POST-GRADUATION PROGRAM IN MOVEMENT SCIENCES

SANTIAGO MAILLANE VANEGAS

IMPACT OF SPORTS PARTICIPATION ON THE OCCURRENCE OF MUSCULOSKELETAL PAIN IN ADOLESCENTS DURING 28 WEEKS OF FOLLOW-UP: ABCD GROWTH STUDY

Presidente Prudente, Sao Paulo, Brazil

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Doctoral thesis presented to the Postgraduate Program in Movement Sciences, School of Technology and Sciences, São Paulo State University (UNESP) campus of Presidente Prudente as part of the requirements for obtaining the title of Ph.D. in Movement Sciences.

Supervisor: Rômulo Araújo Fernandes

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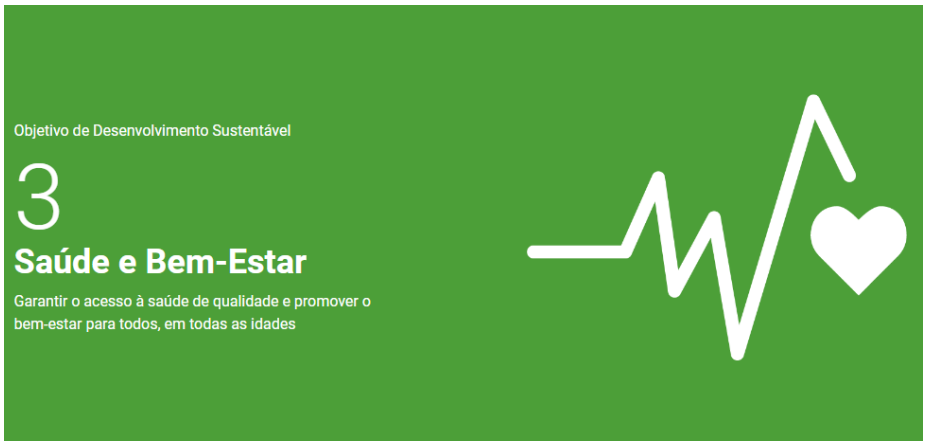
That is why this thesis presents relevant information for the development of the objective: HEALTH AND WELL-BEING.

Goal 3 aims to ensure healthy lives and promote well-being for all, at all ages. For this thesis, the target population is adolescents, who through sports participation seek to enhance physical integrity, considering relevant care for the practice of physical activity domains.



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To my parents Claudia and John Jairo,
My sister Juliana and her husband Juan Pablo, my nephews, Praga, Dali and Figo

For all love, efforts, and sacrifices for my education

With a special mention to my grandmother Consuelo, thank you for everything.

A mis padres John Jairo y Claudia,
Mi hermana Juliana y esposo Juan Pablo, mis sobrinos Praga, Dali y Figo
Por todo el amor, esfuerzo y sacrificios para mi educación.

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“said Don Quixote, “and since you are not experienced in the things of the world, all things that have some difficulty seem impossible to you; But time will pass, as I have said again, and I will tell you some of what I have seen down there, which will make you believe what I have told here, the truth of which” neither admits of reply nor dispute.

“dijo don Quijote—, y como no estás experimentado en las cosas del mundo, todas las cosas que tienen algo de dificultad te parecen imposibles; pero andará el tiempo, como otra vez he dicho, y yo te contaré algunas de las que allá abajo he visto, que te harán creer las que aquí he contado, cuya verdad ni admite réplica ni disputa.”

Miguel de Cervantes.

ABSTRACT

This thesis aimed to explore the association between sports participation and incidence of pain among adolescents in a 28-week follow-up period, as well as to identify the role of sex, biological maturation and training volume into this phenomenon. This longitudinal design of 28 weeks followed 95 adolescents, subdivided according to the presence or absence of participation in sports and the modality practiced, consequently, the groups were: adolescents from non-impact sports, impact sports, and non-sports groups, following the inclusion criteria. They reported the occurrence of pain and were tracked weekly by the research team, “the presence of any pain in the previous 7 days” was self-reported weekly. Anthropometric data such as height and sitting height were collected to estimate as a marker of somatic maturation in a mathematical model, and body composition data was also collected through DXA. The data distribution was analysed using Kolmogorov-Smirnov, and variables were expressed as mean values, standard deviation (SD), and 95% confidence intervals. The significance level was set as 5%. The findings indicate that the association between the sport type and pain occurrence remained significant even after adjusting the models by sex and maturity offset, swimmers had an increased risk of reporting pain neck, shoulders, and trunk pain, compared to the impact sport group, mainly caused by the high volume of practice in the modality. Also, the weekly time spent on sports at vigorous intensity is related to a higher occurrence of pain, adjusted by lean soft tissue, sport modality, and sedentary behaviour. Thus, this thesis presents innovative aspects in the development and implementation of a pain surveillance system related to the adolescent growth and development process, finding that the relationship between pain continues to have a close relationship with sports participation, even considering the somatic growth factor adjustment variable. The volume of training seems to be the most relevant variable in this phenomenon and there exists a limit to how much they should engage in sports to preserve their health. In addition, the vigorous intensity at which said activity is carried out further accentuates the occurrence of pain.

Key words: Multisite pain, Adolescents health, Sports for youths, Maturity offset, Musculoskeletal disorder

RESUMO

Esta tese teve como objetivo explorar a associação entre participação esportiva e incidência de dor entre adolescentes em um período de acompanhamento de 28 semanas, bem como identificar o papel do sexo, maturação biológica e volume de treinamento neste fenômeno. O delineamento longitudinal de 28 semanas acompanhou 95 adolescentes, subdivididos de acordo com a presença ou ausência de participação em esportes e a modalidade praticada, consequentemente, os grupos foram: adolescentes de esportes sem impacto, esportes de impacto e grupos não esportivos, seguindo os critérios de inclusão. Eles relataram a ocorrência de dor e foram monitorados semanalmente pela equipe de pesquisa, “a presença de qualquer dor nos 7 dias anteriores” autorrelatada semanalmente. Dados antropométricos como altura e altura sentada foram coletados para estimar como um marcador de maturação somática em um modelo matemático, e dados de composição corporal também foram coletados por DXA. A distribuição dos dados foi analisada usando Kolmogorov-Smirnov, e as variáveis foram expressas como valores médios, desvio padrão (DP) e intervalos de confiança de 95%. O nível de significância foi definido como 5%. Os achados indicam que a associação entre o tipo de esporte e a ocorrência de dor permaneceu significativa mesmo após o ajuste dos modelos por sexo e desvio de maturidade, os nadadores apresentaram risco aumentado de relatar dor no pescoço, ombros e tronco, em comparação ao grupo de esporte de impacto, causado principalmente pelo alto volume de prática na modalidade. Além disso, o tempo semanal gasto em esportes de intensidade vigorosa está relacionado a uma maior ocorrência de dor, ajustado por tecido mole magro, modalidade esportiva e comportamento sedentário. Assim, esta tese apresenta aspectos inovadores no desenvolvimento e implementação de um sistema de vigilância da dor relacionado ao processo de crescimento e desenvolvimento do adolescente, constatando que a relação entre dor continua a ter estreita relação com a participação esportiva, mesmo considerando a variável de ajuste como fator de crescimento somático. O volume de treinamento parece ser a variável mais relevante neste fenômeno e existe um limite para o quanto eles devem se envolver em esportes para preservar sua saúde. Além disso, a intensidade vigorosa em que tal atividade é realizada acentua ainda mais a ocorrência de dor.

Palavras-chave: Dor multissítio, Saúde do adolescente, Esportes para jovens, Deslocamento de maturidade, Distúrbio musculoesquelético.

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GLOSSARY OF TERMS

ABCD Growth Study – Analysis of Behaviours of Children During Growth

APHV – Age at peak height velocity.

