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Body composition a category for resizing oncologic physical therapy: theoretical review

Abstract

Movement is essential for human beings and is influenced by physical, psychological, social and environmental factors. Within the internal factors are metabolic changes, such as in body composition and interacts with comorbidities given by chronic diseases, including cancer. The role of the physiotherapist is to enhance the maximum achievable movement. Therefore, this review will seek to gather evidence on how physiotherapeutic intervention modifies body composition in pediatric oncology patients Methodology: This study is a retrospective documentary search.[1] A search was carried out in PubMed, OVID and PeDro databases. The selection was carried out in three stages, the first was title review, the second abstracts, the third full text reading, and the extraction of information using the PICO format. Results: A total of 789 were found in the search, eliminated by title (n=721), by abstracts (n=56), in the complete reading (n=7). In total (n=5) were included for the final analysis. The result with the highest statistical significance was given in bone density and anthropometric measurements with a ($p<0.02$). Conclusions: A clear relationship is found between body composition and physiotherapeutic practice in pediatric oncology. The instruments and measures that are used in the evaluation, as well as the interaction modalities, require further research, however, if an intervention such as those found in the reviewed studies, based on movement, is carried out, it would contribute to the improvement of the intervened patient and therefore the improvement of the quality of life of the affected population.

Keywords: body composition, oncology, pediatrics, physiotherapy, environmental factors

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Introduction

Movement is essential for the human being, it implies a change of position of the body and its components. According to the theory of continuous movement, this occurs in a macroscopic and microscopic set relating movement at six different levels of the human organism, cells, tissues, organs, systems, person and family. These levels of continuous movement are in turn influenced by physical, psychological, social and environmental factors.[2] Then the individual movements depend on both external and internal factors, within the latter we speak of molecular mechanisms, such as the processes of division and metabolism, which contributes to cell growth, differentiation and development, nerve transductions and synapses that lead the activation of the different movements in the human being. As for external factors, we talk about the context in which the person is, his family, the activities he performs, for example, the practice of regular physical activity, which could improve the capacity of movement by altering adiposity, heart dimensions, muscle capillarization and muscle enzymatic activation.[3] Physiotherapy plays an important role here, since its objective is the study, understanding and management of human body movement, as an essential element of human health and wellbeing.[4]

Taking into account the above, within the internal factors that modify human body movement, metabolic changes are present, including modifications in body composition that are affected by chronic diseases, such as cancer, or by movement, physical exertion or the same medications.[5] There are few studies where body composition and its relationship with physiotherapy in this type of patients are reviewed in depth, so we consider it important to open the way to this review, not only because of the lack of information, but also because this is one of the most common complications within the pathology. The aim of the study is to gather evidence on how physiotherapy intervention modifies body composition variables in pediatric oncology patients.

Body composition

It is a structural analysis of the physical components of the body, this analysis is performed on five structures, muscle mass, fat mass, bone mass, residual mass and skin. This pentagonal model is described in figure 1, where five levels of analysis are shown. Level I corresponds to the anatomical or elemental level, where we see components such as oxygen, carbon and hydrogen, with their ideal percentages; then follows level II where we find molecular or chemical components such as water, proteins, minerals, glycogen and fat; level III corresponding to the cellular component, level IV with histological or tissue components such as skeletal muscle, soft tissues, bone and adipose tissue and finally level V, which corresponds to the total body component. These are then studied within this analysis with the percentages of each of its components.[2] Next, we will go deeper into the general categories, in which the particular components belonging to each level previously seen are grouped (Figure 1).

