

Musculoskeletal disorders in adolescents: a study on prevalence and determining factors

Perturbações músculo-esqueléticas em adolescentes: estudo da prevalência e dos fatores determinantes

Trastornos musculoesqueléticos en adolescentes: estudio de prevalencia y factores determinantes

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Abstract

Objective: To identify the prevalence of musculoskeletal disorders in adolescents, and to analyze this prevalence relationship with sociodemographic, anthropometric and contextual variables.

Methods: An observational, cross-sectional, descriptive/relational study with quantitative approach was conceptualized, involving 632 adolescents with mean age of 13.36 from six school groups from Central and North Portugal. Data collection protocol included questions of sociodemographic, anthropometric and contextual nature, and also the “Nordic Musculoskeletal Questionnaire” to assess musculoskeletal disorders.

Results: Data showed that 47.4% of adolescents mentioned musculoskeletal disorders within the last 3 months, located in the shoulders (27.8%), dorsal region (25.3%), thigh/hips (26.1%), neck (23.4%), lumbar region (22.8%), and knees (19.6%). We found that musculoskeletal disorders are more prevalent in female adolescents, and among those who spend longer time watching television per day, and also those who go to school by foot or bicycle.

Conclusion: The prevalence of musculoskeletal disorders in adolescents is high and has multicausal origin, turning imperative the implementation of preventive and readapted actions to promote a better musculoskeletal function.

Resumo

Objetivo: Identificar a prevalência das perturbações músculo-esqueléticas em adolescentes e analisar a sua relação com variáveis sociodemográficas, antropométricas e contextuais.

Métodos: Conceptualizou-se um estudo observacional, transversal, descritivo/relacional de cariz quantitativo, que envolveu 632 adolescentes de seis agrupamentos de escolas das zonas centro e norte de Portugal, com média de idades de 13,36 anos. O protocolo de colheita de dados integrava questões de cariz sociodemográfico, antropométrico, contextual e ainda o “Questionário Nórdico Músculo-Esquelético” para avaliar as perturbações músculo-esqueléticas.

Resultados: Os dados mostraram que 47,4% dos adolescentes referem perturbação músculo-esqueléticas nos últimos 3 meses, localizando-se estas aos níveis dos ombros (27,8%), região dorsal (25,3%), coxa/anca (26,1%), pescoço (23,4%), zona lombar (22,8%) e joelhos (19,6%). Verificou-se ainda, que as perturbações músculo-esqueléticas são mais prevalentes nos adolescentes do género feminino, naqueles que gastam mais tempo por dia a ver televisão e ainda nos que se deslocam para a escola a pé ou de bicicleta.

Conclusão: A prevalência das perturbações músculo-esqueléticas nos adolescentes é elevada, tem origem multicausal, tornando-se imperativa a implementação de intervenções de prevenção e readaptação promotoras de um funcionamento músculo-esquelético otimizado.

Resumen

Objetivos: Identificar la prevalencia de trastornos musculoesqueléticos en adolescentes y analizar su relación con variables sociodemográficas, antropométricas y contextuales.

Métodos: Se conceptualizó un estudio observacional, transversal, descriptivo/relacional de aspecto cuantitativo, que incluyó 632 adolescentes de seis agrupamientos de escuelas de la zona centro y norte de Portugal, con promedio de edad de 13,36 años. El protocolo de recolección de datos incluyó cuestiones de aspecto sociodemográfico, antropométrico, contextual e, inclusive, el "Cuestionario Nórdico Musculoesquelético" para evaluar los trastornos musculoesqueléticos.

Resultados: Los datos mostraron que el 47,4% de los adolescentes señalan trastornos musculoesqueléticos en los últimos 3 meses, localizados en el nivel de los hombros (27,8%), región dorsal (25,3%), muslo/cadera (26,1%), cuello (23,4%), zona lumbar (22,8%) y rodillas (19,6%). Además, se verificó que los trastornos musculoesqueléticos tienen mayor prevalencia en adolescentes de género femenino, en los que pasan más tiempo por día viendo televisión y en los que van a la escuela caminando o en bicicleta.