CAPES – Coordenação de aperfeiçoamento de pessoal de nível superior.

DXA – Dual energy X-ray absorptiometry.

IC – Confidence Interval.

LIVE – Laboratory of InVestigation in Exercise.

LST – Lean Soft Tissue.

MVPA – Moderate and vigorous physical activity.

PA – Physical activity.

PHV – Peak height Velocity.

PWV – Peak weight velocity.

RT – Resistance training.

WHO – World Health Organization.

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1 INTRODUCTION

Musculoskeletal pain (hereafter referred to as pain) is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage. This condition is not selective and affects even pediatric populations, with a point prevalence ranging from 4% to 60% (Brattberg, 2004; Rathleff et al., 2013). Due to this prevalence, figures show that among adults chronic unrelieved pain became a worldwide economic concern, costing an estimated US$560-635 billion in 2010 (Smith & Hillner, 2019).

The International Olympic Committee recently emphasised the importance of seeking strategies to maintain the integrity of health in young athletes, which is why surveillance and treatment systems for pain and sports injuries are being increasingly valued (Hainline et al., 2017). Engagement in programs of physical exercise has been suggested as a strategy for prevention of pain (Hainline et al., 2017). However, this assumption seems paradoxical because sports participation in adolescence (the main manifestation of physical exercise among adolescents) increases the chances of some type of symptoms or discomfort. Guddal et al., 2019 discovered that 62% of adolescents reported experiencing pain after sports practice. This raises concerns about the high rates of pain reported by children and adolescents. Additionally, the role of sports participation in this phenomenon is unclear.

The adolescence is a critical period due to the constant structural and physiological changes that can affect sports participation. In fact, during adolescence, biological and chronological age can significantly differ from each other (Dunn et al., 2011). In the sports participation context, these heterogeneities are usually not accounted for (especially among children), leading to poorly optimised training loads, and increasing the risk of injuries and pain. In addition, each sport modality elicits different responses according to its biomechanical needs, goals, physical load, and even the environment where it is performed (water or land) (Lehman & Carl, 2017; Maillane-Vanegas et al., 2022). In an example of these particularities attributed to the engagement in different sports, Malmborg et al., 2022 showed that students who participated in non-contact sports (athletics, swimming, squash, badminton, tennis, figure skating, artistic gymnastics, and diving) were more likely to report frequent pain.

The discussion surrounding the relationship between sports participation and pain is a controversial issue, especially because the engagement in sports is more complex than just “be engaged in”. Other aspects of sports participation (e.g. volume of engagement, intensity, etc.) should be considered to understand in depth how this relevant behaviour might be linked to pain in adolescents (Guddal et al., 2019; Kujala et al., 1999). Therefore, models assessing the interaction between sports participation and pain among adolescents should consider the role of those potential confounders (e.g. biological age, parameters of sport participation [e.g. frequency, intensity]). The complex interaction between human growth, sports participation and pain are rarely mentioned in the literature, particularly considering that most studies are focused on adult high-performance athletes (Malmborg et al., 2022). According to a recent systematic review on the relationship between maturation, growth, and musculoskeletal conditions, the findings remain inconclusive due to high risks of bias, highlighting the need for further research(Swain et al., 2018).

Moreover, the role of sex into this phenomenon is not entirely clear. Previous studies conducted in Canada and Europe have suggested that girls have higher risk of pain than boys (Perquin et al., 2000; Stanford et al., 2008). However, how this sex-difference would interact with biological maturation and the above-mentioned parameters of sports participation is not mentioned on it. Moreover, even the prevalence of pain among boys and girls is not clear in developing settings, making hard to predict if the associations would be the same observed in developed nations where options of sports are substantially different.

Therefore, considering sports participation as a characteristic of daily life in children and adolescents around the world, its interaction with pain in the first two decades of life became a relevant health issue over the last decades. In this sense, the content of this thesis is of great value not only to coaches but also to health professionals and parents, involved in adolescents’ physical integrity. An accurate understanding of the relationship between pain and sports participation during growth will allow us to create strategies to improve the benefits of sports participation.

Therefore, considering the background above described, we have suggested the following hypothesis for this doctoral thesis:

- The prevalence of pain would be higher among adolescents engaged in organised sports than in those adolescents only engage in regular physical education classes;
- The incidence of pain over our follow-up period would be affected by parameters of sports participation (e.g. intensity, volume, the environment where the sport is performed);
- Girls would report more pain than boys over our follow-up period;
- The role of biological maturation would be not relevant in the dynamics behind the association between sports participation and pain;

2 THESIS OBJECTIVES

2.1 General objective

- To explore the association between sports participation and incidence of pain among adolescents in a 28-week follow-up period, as well as to identify the role of potential variables into this phenomenon.

2.2 Specific objectives

- **Chapter 04 (Manuscript 1):** To identify the impact of different sports in the incidence of pain among adolescents in a 28-week follow-up study.

- **Chapter 05 (Manuscript 2):** To compare the incidence of pain between adolescents engaged and not engaged in sports participation and also explore the role of sex, biological maturation and parameters of sports participation into this association.

3 METHODS

3.1 ABCD-Growth Study Design

For the development of this thesis, a longitudinal study was carried out, which is part of a wider research project called “Analysis of Behavior of Children During Growth-ABCD-Growth Study”. The ABCD-Growth Study is a longitudinal follow-up in which the impact of sports participation on different health outcomes among adolescents is monitored. The Ethical Board of the Sao Paulo State University - UNESP, campus of Presidente Prudente, has approved the research project. The project received the approval number: 1.677.938/2016.

The parents / legal guardians completed a written consent form to participate in the study. The adolescents were required to complete a form ratifying their desire to participate. All adolescents participated in the study voluntarily and were provided with comprehensive information about the study's objectives, all procedures, and eventual risks. They were also informed that they could withdraw from the study at any time.

The ABCD Growth study’s inclusion criteria considered whether the adolescent was engaged in sports.

For those adolescents engaged in sports:

i) Previous engagement of at least 12 months in the current sport;
ii) Absence of clinical or metabolic disorders (previously diagnosed);
iii) No regular use of medications that may affect the development and growth of the adolescent;
iv) Aged from 11 to 17 years;
v) To bring back the written consent form signed by the parent/legal guardian.

For the control group, (adolescents not engaged in sports), the following inclusion criteria were applied:

i) No regular engagement in any organized sport / program of physical exercise over the last 12 months;

ii) Absence of clinical or metabolic disorders (previously diagnosed);

iii) No regular use of medications that may affect the development and growth of the adolescent;

iv) Aged from 11 to 17 years;

v) To bring back the written consent form signed by the parent/legal guardian.

For all adolescents who declared to fulfil the inclusion criteria, their parents and/or guardians received the written consent forms. After providing consent, participants were contacted by phone and invited to visit the University facilities to be measured and interviewed by the researchers.

In brief, the ABCD Growth Study was approved by members of the Municipal Department of Sports and Municipal Department of Education. However, due to the COVID-19 pandemic, all data collection was interrupted from 2020 to 2022 by the determination of both the Government of the State of Sao Paulo and the Brazilian Health Authorities, resulting in the loss of the tracked adolescents. In 2022, 95 adolescents were tracked for 28 weeks to test the necessary changes in the ABCD – Growth Study in a post-pandemic scenario, targeting to resume the fieldwork of the ABCD Growth Study in 2023 **(Figure 1 - Flowchart)**.

