep time, and time spent in front of a screen worsened significantly [4,5]. The consequences of these phenomena have been reflected in health indicators such as the increase in the prevalence of childhood obesity and mental health disorders, as well as the detriment of physical condition (PC)[6].

The CF is closely related to the quantity and quality of PA performed daily during physical exercise or sports practice; it includes multiple attributes with multisystem components such as cardiorespiratory resistance, aerobic power, muscular strength, flexibility, agility, and balance[6]. CF has been considered a predictor of morbidity and mortality from all causes. For example, low cardiorespiratory fitness in children and adolescents has been associated with increased body fat, hypertension, increased risk of metabolic syndrome, and worse academic performance[7]. In the same way, muscular fitness is a predictor of health; young individuals with more excellent muscular resistance to repetitive effort or with greater jumping capacity have shown better indicators of cardiometabolic health in adulthood[8].

The evaluation of the CF is essential for identifying the health situation and the sports' athletic potential and for the characterization of factors associated with chronic systemic

disorders and psychomotor deficiencies in children. The evaluation test batteries have been the primary tool to quantify and qualify the different components of physical fitness[9]. CF reference values, which classify individuals into percentiles or categories, are often used to interpret the results of different physical tests by matching how their results compare with those of the general population. If done correctly, the CF classification would facilitate the diagnosis of factors associated with physical health and detecting potential sports talents[10].

The development patterns of the CF of children and adolescents have been well studied and extensively reviewed in North America or Europe, the most widely used assessment batteries worldwide come from these places, and their classification is inherently related to the characteristics of the students from these places[11]. The absence of reference values for the classification of CF needs to be improved in developing countries, and the tendency in practice is to compare the results with international standards. This phenomenon ultimately hinders an adequate interpretation of the results due to the differences that transcend exclusively biological and genetic since the socioeconomic and cultural context can influence the habits and lifestyles of children. Latin American researchers also considered this problem; it denoted the deficiency and promoted the local construction of classification references that would approximate objectification in classifying children and adolescents with apparent ethnic and biological differences to the North American or European[12-14].

By proposing a local reference classification for CF, it is expected to reduce the risk of over or underestimating the individual's motor and physiological capacities during athletic-sports profiling. Likewise, it is expected to serve as a basis for objectifying the evaluation during the addressing of physical training programs and, finally, optimizing the screening of physical risk factors for the development of chronic diseases for groups of children from the ethnic mestizo Caribbean Colombian region.

Following the previous and in response to a latent need at the national scientific level, this research work intended to present the first percentile charts of four tests that reflect some of the components of CF, such as muscle strength, cardiorespiratory fitness, and agility in children from 6 to 10 years old from the city of Barranquilla, located on the Atlantic coast of Colombia.

METHOD

Design and subjects

The present research work was developed within the program "Schools of Sports Training in your Neighborhood", directed by the District Secretary of Recreation and Sports of the City of Barranquilla. It is presented as a descriptive cross-sectional study, where a population of boys and girls was approached who, through their parents, registered to participate in training activities for ten different sports disciplines. No specific sampling was carried out since we worked directly with the entire population that met the following inclusion criteria: age between 6 and 10 years, an inhabitant of the city of Barranquilla or its metropolitan area, and finally, that will have voluntary acceptance of participation with the consent of the parent or guardian. Children with underlying metabolic, cardiovascular, and neuromuscular diseases were excluded, and those who, at the time of the tests, showed symptoms of respiratory infections or disabling musculoskeletal complaints were not considered.

Information collection procedures

The evaluation procedures were developed in July 2021 by a team of 36 sports professionals with a minimum of 3 years of experience in sports training, who were previously retrained by the members of the leading research team in the different selected physical tests. These tests were chosen because they are methodologically simple to use, with a minimum requirement of tools to facilitate their replicability for practical and informative purposes. The information collector professionals were distributed in 6 different sports venues in the city of Barranquilla, places where the activities of the training project would take place. After the due registration, the participating children were summoned to begin the characterization of the CF before starting the training activities in the different sports.

Test and measurements

Anthropometric assessment: weight was calculated using electronic scales (Balance Industrielles, Montreal, Canada) using the average of three measurements. Likewise, height identification was measured using portable stadiometers (Seca 213, Hamburg, Germany) using the average of three consecutive measurements.