Conclusión La prevalencia de los trastornos musculoesqueléticos en adolescentes es elevada, tiene origen multicausal, por lo que se torna imperativa la implementación de intervenciones de prevención y readaptación que promuevan un funcionamiento musculoesquelético optimizado.

Introduction

The World Health Organization (WHO)⁽¹⁾ defines adolescence as a period of life between ages 10 and 19, a transitional phase between childhood and adulthood. This period is characterized by physical, mental and emotional development, in which efforts are made to meet different goals, according to each person's culture. This constitutes a phase of life that begins with puberty, changes in the body, and ends with the consolidation of the individual's development in terms of personality, and who gradually obtains economic independence and integrates into social group.⁽²⁾

Therefore, this is a period marked by intense physical, psychological, behavioral and social changes. This phase is composed by the transition from childhood to adult life, in which many characteristics and habits related to adult lifestyle are acquired and/or consolidated. At this time, this is also a period that individuals present an increase in rate growth of height and weight, which justifies the increase of nutritional needs.⁽³⁾

Studies of the human body biomechanics show that there are postural behaviors that cause imbalance in the body system, leading to compensations that may result in changes of structure and function. During puberty there is asymmetry in the development, since bones grow faster than muscles and tendons, and this fact is particularly noticeable at the level of the spine. Adolescents take some time to adapt to their new body, and they often passing through a phase of introspection, sensitivity and even shame of the body, that is why

they usually have a rounded back posture that may lead to lesions.⁽⁴⁾

Musculoskeletal Disorder (MSD) in adolescents is characterized by the presence of pain or discomfort.⁽⁵⁾ This is a nosological entity that affects muscles, nerves, intervertebral discs, joints, cartilages, tendons, and ligaments, and may occur on specific occasions, systematically or chronically. This entity etiology can be genetic or acquired, and affects – to a greater or lesser extent, daily tasks and the individuals' quality of life.⁽⁶⁾

Epidemiological studies including adolescents suggest that prevalence and incidence has substantially increased worldwide during the last few years, including Portugal, and this increase may even progress into chronic situations that may continue until the adulthood.⁽⁷⁾ The consensus that emerges from many studies conducted by different researchers is that MSDs cannot only be explained through physical factors, but also through social, psychological, environmental and behavioral factors that may precipitate the appearance of this problem.^(2,3,8,9)

Therefore, considering the complexity of above-described and the increasing scale of the problem, the research of the prevalence of these disorders in childhood and adolescence, the acknowledgment of the factors that contribute to their appearance, and the assessment of the impact of measures to promote quality of life are current major challenges both for health professionals and for general population. In fact, the negative impact that these disorders cause – not only in this adolescence, but also in adulthood, constitutes today a real public health problem.^(5,8)

The need to improve individual, biomechanical, organizational and psychosocial MSDs preventive strategies in which the action of health professionals along with multidisciplinary teams, must be promoted and implemented.

Considering the above-described premises and the scale of the problem, the objective of this study is to identify musculoskeletal disorders in adolescents and to establish existing relationships between MSDs and sociodemographic, anthropometric and contextual variables.

Methods

This was an observational, cross-sectional, descriptive/relational study with quantitative approach. A non-probabilistic convenience sample was used including 632 adolescents from six school clusters from Central and North Portugal. We included participants based on the following inclusion criteria: adolescents aged between 10 to 19, and attending from Grade 5 to 12 of school. We excluded adolescents with secondary musculoskeletal disorders, collagen vascular and infectious diseases, onco-hematological diseases, genetic diseases, endocrine disorders (such as thyroid disorders or diabetes *mellitus*), or recent traumatic injuries.

The instrument for data collection (DCI) was a questionnaire made up of four sections. The first section contained sociodemographic data (age, gender, residency, and socioeconomic status). The second section collected anthropometric data (weight, height and BMI based on *International Obesity Task Force*). The third section assessed contextual variables (backpack wearing – its characteristics and weight; time spent per week watching television, computer use and time spent with computer games; type of transportation until the school; type and intensity of physical exercise). Finally, the fourth section included the Nordic Musculoskeletal Questionnaire, validated and culturally and linguistically adapted for Portugal, by Mesquita, Ribeiro & Moreira in 2010.⁽¹⁰⁾ The DCI consisted of 25 dichotomous questions (yes/no) and three questions associated with nine anatomical regions, identified

with the help of a posterior human body figure. The questions related to each anatomical region aimed to assess whether respondents felt any disorder in the last three months (time period chosen to obtain recent and more accurate memories) and whether, during this period, there were any consequences to these individuals daily life. There was also a numerical pain scale for each anatomical region, classified using a *continuum* scale from 0 (no pain) to 10 (worst possible pain) for pain measurement. Data was collected in March, April and May 2017; days when physical education classes took place.