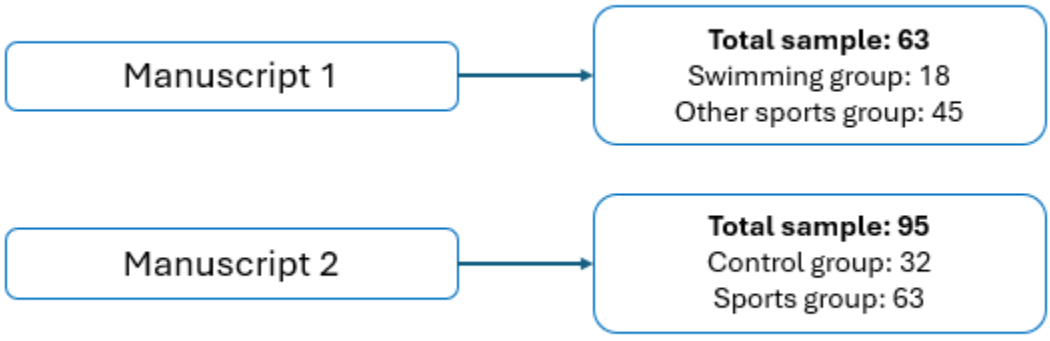

Figure 1. A flowchart about the sample utilized in each manuscript.

Note: From the author

3.2 Sample size estimation

Our sample was for selected by convenience. After receiving approval from the local authorities, researchers contacted coaches (sports clubs) and principals (schools) to describe the aims of the research and inclusion criteria. Researchers contacted 11 schools and sports clubs in the city's metropolitan area and 95 adolescents were tracked for 28 weeks in 2022. Our sample size calculation considered a prevalence of pain of 30.3% and 57.6% among adolescents not engaged and engaged in sports, respectively (Maillane-Vanegas et al., 2022), while the statistical power was 80%, Z=1.96 and we expected 30% of loss to follow-up. The final sample size was set at a minimum of 62 participants completing the follow-up assessment.

3.3 Experimental design

In a normal routine, this is the way by which the adolescent is registered, enters the ABCD – Growth Study database and the follow-up period is initiated **(Figure 2)**:

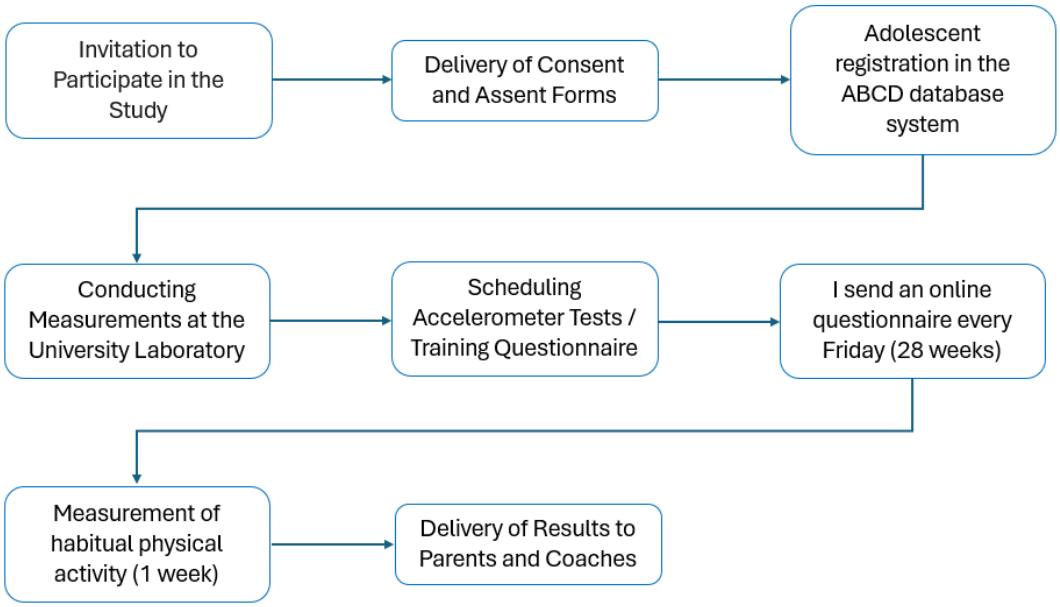

Figure 2. The process to start the follow-up period

Note: From the author

3.4 Study Variables

3.4.1 Sports Participation

Participants were categorized into two groups considering the presence (or not) of sports participation: the “sports group” and “control group" (for Manuscript-2). In the second moment, those adolescents engaged in sports were divided into “Swimming” and “impact sports” (track & field, basketball, judo and soccer) (for Manuscript-1). For both sport groups, beyond the previous 12 months of engagement in the current sport, it was mandatory the participation in championships (at least state level) to characterize organized sports participation. Details about sports participation at baseline, were assessed in a face-to-face interview, where the adolescents engaged in sports were asked to answer the following questions:

- “How long have you been practicing this sport"? (Years and months)
- “How many days a week?” (days/week)
- "How long a day do you train?" (minutes/day)

The multiplication between days a week by time per day of training allowed calculate the weekly training volume.

3.4.2 Resistance training engagement

Engagement in resistance training was assessed through a dichotomic question (yes/no) by a face-to-face interview conducted by the researchers at baseline measurement: “Do you practice resistance training?”. If the answer was affirmative, the adolescent was asked "How long have you been practicing resistance training?" and “How many days a week?”.

3.4.3 Sports participation intensity and habitual physical activity

For our a priori analyses during one whole week, researchers directly measured the sedentary behaviour as a physical behaviour and the time (training volume) spent in different intensities (light [60%-70% of HRmax], moderate [70%-80% of HRmax] and vigorous [80%-90% of HRmax]) during sports participation using a heart rate monitor (sensor attached to the chest at the height of the heart position [Polar H7 model]; POLAR software, Polar Team, Kempele, Finland) **(Figure 3)**.

Figure 3. An example of an accelerometer model was utilized in the study.

Note: from the author.

Moreover, all adolescents took the watch for seven consecutive days to measure the physical activity outside sports participation (sedentary behaviour, light, moderate and vigorous).

3.4.4 Anthropometry and Body composition

Sex (boy/girl), anthropometric measures (body weight, height, and sitting height), and body composition (lean soft tissue and body fatness) were used as covariates. Body weight was measured using an electronic scale (Filizzola PL 150, model Filizzola Ltda, Brazil). In contrast, height and sitting height were measured using a wall-mounted stadiometer (Sanny, model American Medical of the Brazil Ltda, Brazil).

3.4.5 Biological Maturation

The peak of height velocity (PHV) was estimated as a marker of somatic maturation, using mathematical models based on anthropometric measures to calculate the time (in years) remaining (negative values) or past (positive) to PHV, which is an important biological event that follows the human maturation process. The PHV was subtracted from the chronological age, giving the age of peak height velocity (APHV), **(Table 4)** predicted by Moore et al. somatic maturation (Moore et al., 2015).

Table 1. Mathematical formulas predicted by Moore et al. 2015 to calculate somatic maturation.

Sex	
Boys	-7.999994 + [0.0036124 x (Age x Stature)] R^2= 0.896; SEE = 0.542
Girls	-7.709133 + [0.0036124 x (Age x Stature)] R^2= 0.898; SEE = 0.548

SEE= standard error of the estimate

3.4.6 PAIN

Adolescents were tracked weekly by the research team, reporting the occurrence of pain. The questionnaire used to assess pain was an adaptation of the Nordic Questionnaire (Kuorinka et al., 1987; Legault et al., 2014). The use of this type of screening tool is often used in the development and assessment of prevention strategies for work-related pain and symptoms. Regarding pain, the questionnaire has previously been used to satisfactorily identify a high prevalence of symptoms in most investigated body parts in a young Brazilian athlete population. The questionnaire is similar to those used in work safety and ergonomics, it could also be useful for school physical activity programs or individual and team sports (Bleyer et al., 2015).

Researchers contacted adolescents and coach staff weekly to avoid recall bias, considering the positive report of pain throughout the week (Bahr, 2009). Adolescents

received access to an online form, which should be completed throughout the week (the research team and coach staff worked closely to keep the reports updated).