Lower extremity explosive strength – horizontal jump test: On a completely flat, sandy surface, the child stood behind a 3-centimeter-thick starting line, feet together, and then did a single leap forward, as far away as possible. The distance measured as the one identified from the proximal edge of the starting line to the point closest to it, where the posterior part of the rearmost heel landed on the ground. The best result of three attempts was recorded.

Upper extremity strength – maximal push-up test: with the child in a prone position facing forward, hands should be flat on the floor at shoulder width apart, legs should be fully extended, the feet together, and the support will be on the tip of these. From that position, a flexion extension of the elbows is executed without stopping. Only complete movements are counted, and the test was terminated when the child loses the movement's posture or cannot complete two consecutive movements. The best result of two attempts was recorded.

Agility as coordination capacity – lateral jump test: keeping the feet together, the child jumped laterally as many times as possible over a marked line on the floor 5 cm thick and 50 cm long, for 15 seconds. Each time both feet laterally hop, the mark is counted as one hop. This means that two jumps must be completed each time the person being evaluated returns to the starting position. The objective is to jump sideways as many times as possible in the period counted by the stopwatch. It was recommended to jump close to the marked line, bending the knees slightly and using the arms to maintain balance. The best record of three attempts was considered.

Cardiorespiratory fitness – 3-minute run: Within an elliptical circuit demarcated every 5 meters and built for a displacement of 30 meters per turn, the children were encouraged to complete the maximum number of turns in 3 minutes, trying to maintain the highest possible pace, but with the possibility of alternating running with walking within the execution of the test. The total distance traveled at the end of the time interval was recorded. This test was adapted from the 12-minute run test or Cooper test[15], a test that has been the most widely used strategy worldwide to identify aerobic power in adults or non-athletes for over half a century.

Statistical analysis

For the information analysis, the data were collected in an Excel database that was later processed in the statistical software SPSS version 22.0; the variables taken into account in the investigation went through a normality analysis process in which tests were developed statistics for large samples, in this case, the Kolmogórov-Smirnov test was applied, in which normality was determined in the data with an alpha lower than 0.05.

For the univariate analysis, the data went through a previous descriptive analysis in which the variables age, weight, and height of the sample were calculated as measures of central tendency (mean) and measures of dispersion (standard deviation). The data were stratified by specific age to minimize the risk of confusion bias that would overestimate or underestimate the results found. A t-test was used to compare the overall means of age, weight, height, and test results between genders.

Likewise, the outcome variables of the explosive strength, endurance strength, agility as coordination capacity, and aerobic power tests were stratified by sex, and the measures of central tendency and dispersion through percentiles were described. In this way, the percentiles made it possible to identify the grouped data to provide normality patterns for each age evaluated. In this context, all data between the 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles were established as normality parameters for the tests.

The data also received a reliability analysis through the test-retest test in which, through multivariate correlation analysis, the test's ability to

measure variables of resistance, agility, and agility was evaluated according to age and gender, and force were taken from the same subject at least two different times. Finally, the analysis of the data allowed the development of tables of results for motor tests in boys and girls standardized for ages between 6 and 10 years.

Ethical considerations

The design of this study adheres to the ethical principles that protect subjects who participate in scientific studies, based on the Declaration of Helsinki and the World Medical Association. Considering respect for the integrity of the individual and clarifying all possible risks in its development, this study adhered to international ethical standards in exercise and sports sciences 16 and Resolution 8430 of 1993 of the Colombian Ministry of Health. The parents of the participating children gave their consent prior to the beginning of the data collection procedures. This work has the endorsement of the scientific and ethics committee of the Universidad Libre Seccional Barranquilla, identified with act 0042021 of June 15, 2021.

RESULTS

Of 3,427 potential participants enrolled in the sports training program, 3,333 schoolchildren were included in the study, excluding 73 individuals due to age, 11 due to respiratory diseases, and ten who did not attend on the assessment dates. Of those finally evaluated, 1432 (42.96%) were girls, and 1901 (57.04%) were boys. The average age of the girls was 8.02 ± 1.38 years and 8.33 ± 1.44 years for boys. The data shown in Table 1 shows that the highest proportion of girls and boys were found at ten years of age (26.43%) and the lowest at six years of age (15.81%). The overall average body weight for boys was 31.00 ± 9.34 kg and 29.97 ± 8.50 kg for girls, while the average height for girls was 1.3028 ± 0. 10 m and 1.3024 ± 0.10 m in children. Tables 2 and 3 show the percentile ranks (P5; P10; P25; P50; P75; P90, and P95) of the four CF tests for both sexes and according to age.