Before beginning the data collection, parents were invited to participate for voluntary and informed cooperation for the study, and those who agreed signed the informed consent. Participants were informed about the objectives of the study. The confidentiality of the participants' responses was guaranteed, as well as their clinical data. Development of this study followed national and international ethical and legal aspects of research on human subjects. The study was approved by the Ethics and Research Committee. The Statistical Package for the Social Sciences (SPSS) version 22.0 was used for statistical analyses. Student's t-tests and Mann–Whitney U test (MWU) was used to study the relationship between variables, and to compare the means of a quantitative variable of the two groups including different individuals. Kruskal Wallis test was adopted to compare the means of a quantitative variable in three or more groups of different individuals. The equality of more than two means was tested. In addition, we used *post-hoc* tests to determine in what extent every mean differed from each other. A p value of 5% was considered statistical significance.

Results

The adolescents that comprised the sample were aged between 11 (younger) and 17 (older), with a mean of 13.36 years old, and standard deviation of 2.08. Of participants, 58.2% were girls and 41.8% boys. The majority of adolescents (75.3%) lived in rural areas and were considered to be of intermediate socioeconomic status (53.9%).

In relation to weight state, we observed that adolescents weighed, on average, 53.89 kg (SD=11.44), were 1.59 meter high (SD=0.08), and most of them (71.5%) were eutrophic. In addition, 12.0% of adolescents were overweight, a fact that was more associated to boys ($\chi^2 = 6.341$; $p = 0.023$) with statistically significant differences.

The vast majority of adolescents (97.5%) wore a backpack to carry their school material with adjustable (82.3%) and padding (78.5%) straps, but with no waist belt, sternum strap or metal support. We observed that 79.8% of the participants used bus/car to go to school, and only 20.2% go to school by foot or by bicycle. They wear the backpack on average 20 min/day, 80.0% on both shoulders and 20.0% (especially girls) on one shoulder only. Furthermore, we confirmed that, besides wear a backpack, 87.3% of the participants carry other equipment, mainly sports, visual education and technological support materials. The common backpack weight ranged between 12% and 19% of the body weight of the majority of the participants.

Most of the adolescents (56.8%) exercise on a regular basis. Soccer/futsal (33.7%) and basketball (22.1%) were the most commonly mentioned sports, both practice at a moderate rate. A total of 72.8% of participants dedicated, on average, 2 hours per day to watch television, and this practice was higher among girls; however, statistical differences were not significant ($t = 1.087$; $p = 0.342$). The posture adopted by 38.6% of the respondents was lying down on the couch. The time spent using technological devices (audio/video devices and computer) by adolescents varied between 0 and 32 hours/week, which corresponded to a mean of 13.92 hours. Despite mean values differed between girls and boys, no significant statistical differences ($p=0.681$) were found.

The prevalence of MSDs mentioned by adolescents in the last three months (Table 1) was ($n=300$) 47.4%, and they were located at different levels (multiple answers), but had greater focus on the neck (23.4%), shoulders (27.8%), dorsal region (25.3%), lumbar region (22.8%), thigh/hips (26.1%), and knees (19.6%).

Table 1. Prevalence of MSDs and anatomical regions affected

Musculoskeletal disorder	Total n(%)
No disorder	332(52.6)
With disorder	300(47.4)
Body regions	
Neck	70(23.4)
Shoulders	83(27.8)
Dorsal	76(25.3)
Lumbar	68(22.8)
Thigh/Hips	78(26.1)
Knees	59(19.6)

The intensity of pain mentioned by adolescents with MSDs (Table 2) is showed mainly as mild (34.7%) and moderate (41.3%) pain, however, we verified that 16.0% of them reported severe pain and 8.0% very severe pain.