Fat mass

The total fat mass represents in the organism an essential component of energetic reserve and as a nervous insulator. It is a component susceptible to present variations in the subject according to age, sex and time. Composed of 83% fat tissue, of which 50% is located subcutaneously, we will see how its distribution in the organism is irregular depending on whether we are talking about reserve adipose tissue or essential fat.[2]

Fat-free or lean mass

It is composed of minerals, proteins, glycogen and water, that is, it groups the total intracellular and extracellular body water, for the

adult the average values of hydration are 73% and the approximate density of 1,1000g/ml at 36°C of temperature, for the child, the density is lower (1,084g/ml), due in part to an unfinished process of ossification.[2]

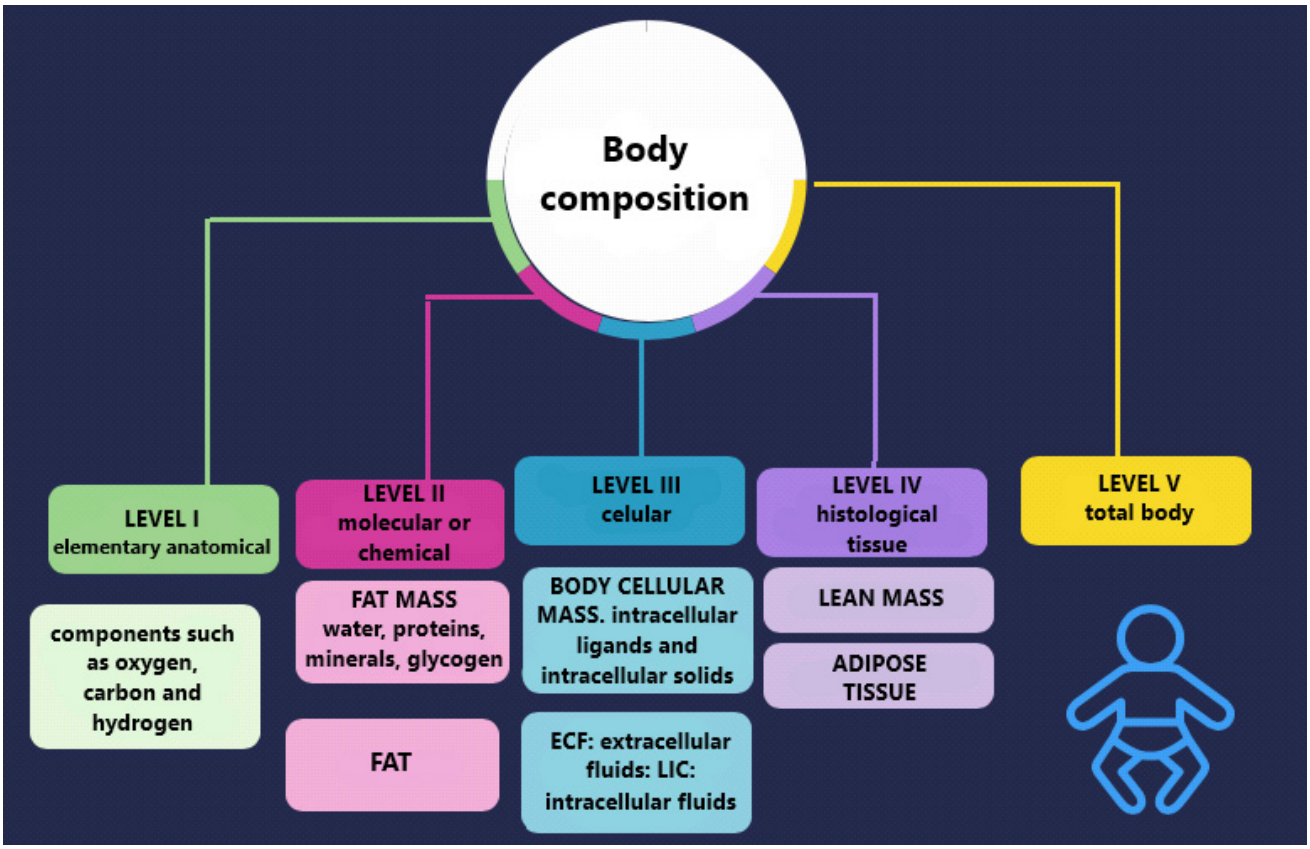

Figure 1 Body composition levels, authored by the researcher.