Table 1. The proportion of ages and average anthropometric characteristics of the subjects studied.

Age (years)	No. (%)	Weight (kg)	Size (M)
Girls			
6,0-6,9	246 (17,18)	22,96±5,29	1,18±0,07
7,0-7,9	326 (22,76)	27,27±8,65	1,23±0,06
8,0-8,9	298 (20,81)	29,79±6,69	1,29±0,08
9,0-9,9	269 (18,78)	34,80±8,09	1,36±0,07
10,0-10,9	293 (20,47)	39,42±8,83	1,43±0,09
Children			
6,0-6,9	281 (14,78)	22,43±3,66	1,18±0,07
7,0-7,9	336 (17,67)	25,00±4,52	1,24±0,08
8,0-8,9	323 (16,99)	28,71±4,49	1,30±0,06
9,0-9,9	373 (19,62)	30,94±3,91	1,35±0,07
10,0-10,9	588 (30,93)	32,39±3,46	1,41±0,07

Table 2. Percentile ranks in the different CF tests performed on girls.

Test/Age	Half	OF	CI (95%)	P5	P10	P25	P50	P75	P90	P95
Horizontal jump (cm)										
6,0-6,9	92,73	18,25	90,44-95,05	62	69	80	92	107	115	121
7,0-7,9	97,73	17,93	95,78-99,69	70	74	84	99	110	121	127
8,0-8,9	106,36	19,49	104,14-108,59	71	82	95	107	117	129	137
9,0-9,9	111,46	20,37	109,09-113,90	84	88	97	110	125	138	147
10,0-10,9	118,00	24,37	115,20-120,80	85	91	102	117	133	150	157
Lateral jumps (reps)										
6,0-6,9	21,18	7,70	20,22-22,13	10	13	15	20	25	30	35
7,0-7,9	25,87	8,36	24,89-26,74	13	15	20	26	31	34	39
8,0-8,9	30,33	11,87	28,96-31,71	14	16	23	30	35	40	45
9,0-9,9	32,64	9,27	31,53-33-74	16	20	26	30	36	43	47
10,0-10,9	35,28	11,72	33,96-36,61	21	24	29	33	40	49	53
Push-ups (reps)										
6,0-6,9	3,10	2,21	2,58-3,62	0	0	0	1	5	8	11
7,0-7,9	3,90	3,08	2,45-3,36	0	0	1	3	6	9	11
8,0-8,9	4,51	3,96	4,05-4,97	0	1	3	5	7	10	12
9,0-9,9	5,10	4,18	4,25-5,24	1	3	4	6	8	11	14
10,0-10,9	6,60	3,47	5,21-6,99	1	3	5	8	10	12	15
Running in 3' (m)										
6,0-6,9	311,92	51,25	305,55-318,29	180	260	300	320	340	365	382
7,0-7,9	315,32	68,12	307,76-322,87	187	280	330	340	360	390	410
8,0-8,9	322,46	77,83	321,57-327,54	200	305	335	367	380	405	422
9,0-9,9	325,01	80,76	325,42-334,59	220	354	380	389	404	427	444
10,0-10,9	334,65	77,62	333,24-343,51	244	368	380	401	415	433	450

SD: standard deviation; CI: confidence interval of the mean; P: percentile; Reps: repetitions.

Table 3. Percentile ranks in the different CF tests carried out in children.