For each body region (neck, shoulder, upper back, elbows, wrists/hands, lower back, hip/thigh, knees, and ankles/feet) **(Figure 7)**, there are three yes/no questions: (i) the presence of any pain in the previous 7 days, (ii) impairment in daily activities over the previous 7 days due to pain, and (iii) consulting a health professional because of pain. The validation study presented satisfactory Kappa index values, ranging from 0.63 to 1.00 (de Barros & Alexandre, 2003).

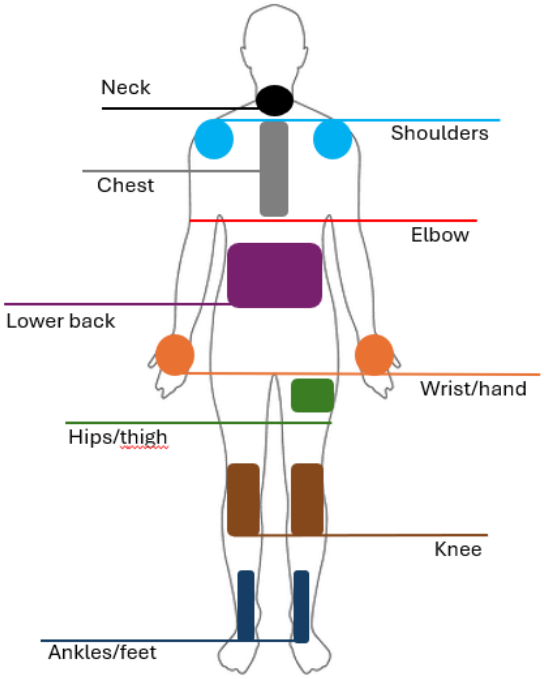

Figure 4. The scheme of the body subdivided into regions

Note: From the author

3.5 Statistical Analyses

Initially for the descriptive exploration, the data distribution was analyzed using Kolmogorov-Smirnov test and variables expressed as mean values, standard deviation (SD) and 95% confidence intervals. All statistical analyses were performed using the SPSS IBM statistics software (version 29.0, Chicago, IL, USA). The statistical

significance was set at 5%. Below is presented the statistical analyses carried out in each manuscript of the thesis.

3.5.1 Statistical analyses - Manuscript 1:

The student's *t*-test (continuous data) and chi-square (categorical data) were used to compare means and assess associations' existence between the "swimming group" and "impact sports" respectively. The magnitude of the correlation (Pain and sports participation) was expressed as *r* and its 95% confidence intervals (95%CIs) using Linear Regression, adjusted by sex, age, PHV, training volume, vigorous physical activity, and resistance training. The prevalence and occurrence were calculated with 95% CIs. Kaplan-Meier plots and risk of pain through 28 weeks were calculated for the absence of pain during the 28-week follow-up. Analyses were carried out on the statistical software SPSS(version 29.0), and the significance level was set as 5%.

3.5.2 Statistical analyses - Manuscript 2:

Measures of central tendency, dispersion, and frequency were used as descriptive statistics. The student's t-test (continuous data) and chi-square (categorical data) were used to compare means and assess associations' existence between the "sports group" and "control group" respectively. Bivariate correlation was used to observe the relationship between sedentary behavior, intensity of physical activity (moderate, vigorous), and total time week training time with the appearance of pain in each segment, expressed as r and its 95% confidence interval. Correlations were adopted as measures of effect-size and graded as small effect-size <= 0.10, medium effect-size >0.10 to <= 0.49 and large effect-size >= 0.50 to <= 0.70 and very large effect-size >0.70 (MAHER et al. 2013). Subsequently, the associations (Pain and sports participation) were expressed as β and its 95% confidence intervals (95%CIs) using Linear Regression, adjusted by sex, somatic maturation, lean soft tissue, sports modality, and sedentary behaviour. The occurrence was calculated with 95% CIs. Kaplan-Meier plots and risk of pain through 28 weeks were calculated for the absence

of pain during the 28-week follow-up. Analyses were carried out on the statistical software SPSS (version 29.0), and the significance level was set as 5%.

4 RESULTS

In this section, the findings and discussion of the Thesis will be presented in two segments:

The first manuscript entitled “Musculoskeletal pain in adolescents involved in impact and non-impact sports - ABCD Growth Study”, was accepted for publication in the journal Pediatric Exercise Science on 07/31/2024.

The second manuscript will be presented in full, Summary, Introduction, Methods, Results and Discussion. This second manuscript was never submitted in any Journal, and will not be submitted before the presentation of this thesis.

4.1 Manuscript 1:

Original article

MUSCULOSKELETAL PAIN IN ADOLESCENTS ENGAGED IN IMPACT AND NON-IMPACT SPORTS - ABCD GROWTH STUDY

Running title: **Musculoskeletal Pain in Adolescents**

Purpose: This study aimed to identify, through a 28-week follow-up, the association between pain and engagement in different sports among adolescents. *Methods:* In total, 63 adolescents reported the occurrence of pain, which was tracked weekly. Participants were categorised into two groups based on their sports participation: “swimming group” and “impact sports group". Researchers directly measured the time spent in different intensities during sports participation for one week using a heart rate monitor. For the covariates, body mass, body fatness, and whole body lean soft tissue were assessed using a dual-energy x-ray absorptiometry (DXA) scanner. Kaplan-Meier plots and risk of pain were calculated for the absence of pain during the follow-up. *Results:* The association between the sport type and pain occurrence remained significant even after adjusting the models for potential confounders, showing that swimmers had an increased risk of reporting pain in the neck (HR= 3.33 [95%CI: 1.53 to 7.25]), shoulders (HR= 2.21 [95%CI: 1.17 to 4.21]), and trunk (HR= 5.60 [95%CI: 2.28 to 13.70]). *Conclusion:* The association between the sport type and pain occurrence is evident even when controlling for confounding factors.

Key words: Pain, Adolescents, Sports, Growth, Musculoskeletal disorder

Introduction

Musculoskeletal pain (hereafter referred to as pain) is defined as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage," which does not have to be related to apparent tissue damage (24). The International Olympic Committee recently emphasised the importance of assessing pain and injuries in athletes (10). Pain is not a selective condition, and it also affects paediatric populations, with a reported prevalence of current pain ranging from 4% to 60% (25), including multi-site pain manifestation (12), with an increased risk of continuing to feel pain later in life, which is cause for concern (3,7).

The growth spurt in adolescence is critical period due to the constant structural and physiological alterations, that can affect sports participation. In fact, the peak height velocity (PHV) and timing of maturity differ significantly in adolescents of the same chronological age (8). In youth sports, these differences are often not considered, resulting in suboptimal training and an increased risk of injuries and pain. In addition, each sport elicits different responses according to its biomechanical aspects, physical load, and even the environment where it is performed (water or land) (16). As an example of this, Malborg et al. (2022) described that adolescent engaged in non-contact sports (athletics, swimming, squash, badminton, tennis, figure skating, artistic gymnastics, and diving) were more likely to report frequent pain (17).

Previous studies have investigated the perception of pain and biological maturity in adolescents who are active in sports. In their review, Swain et al. (2018) showed that the relationship between maturation, growth, and musculoskeletal conditions remains inconclusive, and the available evidence is still insufficient to make inferences about a clear association (28). The current knowledge presents a high risk of bias (no articles in the literature have adequately addressed all bias domains) (28), which

impedes our ability to establish whether biological maturity and growth are independent risk factors for musculoskeletal conditions (28). In addition, there is limited longitudinal evidence on these conditions, considering variables that directly influence the occurrence of pain.