Total cellular water

Water is the most abundant element in the body and remains constant in healthy people. But it is altered when there are conditions that affect the internal environment such as chronic diseases and certain lifestyles, in addition to hydroelectric alterations, hemorrhages and renal insufficiency.[6] This constitutes between 75 and 80% of the cellular protoplasm I feel a third part of the Corporal Cellular Mass.[7]

These levels, as we have been discussing, can be modified by both external and internal factors in a bidirectional manner, so in this study it is pertinent to review what happens with body composition and childhood cancer.

Body composition and childhood cancer

In Colombia, in the pediatric population, an estimated 764 new cases of cancer per year were found in boys and 558 in girls[8] presenting alterations caused by: a) the tumor, b) related to the patient and c) related to antineoplastic treatments.[9] These include chronic disorders such as obesity, osteopenia, muscular atrophy, motor, growth, endocrine and cardiovascular risk disorders.

As for the side effects of the treatment, the most common is hyponatremia, where plasma osmolarity is the determinant of body water distribution.[10] When the osmolarity changes in one of the two compartments, water freely crosses the cell membranes again balancing the intracellular and extracellular osmolality to keep it within normal limits. In cancer ADH is inappropriately released, increasing sodium excretion. This also produces nausea, leading to modifications in metabolism.[10,9] These alterations completely modify body composition, reflected in loss of muscle mass, weight gain due to the release of fluids, loss of mass, weight gain and changes in adiposity.

Physiotherapy and body composition in pediatric oncology

In this context, physiotherapy has positioned itself among the professions that contribute to the improvement of the oncological patient's quality of life before and during treatment, during recovery, after recovery and in the terminal phases of the disease, influencing the increase of muscle and bone mass, reduction of fat percentage and total body water.[11,10] A research developed in Cali by Fasina A, et al.[12] reviews, from the cellular physiology, the changes that physical activity can generate in the body composition, specifically that "The molecular effects of physical activity at intracellular level are the alteration of the intracellular concentration of calcium and the energetic states (ATP/ADP), which will finally imply in the synthesis of proteins and muscular growth. At the mitochondrial level there is an increase in mitochondrial content throughout the trained muscle fibers generating an increase in aerobic energy from fatty acids and carbohydrates, this happens in both slow and fast fibers as they adapt to exercise. The mitochondrial increase helps increase ATP induced in muscle by training and improves metabolic control, oxidizing more fatty acids and less glycogen, which ultimately participate in muscle performance."[12,13]

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Methodology

Type of study

This study is a retrospective documentary search[1] where the first objective is to identify, extract and describe the information found based on the research objectives and supported by the inclusion and exclusion criteria.

Search

A search was performed in three databases PubMed, PeDro and OVID on three different dates, with Mesh terms such as Physical Therapy Modalities, Neoplasm, Pediatrics, Body composition, oncology, body water and oncology, intra and extracellular water, fat mass and oncology and Child. AND and OR connectors were added to these terms in each of the search equations, and filters such as articles no older than 9 years, free and full text, were applied in each of the search engines to minimize the search.

Identification and selection

The criteria taken into account for the selection of articles are studies focused on children, adolescents and young adults (0-17 years and 9 months). That they have as pathology some type of cancer, which is found with the latency of the pathology. These should contain or talk about body composition variables, which talk about physiotherapy in the population previously exposed. Studies in languages other than Spanish or English were excluded, as well as those that, as a methodology, had a theoretical review and studies older than 9 years were eliminated, in accordance with the inclusion and exclusion criteria.

In a first step, records were identified by searching the databases identified above. The titles of all retrieved articles were reviewed. Titles that did not meet the predefined inclusion criteria were excluded, abstracts were reviewed and records that did not meet the inclusion criteria were excluded. After abstract review, if there were articles with which we were unsure of relevance, we reviewed the full texts.