Table 2. Intensity of pain felt by adolescents with MSD

Intensity of pain	Total n(%)
Mild pain	104(34.7)
Moderate pain	124(41.3)
Severe pain	48(16.0)
Very severe pain	24(8.0)
Total	300(100)

To analyze the existing relationship between independent variables and MSD (dependent variable) among adolescents, we used parametric and non-parametric tests. By considering the large number of variables, we decided to present only those that were statistical significance. Therefore, we confirmed that MSDs were more prevalent among adolescents of female gender ($t=-3.358$; $p=0.001$), and for those who spend more time watching television per day ($\chi^2 = 6.532$; $p=0.038$), and among those who went to school by foot or by bicycle ($U= 1531.500$; $p=0.018$). No statistical significance ($p>0.05$) found in the other variables such as age, residency, weight, backpack wearing, and physical exercise.

Discussion

Sociodemographic characteristics of the adolescents of this research agree with other studies conducted recently in the Portugal context with the same target population.^(7,11,12) This sample is mainly com-

prised of adolescents of female gender (58.2%), with a mean age of 13.36 years, living in rural areas (75.3%), and belonging to intermediate socioeconomic classes (53.9%), confirming the expected correlation of the living conditions in country side areas of the country.⁽¹³⁾

From an anthropometric perspective, adolescents weighed, on average, 53.89 kg, and they were 1.59 meters high, and mainly eutrophic (71.5%). However, 12.0% of them were overweight (mainly boys) a condition that promotes the appearance of MSDs according to other study⁽¹³⁾, which states that adolescents with BMI above the ideal often present higher rates of postural changes in different body regions.^(14,15)

Many authors have highlighted that adolescents often wear backpacks incorrectly, carry excessive load inefficiently, and expose themselves to serious and great postural deviations. As a solution, they advise adolescents, to carry on a safe load limit, and for not carrying loads weighting over 10% of their body weight.^(16,17) In fact, the majority of adolescents (97.5%) carried their school material in a backpack with adjustable and padding straps, but with no waist belt, sternum strap or metallic support, which contributed to a greater tension at the musculoskeletal level. Adolescents wore a backpack, on average, 20 min/day, and 20.0% of them (especially girls) wore it on one shoulder only. Furthermore, 87.3% of the respondents carried other equipment for sports and visual education support and technology materials, which contributed to the fact that the majority of the participants carried loads that represented from 12% to 19% of their body weight. This data contradicts the recommendations of WHO and Portuguese Directorate-General for Health, since these organizations recommend that the weight that should be carry to not exceed 10% of their body weight as a safe limit.^(16,18,19)

It was also revealed that most of the adolescents of the study (56.8%) practice physical exercise on a regular basis, (soccer/futsal and basketball) at a moderate rate. The evidence of the impact of physical activities on MSDs in adolescents has generated much controversy among authors and it is far from reaching consensus. Many researchers defend

that the lack of physical activities is responsible for the appearance of disorders in an early stage of life; but the practice to excess is also harmful, since once pushed to certain limits – pushing hard muscles, tendons, bones and joints, physical activity that may act as a pathological agent on the locomotive system.^(20,21)

Exposure of adolescents to informational technologies has increased in the educational setting, leisure and family environments, and this is a growing phenomenon among all socioeconomic classes worldwide.^(3,8,22) We observed that 72.8% of the participants spent, on average, 2 hours per day watching television, and the position adopted is lying on the couch. The average time spent using new technologies (audio and video devices, and computer) is 13.92 hours/week, adopting static, repetitive and continuous postures that cause consequential damages. We agree that the benefits of using these technologies are evident: greater access to quality information, possibility of exchanging information with other persons and with distant communities, improvement of cognitive abilities, and even the availability of leisure activities. However, the unregulated and abusive use of technological devices is a factor that contributes to sedentarism and posture changes (with ergonomic disturbances, inadequate proportion of furniture at schools and at home) and structural changes in the skeleton, with overload in joints, tendons, ligaments and muscles, that may cause musculoskeletal deformities.^(23,24)