The pain surveillance system in adolescence is an important component in detecting and preventing musculoskeletal disorders or complaints and their costly consequences (14,15). However, pain conditions in youth sports, associated with somatic maturity and types of sport, are rarely mentioned in the literature, particularly considering that most studies are focused on adult high-performance athletes (18). Within a paediatric context, the literature already shows how pain in adolescence can predict pain conditions in young adulthood, and early identification is extremely important to prevent pain from becoming persistent (3,7,15). Considering this, there is a need to recognise risk factors for pain in adolescent athletes, regardless of the cause.

In light of this, the current work aimed to identify, in a 28-week follow-up study, the association between pain and engagement in different sports among adolescents.

Material and Methods

Sample

This longitudinal study is part of the ongoing research entitled “Analysis of Behaviors of Children During Growth – ABCD Growth Study”, carried out in the city of (deleted for double-blind review) (~200,000 inhabitants, located in the western part of the (deleted for double-blind review), with a Human Development Index of 0.807). The Ethical Committee Board of the *(blinded)* University approved the ethical aspects of the ABCD Growth Study. All information obtained from the adolescents is confidential

and for strict research use. The adolescent, caregiver, and sport trainers were immediately informed if any anomaly was detected.

In the ABCD Growth Study, the inclusion criteria were: i) aged between 11 and 17, (ii) no clinical or metabolic disorders (previously diagnosed) that may interfere with the practice of habitual physical activity, (iii) no regular medicine use, and (iv) a minimum of 12 months of participation in sports (for all sports clubs). For all adolescents who self-declared fulfilling the inclusion criteria, their parents and/or guardians received the written consent forms. After providing consent, participants were contacted by phone and invited to visit the University facilities to be measured and interviewed by the researchers.

The ABCD Growth Study has been conducted since 2017, and details about its sampling process are described elsewhere (6,29). In brief, the ABCD Growth Study was approved by members of the Municipal Department of Sports and the Municipal Department of Education. After receiving approval from the local authorities, researchers contacted coaches (sports clubs) and principals (schools) to describe the aims of the research and inclusion criteria. Researchers contacted 11 schools and sports clubs in the city's metropolitan area, and 285 adolescents started the follow-up. However, due to the COVID-19 pandemic, all data collection was interrupted from 2020 to 2022 by the determination of both the State of Sao Paulo and Brazilian Health Authorities, resulting in the loss of the tracked adolescents. In 2022, 63 adolescents were tracked for 28 weeks to test the necessary changes in a post-pandemic scenario, targeting the resumption of the ABCD Growth Study in 2023. Thus, the study sample comprised 63 adolescents tracked during 28 weeks in 2022.

Dependent variable: Pain

Adolescents reported the occurrence of pain and were tracked weekly by the research team. An adaptation of the Nordic Questionnaire was used to assess pain (Kuorinka et al. 1987, 1990) (14,20,30). Researchers contacted adolescents and coaching staff weekly to avoid recall bias, considering a positive pain report during the previous week (1). The adolescents were given access to an online form, which they were asked to complete throughout the week (the research team and coaching staff worked closely together to keep the reports updated). Before the study, the researchers contacted parents/legal guardians and adolescents to provide instructions about the correct way to complete the questionnaire and answer any questions about the procedures. It was emphasised that the questionnaire should reflect only the teenager's perception. Coaches knew that the questionnaires were being completed but did not interfere in the process. Access to the data reported in the online questionnaire was restricted to the research team, the adolescents, and their parents/legal guardians.

The questionnaire presents a scheme of the body subdivided into regions (neck, shoulder, upper back, elbows, wrists/hands, lower back, hip/thigh, knees, and ankles/feet) **(supplement 1)**. For each body region, there are three yes/no questions relating to (i) the presence of any pain in the previous 7 days, (ii) impairment in daily activities over the previous 7 days due to pain, and (iii) consulting a health professional in the previous 7 days because of pain. The validation study presented satisfactory Kappa index values, ranging from 0.63 to 1.00 (2).

In the current study, “the presence of any pain in the previous 7 days” was self-reported weekly (every Friday), and the occurrence and incidence of the outcomes were considered.

892 **Independent variable: Sports participation**

893 Participants were categorised into two groups considering the presence (or not)
894 of physical impact in the sports practice: the “swimming group” (n= 18 adolescents)
895 and the “impact sports group" (n= 45 adolescents [basketball, gymnastics, track & field,
896 and judo]). At baseline, the participants reported the previous time of engagement in
897 the sport (months), the weekly frequency of training (days/week), and resistance
898 training (days/week). Furthermore, during follow-up (28 weeks), 1 week was assigned
899 a priori for researchers to directly measure the time (training volume) spent in different
900 intensities (light, moderate, and vigorous) during sports participation using a heart rate
901 monitor (sensor attached to the chest at the height of the heart [Polar H7 model];
902 POLAR software, Polar Team, Kempele, Finland).

903 **Covariates**

904 The adolescents were scheduled to visit the university facilities for various
905 assessments (DXA, anthropometric data, and face-to-face interviews), which lasted
906 approximately 30 minutes per adolescent. Sex (boy/girl), anthropometric measures
907 (body weight, height, and sitting height), and body composition (lean soft tissue and
908 body fatness) were used as covariates. Body weight was measured using an electronic
909 scale (Filizzola PL 150, model Filizzola Ltda, Brazil) and height and sitting height using
910 a wall-mounted stadiometer (Sanny, model American Medical of the Brazil Ltda,
911 Brazil). Peak height velocity (PHV) was estimated as a marker of somatic maturation,
912 using mathematical models based on anthropometric measures to calculate the time
913 (in years) remaining (negative values) or past (positive) to PHV, which is an important
914 biological event that follows the human maturation process: Years from age of PHV for
915 males = -7.999994 + [0.0036124 x (Age x Stature)] and Years from age of PHV for
916 females = -7.709133 + [0.0036124 x (Age x Stature)] (19). Body mass (kg), body

fatness (%), and whole body lean soft tissue were assessed using a dual-energy x-ray absorptiometry (DXA) scanner (Lunar DPX-NT; General Electric Healthcare, Little Chalfont, Buckinghamshire, UK) with GE Medical System Lunar software (version 4.7). DXA measurements were performed in the morning after a light breakfast, and the scanner quality was tested by a trained researcher before each measurement day, following the manufacturer's recommendations. Covariates were measured only once at the beginning of follow-up.

Statistical Analysis

Measures of central tendency, dispersion, and frequency were used as descriptive statistics. The student's *t*-test (continuous data) and chi-square test (categorical data) were used to compare means and assess the existence of associations between the "swimming group" and "impact sports group" respectively. The magnitude of the associations (pain and sports participation) was expressed as *r,* with 95% confidence intervals (95%CIs), using Linear Regression, adjusted by sex, age, PHV, training volume, vigorous physical activity, and resistance training. The prevalence and occurrence were calculated with 95% CIs. Kaplan-Meier plots were used to calculate the absence of pain during the 28-week follow-up. Analyses were carried out on the statistical software STATA (version 19.0), and the significance level was set as 5%.

Results

A total of 63 adolescents (27 girls and 36 boys) actively participated in the 28-week weekly follow-up. Considering adolescents engaged in swimming and impact sports, there were similarities in age, maturation, body composition, and resistance training engagement. Most sports participation parameters were higher among swimmers (**Table 1**).

Overall, there were 1277 reports of pain over the follow-up period. The number of pain events per week was higher among swimmers in the neck (p-value= 0.029), shoulder (p-value= 0.010), and trunk (p-value= 0.036), compared with the other sports modalities.