Results

General

A total of 789 articles were found in the search, of which 789 were eliminated (n=721), because some were repeated, the topics were not relevant, due to the title, or did not meet the inclusion criteria; remaining (n=68) of the selected articles then Abstracts reviews are performed and eliminated (n=56), corresponded to descriptive and informative articles, which do not meet the criteria of ages, inclusion of physical therapists or that talk about topics that do not include body composition, or that are repeated, leaving (n=12) studies that are completely reviewed, of which are eliminated (n=7) because the content is not relevant to the review. In total (n=5) were included for the final analysis.

Of the 5 articles analyzed, 1 was a systematic review; 1 was a randomized controlled study; 1 was a blinded clinical trial; 1 was a parallel randomized clinical trial and 1 was a meta-analysis. In these articles different protocols of physiotherapeutic treatment implemented in oncological services were identified, within these we found as one of the problems the body composition from its evaluation, physiotherapeutic treatment and the results of this.

Locations

As part of the search for evidence, the location of the authors of the selected studies was recognized; one of them was located in Australia[11] another in Rotterdam[14] one in Finland;[15] finally two in the USA (Utah[16] and Texas[17]).

Authors' professions

From the authors participating within the articles selected for this research, the areas or professions to which they belong and which are administered by the articles in question are extracted. Four articles in which physiotherapists are involved;[11,14,15,17] one involving occupational therapists, yoga instructors, physical therapy assistants, exercise physiologists, and fitness instructors;[14] one article involving nurses;[15] one involving kinesiologists;[16] one involving nutritionists[16] one involving epidemiology, radiology and oncology professions.[17]

Population

Within the selected studies, the population found belongs entirely to the pediatric category, however, each study handles different age groups and characteristics of the population, such as participants from 0 to 18years undergoing intensive cancer treatment.[11] Children with ALL aged 1 to 18 years who were not cognitively impaired and had a good command of the Dutch language were eligible.[14] Children aged 4 to 10 years with standard-risk ALLs.[16] Children diagnosed with B-cell or T-cell ALL between 4 and 18 years of age.[17] Finally, children between the ages of 3-16 years old.[15]

Type of cancer

The types of cancer most frequently mentioned in the studies are: cancer in general[11] four out of the five studies mention acute lymphoblastic leukemia,[14–17]one study mentions solid tumors[14] and finally two studies mention osteosarcomas.

Measuring instruments

Within this review, several measurement instruments for body composition were identified, among these, in a study conducted by Hartman et al.[14] anthropometric measurements were taken based on height, using a Harpenden stadiometer, and weight using a standard clinical scale. The body mass index (BMI) was calculated as weight/height. For children aged 4 to 19 years, body composition parameters, BMDTB and BMDLS were measured using dual-energy X-ray absorptiometry (DXA; Lunar DPX-L, Madison, WI). Total body DXA provided estimates of body composition: LBM consisting primarily of muscle mass and percent body fat.

Another research conducted by Kauhanen et al.[15] Evaluates body composition with measurements of height, weight, body mass index, waist circumference. The precise measuring marks or instruments are not specified. In addition to that, metabolic risk factors are examined, as it has been shown that childhood cancer survivors are more insulin resistant and have higher cardiovascular risks than healthy children.

In the study conducted by Moyer et al.[16] For the measurement of body composition the variable of muscle mass is taken, by analysis of the tibia with peripheral quantitative computed tomography (pQCT; Stratec XCT 2000, Norland Medical Systems Inc, Fort Atkinson, WI). Finally, Ness et al.[17] based on weight in kilograms (kg) and height in centimeters (cm) without shoes were measured on an electric scale and height meter, respectively. Weight in kg was divided by height in meters (m) squared to determine body mass index (BMI) values, which were converted to age- and sex-specific percentiles using data from the Centers for Disease Control and Prevention (CDC) growth charts. Likewise, dual X-ray absorptiometry (DXA) was used to determine bone mineral density (BMD) in grams per square centimeter (g /cm2).

In the systematic review conducted by Grimshaw et al.[11] the instruments with which body composition measurements are taken are not identified.