The results concerning the prevalence of MSDs in adolescents may not be dissociated from the above-mentioned aspects, and this confirm the tendency demonstrated in epidemiological studies of being high.^(3,8,22) In fact, 47.4% of the participants had MSD located in diverse (and simultaneous) body regions. A national study⁽¹²⁾ about adolescents' health demonstrated that 35% of adolescents mentioned they feel pain in the neck/shoulder area, and 38.6% at the lumbar level. The results of other researchers identify scenarios with characteristics that are very similar to our study.^(3,7,8,12)

For most adolescents, the pain felt in the body regions above-mentioned are of moderate (41.3%) and mild (34.7%) intensity. However, we could not

ignore the fact that 16.0% of adolescents reported that they feel severe pain and 8.0% very severe pain. The International Association for the Study of Pain (IASP) defines pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, and when associated with adolescents, pain does not only affect the current health status, but also may cause the development of chronic pain in adulthood, with severe consequences in the quality of life.^(25,26) In fact, pain may not be understood as an isolated and occasional manifestation, but as an event with some dramatic consequences in the person's development of health and well-being throughout life and in the sustainability of the countries' own health care systems.

The analyses of the relationship between variables have revealed that MSDs are more prevalent in female adolescents. This difference between genders can be explained because of different threshold in the perception of musculoskeletal symptomatology, greater muscle flexibility in female gender, or even hormonal changes during puberty.⁽²⁷⁾ Participants that spend more time per day watching television and using new technologies for longer periods also have more prevalence of MSDs. This data strengthens the idea of other researchers stating that the frequent use of informational technologies becomes a high risk factor to develop MSDs.^(23,24) Likewise, commuting to school by foot or by bicycle is also a risk factor for disorders to appear, since the load of backpack associated with balance in motion generates posterior movements of the body's center of gravity, and this imbalance is compensated by moving the body forwards, which can lead to spine deviation.^(12,14,28) The results of this study lead to the need of greater investments in preventing these disorders in adolescence, as one of the pillars of the National Service for Health, on the basis of promotion and continuity of care, and it can be a powerful resource for individuals, families and the whole society.

The limitations found in this study were: the use of a convenience non-probabilistic sample, which does not allow us to generalize results with statistical accuracy; data collection made through a questionnaire self-complete by adolescents, which may

present some interpretation biases, due to underestimating or overvaluing MSDs problem and, therefore, may interfere in the validity of data; the use of simple questions to assess physical activity practice, instead of using a scale to evaluate physical activity and sedentarism, such as WHO HBSC (World Health Organization, Health Behavior in School-aged Children), which would allow us to classify adolescents in "active", "inadequately active" or "inactive", thus, it was not possible to obtain more accurate and reliable data regarding this variable.

In spite of the limitations mentioned, we consider that the research addresses a very relevant topic at the time, contributing with its important results to nursing scientific knowledge. We suggest the development of further studies to compare the evolution of people's health potential throughout their lifecycle in the same time period and in a longitudinal perspective.

Conclusion

Adolescents who were part of this study's sample revealed a high prevalence of MSDs. The discomfort they mentioned is located mainly in the following anatomical regions: neck, shoulders, dorsal region, lumbar region, thigh/hips and knees. Even though the pain intensity pattern was between moderate and mild for the majority of the adolescents, this is important to consider different results with growing severity as they reported severe and even very severe pain. As expected, considering the determiners mentioned in similar studies, within this group of adolescents, MSDs are more prevalent in girls, and among those who spend more time per day using new technologies and in the type of transportation used to go to school, since going by foot or by bicycle becomes more harmful. We conclude that the origin of musculoskeletal disorders in adolescents is dynamic, multifaceted and multidimensional, because, if in one hand, there are factors that are of particular importance as they influence directly on the appearance of these manifestations – such as those of mechanical origin, on the other hand, there are other factors

that influence indirectly, mainly those related with social, cultural and organizational origin.

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Collaborations

Martins RL, Carvalho N, Albuquerque C, Andrade A, Martins C, Campos S, Batista S and Dinis AI contributed to the design of the study, analysis and interpretation of data, drafting the manuscript, relevant critical review of the content and approval of the final version to be published.

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