Training volume was positively related to higher self-reported pain throughout the 28 weeks in the neck (r= 0.454) and trunk (r= 0.500), while vigorous physical activity was negatively related to less self-reported pain during the follow-up in the shoulders (r= 0.373) but positively in the ankles/feet (r= 0.351). Finally, resistance training was positively related to higher self-reported pain in the ankles/feet (r= 0.461) **(Table 2).**

During the follow-up, 50% of athletes recorded at least one episode of pain during the 28 weeks, more highly represented by hips (65.1% [95%CI: 53.3 to 76.8]), ankles/foot (63.4% [95%CI: 51.6 to 75.3]), and shoulders (63.4% [95%CI: 51.6 to 75.3]), while the neck (41.2% [95%CI: 29.1 to 53.43]), trunk (33.3% [95%CI: 21.6 to 44.9]), elbows (33.3% [95%CI: 21.6 to 44.9]), and wrists/hands (22.2% [95%CI: 11.9 to 32.4]) were affected in between 22% and 41% of the adolescents (**Figure 1, Panel A**). The type of sport practiced affected the occurrence of pain in the neck, shoulders, and trunk (**Figure 1, Panel B**). These values are presented in **Figure 1**.

The association between the sport type and pain occurrence remained significant even after adjusting the models for potential confounders (sex and maturity offset) (**Figure 2, Panels A, B, and C**). Swimmers had an increased risk of reporting pain in the neck (HR= 3.33 [95%CI: 1.53 to 7.25]) (**Figure 2, Panel A**), shoulders (HR= 2.21 [95%CI: 1.17 to 4.21]) (**Figure 2, Panel B**), and trunk (HR= 5.60 [95%CI: 2.28 to 13.70]) (**Figure 2, Panel C**) compared to adolescents engaged in other sports. These values are shown in **Figure 2**.

Discussion

The current study aimed to identify the occurrence of pain and its association with sports participation in adolescents. Emphasis is consistently placed on the role of sport in enhancing health in paediatric groups (which is widely recognised). However, less attention has been given to potential side effects of sports participation, such as pain. Our study found that all adolescents experienced at least one pain episode during the 28-week follow-up.

Regarding our sample, adolescents commonly experienced lower back, hip, ankle/foot, and shoulder pain. Similar information is found in the literature. A survey of 7596 Norwegian adolescents identified neck and shoulder pain as the most prevalent pain symptom (17%)(9). Another survey conducted with Swedish adolescent athletes reported the knee (27%) and lower legs/feet (17%) as the most common body regions to receive pain reports at baseline. This pattern changed during the follow-up period (lower back 21% and knees 18%) (17). Another survey in Brazil identified that 58% of all adolescents reported pain in the week before the interview, with reports of pain in the lower limbs being higher among adolescents engaged in martial arts, such as judo, karate, and kung-fu (16). In the current study, pain in the lower limbs was similar among swimmers and adolescents engaged in other sports, although this similarity may result from only considering one martial art, with few adolescents engaging in judo (n=14).

The background described above ratifies that pain is an outcome commonly diagnosed in adolescents, especially those regularly engaged in sports.

We found that factors related to sports participation, such as vigorous physical activity and training volume, can influence pain. Like sports injuries, pain is often linked to stressed tissue. Although there were variations in the methodologies used, our results align with the current literature. Rathleff et al., in a cross-sectional study, found that one in five of 2953 adolescents reported pain (25), mainly those with a high level of sports participation, while Malmborg et al., in a cross-sectional survey of sports school students, reported that at least one in three students experienced an episode of pain during the week before the interview (18).

Despite all compelling evidence linking sports participation to benefits for paediatric health, there is a close relationship between sports participation and the appearance of pain symptoms (11). The impact of sports participation on pain seems stronger when the training volume is high. The definition of “excessive sports participation” among adolescents seems controversial, but recommendations hint at a maximum of 16 hours per week (22). In our study, swimmers spent time in practice close to this limit (mean 13.9 h/week [95%CI: 12.5 to 15.4]), while the other sports group reported around 7.3 h/week (95%CI: 6.3 to 8.3), without considering the intensity. Similarly, leisure-time physical activity was positively related to pain in adolescents, while the co-occurrence of different areas of pain was more common in subjects participating in sports (13). In terms of how sports participation interacts with pain, another relevant aspect to be considered beyond the time of engagement in sports is the right moment to start sports participation. Parents and coaches usually attribute greater athletic performance to early initiation in sports (which is not entirely true), but the exact amount of training necessary to achieve athletic success and an

eventual threshold to avoid injuries remain unknown among paediatric groups (4,23). Moreover, most recommendations about sports initiation / specialization only consider chronological age, while biological maturation (biological age) receives less attention (4,22,23).

The higher occurrence of upper body pain among swimmers seems more due to the duration of exposure rather than biomechanical aspects or environmental factors. Unlike the other modalities, swimming combines large training loads, high technical requirements, and demands on strength to overcome an external load, mainly in the upper limbs, leading to joint and muscular overloads and increasing the risk of injury. In a similar study, Capaci et al. (2002) highlighted that swimmers experiencing musculoskeletal pain reported swimming significantly more hours per week than those without pain (8.86 ± 1.25 vs 8.00 ± 1.06 h/week) (5). Ristolainen et al. (2014) also found a positive relationship, reporting that the mean number of kilometres swam was significantly higher in injured swimmers than non-injured swimmers (1612 km/year vs. 1380 km/year) (26).

There were no relevant differences in the association between sex and sports participation. This may be due to the low participation of girls in our study. However, it is important to mention that the literature presents evidence that the female sex is a determinant in the presence of pain. Based on findings from a Canadian sample, Stanford et al. (2008) reported that girls tend to have more pain complaints than boys at all ages (27). Similarly, Perquin et al. (2000) show how 27% of Dutch adolescents reported multi-site pain, with females presenting prevalence twice as high as males (21).

Our study has limitations. First, due to the challenges related to the monitoring of sports teams, randomisation is not a reality in this approach. Thus, there are disparities related to sex and sports distribution. Second, pain is a sign that can be overestimated or underestimated according to the perception of each adolescent, which could also influence the results. Finally, the training parameters were measured through a cross-sectional approach at baseline, while pain was measured longitudinally. Thus, monitoring training parameters using a longitudinal approach is highly recommended to identify any cause-effect relationship between the variables.

Conclusions

In summary, adolescent swimmers reported more pain than adolescents engaged in other sports, and the training volume was the most relevant variable in this phenomenon. Although sports participation is widely recommended for adolescents in modern society, it is important to promote diversification in sports participation and raise awareness about imposing a limit to how much adolescents should engage in sports to preserve their health integrity. The current study supports the idea that to prevent pain, coaches and parents should be careful to avoid excessive sports participation among adolescents (21).

Acknowledgements

Availability of data and materials: The data used to support the findings of this study are available from the corresponding author upon request.

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Ethics approval and consent to participate: To participate in the study, adolescents provided informed consent forms signed by a parent or guardian. The Ethical Board of the *(blinded)* University *(blinded*) approved the investigation (Process number: 02891112.6.0000.5402), and all procedures performed in this study were conducted in accordance with the 1964 Declaration of Helsinki for Human Studies by the World Medical Association.

Conflict of interest: None.

Declaration of Generative AI and AI-assisted technologies in the writing process: The authors declare that no AI and AI-assisted tools were used in the writing of this manuscript.

Table 1. General characteristics of the sample according to engagement in sports (ABCD – Growth Study; n = 63).