Physiotherapeutic interaction

This section will show the physiotherapeutic interactions shown in the articles selected for this study, within these two proposed modalities were identified, exercise and physical activity.

a) Physical exercise

In the systematic review conducted by Grimshaw et al.[11] eleven of the studies made use of individualized activities in a variety of modes, including aerobic, strengthening and stretching exercises and games. Two studies prescribed yoga, with a duration per session of 15 to 60 min, twice a day once a week. Three studies reported the target intensity as low, moderate, or high, but did not describe how intensity is monitored. Three studies specified a target heart rate. Three studies set the duration of the program between 3 weeks and 3 months. Program duration was determined by the duration of specific treatment phases in seven studies, e.g., from diagnosis to the start of the maintenance phase. Interventions were completed in a hospital setting in 10 studies and at home in two studies.

In the study conducted by Hartman et al.[14] Exercise routines were performed to maintain hand and leg function, stretching exercises to maintain ankle dorsiflexion mobility and short duration high intensity exercises (e.g. jumping) to prevent BMD reduction. Exercises to maintain hand and leg function had to be performed once a day and stretching and jumping exercises twice a day. Follow-up sessions with the inpatient physiotherapist always coincided with regular visits to the outpatient oncology department.

b) Physical activity

The authors Kauhanen et al.[15] propose an intervention based on active video games. It consists of playing nintendo Wii TM with elective active programs daily, for at least 30 minutes, during hospitalization and at home for 8 weeks in total, taking into account the individual conditions of the participants. The intensity of physical activity is recommended as mild to moderate. One way to monitor the relative intensity of activity is to monitor breathing and respiratory rate during activity. Parents are guided by the fact that physical activity of mild to moderate intensity equals only a slightly increased respiratory rate, even if they feel "easy to breathe" or "mild dyspnea" and are advised to monitor the child's condition before and during physical activities.

On the other hand, Moyer et al.[16] incorporated an individualized, age-appropriate exercise program based on a physical activity pyramid for youth. The physical activity pyramid promotes muscle development, flexibility, aerobic exercise, recreational sports, and lifestyle activities. Examples of activities in the pyramid were provided and parents were asked to record the type and amount of physical activity immediately after performing each activity. Activity recording was performed monthly during clinic visits or by telephone, and adjustments were made to the child's activity prescription with consideration of the child's health and ability. Some were initially prescribed a minimum of three 15- to 20-minute sessions of moderate to vigorous activity per week.

To conclude this section we have the research carried out by Ness et al.[17] which is based on a behavioral intervention to support autonomy, combined with a standard set, but individually designed, of seven physiotherapy exercises; however, the article does not specify which were the seven exercises or their prescription, so it is not included in either of the two modalities described above.

Statistical significance of the results body composition

This section will describe the statistical significance found in the reviewed research on body composition, given by the physiotherapeutic modalities and evaluated with the aforementioned instruments.

In the systematic review conducted by Grimshaw et al.[11] Within the significant findings, small to large effect sizes were calculated for short- and long-term body composition outcomes (95% CI -0.09 to 0.1).

For Hartman et al.[14] body composition given by anthropometric and anthropometric-specific measures results were obtained for height with a ($p<0.66$), weight ($p<0.76$), body mass index ($p<0.86$), body fat ($p<0.12$) lean body mass ($p<0.57$).

Body composition in the study conducted by Moyer et al.[16] presents in the results a statistical significance after a follow-up of twelve months with results of ($p<0.64$). Ness et al[17] obtained mean values for bone density and anthropometric measurements for a value of ($p<0.02$).

Finally, one of the studies that does not present statistical results is that of Kauhanen et al.[15] where it is resolved that physical activity and exercise interventions in children with cancer have been shown to be mainly beneficial. Studies on active video games have shown that playing these games can have a positive impact on children's physical activity, energy expenditure and motivation to exercise; these games may also be beneficial for rehabilitation purposes for children with limited physical function. However, the evidence in the field is still limited.