Test/Age	Half	OF	CI (95%)	P5	P10	P25	P50	P75	P90	P95
Horizontal jump (cm)										
6,0-6,9	97,97	20,89	95,49-100,44	63	70	83	98	112	126	133
7,0-7,9	106,67	20,46	104,45-108,90	71	78	93	108	122	132	138
8,0-8,9	114,59	23,47	111,98-117,19	69	88	100	117	130	144	148
9,0-9,9	120,42	22,86	118,07-122,77	88	92	105	119	134	150	160
10,0-10,9	123,52	23,52	121,59-125,46	87	97	110	124	140	152	164
Lateral jumps (reps)										
6,0-6,9	20,95	7,00	20,12-21,77	11	12	15	20	25	30	33
7,0-7,9	24,46	7,49	23,65-25,26	14	15	19	24	30	33	36
8,0-8,9	27,18	8,01	26,30-28,05	15	17	22	28	32	36	40
9,0-9,9	28,72	6,84	28,03-29,42	18	20	24	29	33	38	42
10,0-10,9	29,87	9,36	28,99-30,76	16	20	25	30	34	39	43
Push-ups (reps)										
6,0-6,9	5,44	5,45	4,98-6,49	0	0	1	4	9	12	15
7,0-7,9	5,78	5,62	4,87-6,06	0	0	1	4	9	14	17
8,0-8,9	6,00	6,41	5,29-6,70	0	1	4	8	12	17	20
9,0-9,9	6,24	5,74	5,65-6,83	1	5	9	11	14	19	25
10,0-10,9	6,66	5,65	5,83-6,90	2	5	9	13	17	23	27
Running in 3' (m)										
6,0-6,9	320,44	54,96	313,89-327,01	180	240	300	325	360	370	385
7,0-7,9	323,30	87,24	313,43-333,16	190	270	320	345	370	380	410
8,0-8,9	332,47	83,30	321,85-341,38	190	280	345	370	395	420	440
9,0-9,9	349,10	100,51	338,41-359,79	200	300	360	385	410	445	480
10,0-10,9	352,46	98,60	339,15-358,53	205	320	375	420	440	470	510

SD: standard deviation; CI: confidence interval of the mean; P: percentile; Reps: repetitions.

DISCUSSION

The results of the percentile classification denote for each of the tests the gradual increase according to chronological age and, consequently, with the increase in height and body mass. Likewise, slight differences between the sexes were observed, evidencing higher ranks in boys for the strength and cardiorespiratory fitness tests, while girls showed higher ranks in the agility test. These findings are presented as the first percentile tables of CF tests that can be used as standards to reference the evaluation in children between 6 and 10 in the Colombian Caribbean region.

The standardization of the results of the assessment of the FC has historically been necessary for the population of Latin American schoolchildren since the European reference marks differ substantially from the factors conditional to the integral physical development of children, from the biological dimension, anthropometric, socioeconomic, and cultural. For the selection of the physical tests, they were chosen mainly for their simplicity at the methodological and logistical level, considering the large population of children who were part of the training sports program and who had to be addressed in a period conditioned by the availability of the scenarios and by a team limited in the number of members.

Similar percentile classification studies in Latin America have used hand pressure tests as a standardization measure[12] or as a factor associated with the physical well-being of schoolchildren[13]; however, this test requires manual dynamometers, which restricts the possibilities of its use. Access since the availability of the equipment is required and the results are conditioned to models from different manufacturers and their level of calibration, as well as the divergences in the measurement protocol to be followed, which can reduce the reliability and subsequent classification of the results. For these reasons, the research group for this study decided to perform the *push-up test* to measure upper body strength because it is a simple test, requires no equipment, and can be performed in virtually any setting.

The long jump or horizontal jump test was included in the validation for Colombia of the International Fitness Scale (IFIS) carried out by Ramírez-Vélez *et al*. *in* 2017, using a population of children residing in Bogotá [14]. This city is located 2,640 meters above sea level, in front of Barranquilla, which is practically at sea level. Although due to the geographical diversity of Colombia, they differ enormously between the Andean and Caribbean regions, environmental and atmospheric conditions can influence physical responses and adaptations to CF tests, especially against cardiovascular endurance and aerobic power tests. This geographic and environmental diversity highlights the importance of having regional reference records, which facilitate the categorization of CF for local children.

The proposal of the present study regarding the measurement of cardiorespiratory fitness is based on a shorter adaptation of the classic 12-minute running test or, as it is known worldwide, the Cooper test. Considering that those who carried out the test were children between 6 and 10 years old, not athletes or healthy adults, 3 minutes of running at the maximum possible pace could reflect the ability to tolerate aerobic effort in a prudent observation window for the population studied. In the construction of normative values for children and adolescents of cardiorespiratory fitness tests, the use of the 20m Shuttle-Run Test has been preferred, as carried out by Ramirez-Velez *et al.*[17], among schoolchildren living in the city of Bogotá or Santander *et al.*[18], in Argentine adolescents from the province of Neuquén. In both cases, the age ranges were above ten years since the test is adapted to adolescents' mobility capacity and not younger children.