Independent variables	Swimming (*n*= 18) Mean (95%CI)	Other sports (*n*= 45) Mean (95%CI)	*p*-value
General characteristics			
Boys / Girls	9 / 9	27 / 18	---
Age (years)	15.1 (14.3 to 18.8)	14.7 (14.0 to 15.4)	0.536
PHV (years)	2.1 (1.5 to 2.7)	1.6 (1.1 to 2.2)	0.290
Body mass(kg)	63.8 (57.2 to 70.5)	65.0 (59.1 to 70.9)	0.827
Height (cm)	169.5 (164.3 to 174.7)	167.0 (162.7 to 171.3)	0.501
Whole LST (Kg)	48.3 (42.51 to 54.21)	46.7 (42.8 to 50.6)	0.646
Body fatness (%)	21.4 (17.08 to 25.71)	23.8 (21.3 to 26.2)	0.303
Sports participation			
Previous practice (months)	67.9 (45.4 to 90.4)	49.1 (32.9 to 65.3)	0.196
Vigorous PA (min/day)	19.7 (12.9 to 26.4)	14.8 (12.2 to 17.4)	0.170
Bout section (min/day)	146.6 (135.6 to 157.7)	92.5 (84.2 to 100.8)	**0.001**
Frequency (days/week)	5.7 (5.3 to 6.1)	4.6 (4.2 to 5.1)	**0.001**
Weekly volume (min/week)	838.1 (750.6 to 925.4)	440.2 (378.1 to 502.2)	**0.001**
Pain			
Neck (events/wk)	4.2 (1.0 to 7.5)	0.55 (0.17 to 0.93)	**0.029**
Shoulders (events/wk)	7.2 (3.5 to 10.9)	2.0 (1.0 to 3.0)	**0.010**
Trunk (events/wk)	3.8 (0.5 to 7.0)	0.3 (0.1 to 0.5)	**0.036**
Elbows (events/wk)	1.7 (0.1 to 3.5)	0.9 (0.1 to 1.6)	0.285
Low back (events/wk)	5.2 (1.2 to 9.2)	1.6 (0.8 to 2.4)	0.082
Wrists/hands (events/wk)	1.4 (0.1 to 3.3)	0.5 (0.1 to 1.0)	0.345
Hips (events/wk)	4.8 (1.2 to 8.5)	2.9 (1.6 4.2)	0.309
Knees (events/wk)	3.3 (0.1 to 6.9)	2.0 (0.7 to 3.2)	0.453
Ankles/feet (events/wk)	3.3 (0.1 to 6.7)	3.1 (1.7 to 4.4)	0.869
Categorical	*n* (%)	*n* (%)	*p*-value
Resistance training			
RT $_{yes}$	16 (88.9%)	35 (77.8%)	0.482
RT $_{\geq 3\ days/week}$	12 (66.7%)	21 (46.7%)	0.247
RT $_{\geq 1\ year}$	8 (44.4%)	18 (40.0%)	0.968

95%CI: confidence interval; LST= lean soft tissue; PHV= peak of height velocity; RT= resistance training.

Table 2. Linear regression (standardised coefficient) between the self-reported pain during the 28-week follow-up and training parameters among adolescents (ABCD – Growth Study; n = 63).

	Neck	Shoulders	Trunk	Elbows	Low back	Wrists/hands	Hips	Knees	Ankles/feet
	r	*r*	*r*	*r*	*r*	*r*	*r*	*r*	*r*
Overall sample (n= 63)									
Training volume (min/wk)	**0.454**	0.368	**0.500**	-0.092	0.127	-0.044	-0.026	-0.006	-0.262
Vigorous PA (min/day)	-0.142	**-0.373**	-0.123	0.028	0.112	0.272	-0.026	0.197	**0.351**
RT (days/wk)	-0.119	0.137	-0.130	0.327	0.102	0.138	0.299	0.191	**0.461**

Linear regression adjusted by sex, PHV, age, training volume, vigorous physical activity, and resistance training (days/week); PA= physical activity; RT= resistance training.

Figure 1.

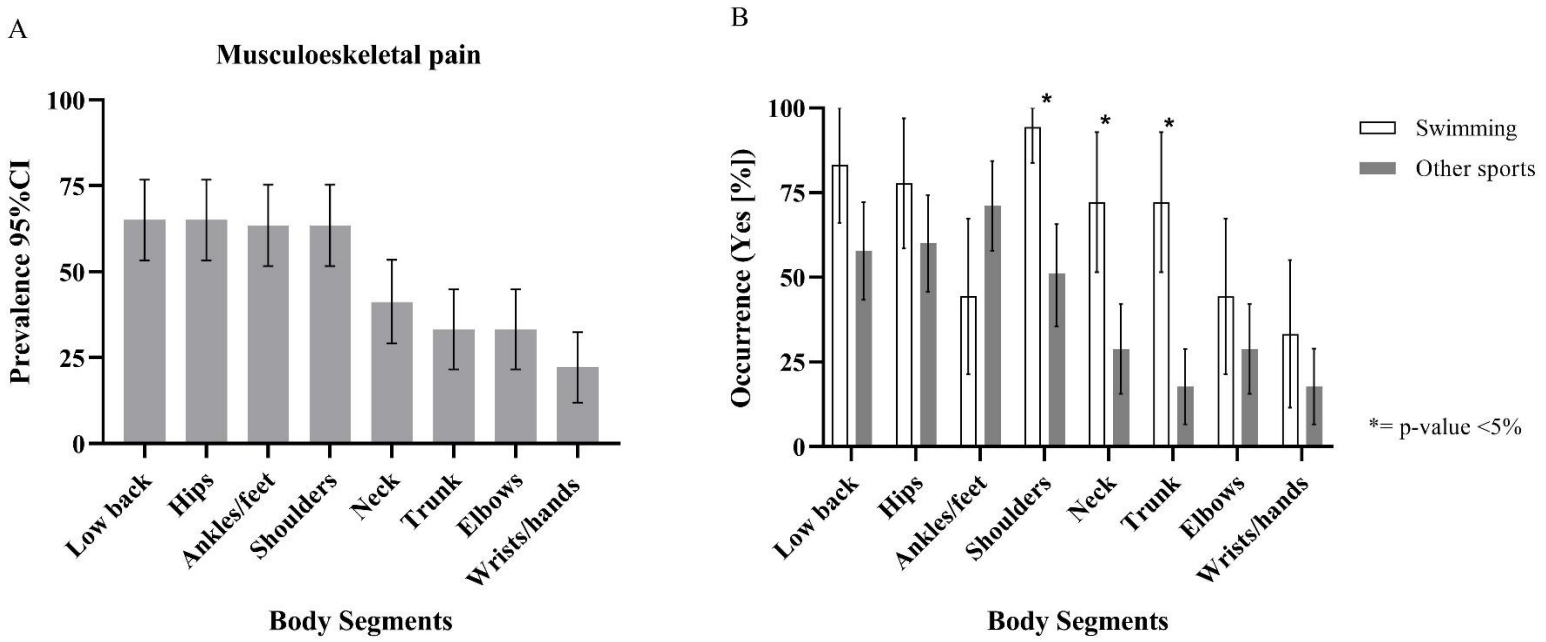

Figure 1. Prevalence (and 95%CI) of pain among adolescents (Panel A) and according to sports participation (**Panel B**; ABCD—Growth Study; n = 63).

Figure 2.