Discussion

From the search performed and the extraction of information, it was found that most of the studies were carried out in Europe and North America. Although these countries have a high incidence of oncological cases, it is striking that continents such as Asia, specifically China, which has the highest incidence (48.4%) is not actively generating research on this topic, on the other hand, a large number of cases occur in South America, these countries are not present in the research conducted, being the changes in body composition those with the greatest presence in oncology.[18]

On the other hand, the professions that collaborate or are conducting research on body composition in pediatric oncology are mostly physiotherapists, working together with occupational therapists, yoga instructors, physiotherapy assistants, exercise physiologists, fitness instructors, in one case, nurses, nutritionists and kinesiologists, physical conditioning instructors, in one case, nursing, nutritionists, kinesiologists, this last term is associated to the profession that in Colombia and other countries is known as physiotherapy, however, taking into account the locations found within the review, it is associated to the term that is characteristic of any of these. It is well known that professions such as nutrition work hand in hand with metabolic changes, such as changes in body composition, which are also the subject of study of physiotherapy, because, as seen in the review, they modify these variables. Not to mention the other interprofessional work that is done in the same line and that to have positive results should be given in each of the sites where this type of patients are attended.

For the age ranges found in the review, these are consistent with the correlation analysis of cancer type by age. Thus, the population

aged 0-18 years and from 4 to 10 years, present as diagnosis acute lymphoblastic leukemia, being this the type of cancer that occurs mostly in those ages, followed by osteosarcomas and solid tumors. This population is evaluated with measuring instruments such as the stadiometer and a scale to measure height and weight and define the body mass index, which is found as an anthropometric meter, qualified among the doubly indirect methods of body composition analysis with a very large margin of error, however, it is the most used for this measurement. In addition, X-ray absorptiometry is used for the percentage of muscle mass, body fat and bone mineral density and peripheral quantitative computed tomography, classified as indirect methods of body composition analysis, although these are not the only instruments with which data can be taken; magnetic resonance imaging, plethysmography and bioimpedancemetry are also used. In this same line, the investigations focused on taking variables such as weight and height, only one of these took into account variables of body composition (muscle mass, body fat and bone mineral density) without being the only ones present in the category, it should also take into account the results in total body water and tissue measurements, to make a complete analysis of what we call body composition.

Once the results of the evaluations are obtained, it is possible to identify two major intervention modalities, exercise and physical activity, which differ in that the former is a subcategory of physical activity, this is planned, structured, repetitive and useful in that its objective is the improvement or maintenance of one or more components of physical fitness.[19] The second is defined as any bodily movement produced by skeletal muscles that requires energy expenditure. Physical activity includes exercise, as well as other activities involving bodily movement that are performed as part of play, work, active transportation, household chores, and leisure or recreational activities.[19] Within the review there are strategies of games that focus on aerobic work, strength and stretching or movement modalities, which are interactive and striking for this specific population, and that seek to promote physical activity and physical exercise, however, although the modification of body composition variables is sought as a global objective, these do not take into account at any time, the intensities from the metabolic expenditure, on the contrary, in research such as that conducted by Cortés et al.[20] where the final objective does not include metabolic modifications and nevertheless an intensity prescription is made with METS, but the metabolic changes seen from the body composition are not evaluated.[21]

Conclusion

The results presented by the studies seem to support positive effects on body composition and since there is a synchronous and bidirectional relationship between movement and this microscopic variable, it is hypothesized that the actions proposed at the macro level will affect this micro variable.[3]

Under this assertion, if an intervention such as those found in the reviewed studies, based on movement, is performed, it would contribute to the improvement of the intervened patient and therefore the improvement of the quality of life of the affected population. However, there are still few researches that have been dedicated to study the role of physical therapy within this specific variable, being so important its role within it; therefore, it is of great interest that the profession finds more research strength in the potential of this relationship.