Previous national studies have used CF tests as a factor associated with the cardiometabolic health and nutritional status of school-age children, such as the study by Herazo *et al.*[19], where they described that children from Barranquilla with a lower level of physical activity present worse results in the assessment of FC and higher prevalence of obesity. Previously, Prieto-Benavides *et al.* [20] had stated that children who spent more time daily in moderate or vigorous physical activities had better levels of CF-related to health, considering the measurements' strength, flexibility, and resistance. However, the measures obtained to reference the findings of the CF on local or national categorical parameters have yet to be considered; measures of central tendency have been permanently used to generate

comparisons between subgroups or, failing that, associations with categories with international classifications.

Finally, considering that the present study was carried out during the period when the restrictions related to social isolation after the COVID-19 pandemic were partially lifted, it is valid to consider that the CF findings presented in the percentile tables could be influenced due to the lack of PA derived from face-to-face school activities and limitations in the use of sports venues and parks in urban areas during the year 2021. These phenomena were exposed by Zhou *et al.* [21], who reported in their longitudinal study the reduction in aerobic capacity and explosive strength in adolescents during the 6-month confinement, being especially impressive in those individuals who, prior to the pandemic, had better CF indicators. In contrast, the findings of Matute-Portilla *et al.*[22] showed that children living in rural areas of Ecuador improved their CF during the period of confinement during the pandemic, showing an increase in aerobic capacity, strength, and flexibility.

Strengths and limitations

In addition to representing the first percentile classification for the city of Barranquilla (Colombia) and the region, the expertise of the evaluators and the quality of the infrastructure of the sports venues where the procedures were carried out can be considered as the strong points in the section methodology of the present study. However, the study has several limitations that must be considered and analyzed for future studies with similar approaches. In addition to the already mentioned possibility of presenting results of children amid restrictions on school activities in person, no analysis criteria were established according to socioeconomic level, and despite having more than three thousand subjects, the number of individuals evaluated is lower than in similar studies carried out internationally. Physical fitness components such as flexibility and balance were not included due to limitations in the tools available. Another of the limitations that can be evidenced and that is inherently related to the cultural diversity of the Colombian Caribbean was the non-differentiation of the ethnic or racial origin of the participants, considering that beyond the mestizo predominance, in the city of Barranquilla, there is a strong presence of black and indigenous communities.

Practical implications

A percentile classification with children from a common place of origin denotes critical practical implications, reducing the risk of overestimation or underestimation compared to the international scale. Likewise, it would promote objectification in the categorization of children in sports initiation and training programs in a specific context; it would simplify the follow-up in physical conditioning programs in the medium and long term; it would also manage to optimize the identification of cardiometabolic risk and deficits in motor development in school or population screening; and finally, the local classification of the CF would encourage the scientific production that manages to expand or contrast the findings at the national level in the sciences of physical activity, health, and sport.

CONCLUSIONS

The results of this study provide the first normative tables for tests that estimate CF in children in the city of Barranquilla, Colombia. For each test, it is possible to appreciate the gradual increase in the percentile classification according to chronological age and slight differences between sexes, evidencing higher ranges in boys for strength and cardiorespiratory fitness tests than boys. In comparison, girls showed higher ranges and higher agility tests than boys. By addressing an unprecedented theme for the region, the presentation of the findings must mean progress for the construction of measures more in line with the characteristics of the Colombian Caribbean, also assuming an essential advance in the development of sciences applied to a sport that could be replicated nationally. The authors encourage professionals interested in exploring the proposed classification and contrasting it with their results, in addition to directing the construction of new classifications that overcome the limitations of the present study, including a larger population from various departments of the region and that include other components. a physical condition such as flexibility, balance, and coordination.

DECLARATION OF CONFLICTS OF INTEREST

The authors of this research work declare that there is no conflict of interest with organizations, companies, or natural persons, the objective of the work is merely academic, and it was financed by the institutions to which the researchers pay taxes.

AUTHORS' CONTRIBUTION

Roberto Rebolledo Cobos: conception of the research idea, study design, survey design, interpretation of the results, writing, and approval of the final manuscript.

Adel Rodríguez Delgado: study design, review, correction, and approval of the final manuscript.

Yoly Yepes Charris: drafting, reviewing, and approval of the final manuscript.

Tammy Pulido Iriarte: drafting, reviewing, and approval of the final manuscript.

Jorge Gil Cataño: review and approval of the final manuscript.

Laura Ardila Pereira: monitoring of project execution, administrative procedures, and logistics in data collection, review, and final approval of the manuscript.

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