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Ethical considerations and conflicts of interest

This research is classified with minimal risk, supported by resolution number 8430 of 1993, because it is a theoretical review study where a search, data extraction and description of the data will be carried out, so there will be no contact with population groups that could be at risk. It is declared that the authors have no conflict of interest.

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References

1. Castillo L. Reference and bibliographic information services. Academic year 2001–2002 Associate Professor: Lourdes Castillo 1. 2002;1–12.
2. Gonzalez Jimenez E. Body composition: Assessment and clinical value. *Endocrinol Nutr*. 2013;60(2):69–75.
3. Finch E. The movement continuum theory of physical therapy. 2016.
4. Moratto FVCMERGB. Law 528 of 1999. 1999;1999(43):1–11.
5. Jennifer WB, Robert MB, Carol H, et al. Resistance training effects on metabolic function among youth: A systematic review. *Pediatr Exerc Sci*. 2017;29(3):297–315.
6. Zapata NJA, Gallardo CJA, Lluncor VJO, et al. Body water measured by electrical impedance and its estimation according to conventional formulas and as a function of ideal weight and sex, in overweight or obese adults. *Rev Medica Hered*. 2016;27(3):162.
7. Restrepo JFP. Shock, Nutrition and Key, Points. 2006.
8. GOMEZ FR, CEBALLOS CW, ACEVEDO MLSLLMTSJJP. Statistical Yearbook 2017. 2017;368.
9. Valenzuela LK, Rojas P, Basfi–fer K. Nutritional assessment of the cancer patient. *Nutr Hosp*. 2012;27(2):516–523.
10. Dubery MGJ. Effect of an exercise program in children and adolescent long–term survivors of acute lymphoblastic leukemia. Randomized Clinical Trial. *Sci Med Data*. 2018.
11. Sarah LG, Nicholas FT, Nora S. The Feasibility of Physical Activity Interventions During the Intense Treatment Phase for Children and Adolescents with Cancer: A Systematic Review. Pediatr Blood Cancer. 2016;63(9):1586–1593.
12. Fasina AS, Raji A, Oluwatosin GA, et al. Properties, Genesis, Classification, Capability and Sustainable Management of Soils from South–Western Nigeria. *Int. J. Soil Sci*. 2015;10(3):142–152.
13. Stout NL, Baima J, Swisher AK, et al. A Systematic Review of Exercise Systematic Reviews in the Cancer Literature (2005–2017). *PM R*. 2017;9(9S2):S347–S384.
14. Hartman A, Winkel ML, Beek RDV, et al. A Randomized Trial Investigating an Exercise Program to Prevent Reduction of Bone Mineral Density and Impairment of Motor Performance During Treatment for Childhood Acute Lymphoblastic Leukemia. *Pediatr Blood Cancer*. 2009;53(1):64–71.
15. Kauhanen L, Järvelä L, Lähteenmäki PM, et al. Active video games to promote physical activity in children with cancer: A randomized clinical trial with follow–up. *BMC Pediatr*. 2014;14:94.
16. Moyer MLJ, Ransdell L, Bruggers CS. Fitness of children with standard–risk acute lymphoblastic leukemia during maintenance therapy: Response to a home–based exercise and nutrition program. *J Pediatr Hematol Oncol*. 2009;31(4):259–266.

17. Ness KK, Kaste SC, Zhu L, et al. Skeletal, neuromuscular and fitness impairments among children with newly diagnosed acute lymphoblastic leukemia. *Leuk Lymphoma*. 2015;56(4):1004–1011.

18. Bray F, Ferlay J, Soerjomataram I, et al. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin*. 2018;68(6):394–424.

19. Confederation W, Therapy P, Glossary W. WCPT Glossary: terms used in WCPT policies and resources. 2017.

20. Cortés RÉ, Escobar ZP, González GL. The effect of game–based exercise on infant acute lymphocytic leukaemia patients. *Rev Fac Med*. 2013;61(4):349–355.

21. Health M of. Resolution 8430 of 1993.

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