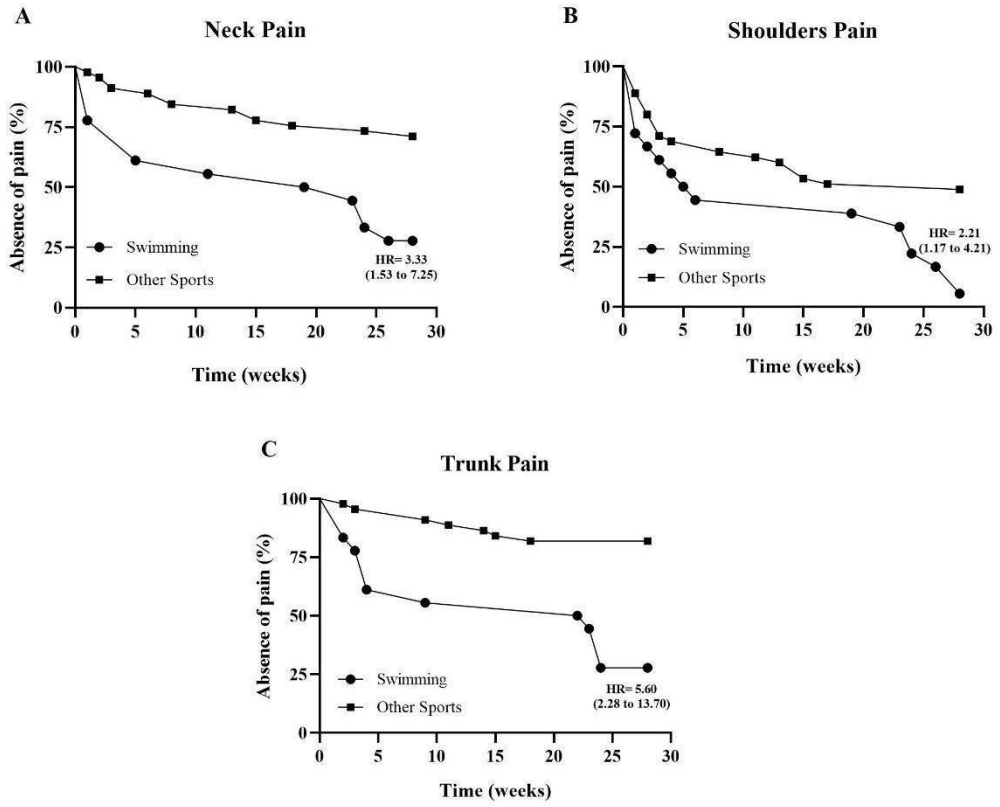

Figure 2. Kaplan-Meier plots and risk of pain during 28 weeks among adolescents (ABCD—Growth Study; n = 63).

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4.2 Manuscript 2:

Original Article

Association between sports participation and incidence of pain in adolescents: ABCD Growth Study

Abstract

Purpose: To compare the incidence of pain between adolescents engaged and not engaged in sports participation and also explore the role of sex, biological maturation and parameters of sports participation into this association. **Methods:** In total, 95 adolescents categorised into two groups, considering the presence (63 adolescents) or not of sports participation (32 adolescents). For one week, researchers directly measured the sedentary behaviour as a physical behaviour and the time training volume spent in different intensities light, moderate, and vigorous during sports participation using a heart rate monitor. In addition, they reported the occurrence of pain every week for 28 weeks using an online form. Bivariate correlation was used to observe the relationship between sedentary behaviour, intensity of physical activity and total time week training time with the appearance of pain in each segment. Kaplan-Meier plots and risk of pain were calculated for the absence of pain during the follow-up. **Results:** The percentage of adolescents reporting at least one pain event during the follow-up period did not differ between the two groups, however, the number of pain events reported in athletes was higher. A steeper slope indicates a higher event rate risk to report pain over the 28 weeks was higher for shoulders (P = 0.001), elbows (P = 0.013), hips (P = 0.031), and ankles/feet (P = 0.038) mostly in the sports participation group. Every increase of one minute per week of sports participation resulted in more than 0.004 pain events in the neck (95%CI: 0.001 to 0.007), 0.011 events in shoulders (95%CI: 0.006 to 0.014), 0.004 events on the trunk (95%CI: 0.001 to 0.007) and 0.002 events on elbows (95%CI: 0.001 to 0.004). **Conclusion:** The weekly time of engagement seems a relevant aspect of sports participation responsible for the higher number of pain events among adolescents, especially among adolescent athletes.

Introduction

The International Association for the Study of Pain (IASP) defined pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage" (Raja et al., 2020). Figures show that pain is already responsible for significant economic burden (US$ 560-635 billion in 2010) among adults (Smith & Hillner, 2019). However, pain is not an outcome exclusively observed in adults, being a condition commonly reported by children and adolescents, with prevalence ranging from 4% to 60% and tracking from early life to adulthood (Brattberg, 2004; Rathleff et al., 2013). The literature already shows that the impact of the presence of pain in adolescence is such that it can predict pain conditions in early adulthood, and early identification is of the utmost importance to prevent pain from becoming persistent (Hainline et al., 2017).

Moreover, adolescence is a critical period for human growth with potential to affect pain. Puberty itself is characterised by significant somatic growth and marked musculoskeletal changes, factors that increase the adolescent's vulnerability to episodes of pain (Swain et al., 2018). Sex is another variable to be considered in this complex phenomenon linking pain to sports participation because girls seem more vulnerable to pain than boys, while sports parameters and maturation are two variables strongly affected by sex (Perquin et al., 2000; Swain et al., 2018). Therefore, models assessing the interaction between sports participation and pain among adolescents should consider those potential confounders.

Sports participation is the main manifestation of physical exercise among adolescents and its practice has been consistently related to many positive health aspects (Malina, 2017). However, in a paradox the same sports participation can increase the risk of pain and injuries. Guddal et al., 2019, analysed the presence of pain in 7,596 adolescents and found that 62% of them reported pain after sports practice, evidencing the concern that children and adolescents report pain at alarming rates as well as sports participation seems to play a relevant (and yet unclear) role into this phenomenon. The discussion surrounding the relationship between sports participation and pain is a controversial issue, especially because the engagement in sports is more complex than just “be engaged in”. Aspects of

sports participation (e.g. volume of training, intensity, etc.) should be considered to understand in depth how this relevant behaviour might be linked to pain in adolescents (Kujala et al., 1999). It's important to note that all the studies were conducted in high-income countries. There haven't been any studies in low-income countries like Brazil where adolescents are observed over an extended period. It's also important to consider variables related to sports participation (intensity, volume) along with somatic maturation. This makes it crucial to further explore this topic.

Thus, this manuscript aimed to analyse the association between sports participation and incidence of pain among adolescents, as well as to identify the role of biological maturation, sex and training parameters into this association. We have hypothesised that the engagement in sports would increase the risk of pain among adolescents, while this association would be affected by biological maturation (higher incidence of pain in more mature adolescents), sex (higher incidence among boys) and training parameters (higher incidence in adolescents spending more time in sports practice [volume]).

Material and Methods

Sample

This longitudinal study is part of the ongoing research entitled “Analysis of Behaviours of Children During Growth – ABCD Growth Study”, conducted in Presidente Prudente (Western part of the Sao Paulo State). This study was approved by the Ethical Board Committee of the Sao Paulo State University (Process number: 02891112.6.0000.5402).

For this study, adolescents who were engaged in sports were included if they: i) had previous involvement of at least 12 months in the current sport; ii) did not have clinical or metabolic disorders (previously diagnosed); iii) did not regularly use medications that may affect the development and growth of the adolescent; iv) aged from 11 to 17 years; vi) signed written consent form. We do not limit the participation of adolescent athletes, referring to the nature of the objectives, whether in the form of annotation or subjective perception in the

scoring of the impact modalities, we address group participation modality such as basketball or individuals such as gymnastics, athletics and judo.

For the control ones, adolescents not engaged in sports, the following inclusion criteria were applied: i) no regular participation in sports in the previous six months; ii) signed written consent form; iii) absence of clinical or metabolic disorders (previously diagnosed); iv) no regular use of medications; iv) aged from 11 to 17 years. For all adolescents who declared to fulfil the inclusion criteria, their parents and/or guardians received the written consent forms. After providing consent, participants were contacted by phone and invited to visit the University facilities to be measured and interviewed by the researchers.

The ABCD Growth Study has been conducted since 2017, and details about its sampling process are described elsewhere (Werneck et al., 2018). In brief, the ABCD Growth Study was approved by members of the Municipal Department of Sports and Municipal Department of Education. However, due to the COVID-19 pandemic, all data collection was interrupted from 2020 to 2022 by the determination of both the State of Sao Paulo and Brazilian Health Authorities, resulting in the loss of the tracked adolescents. The dataset used in this manuscript was built in 2022, when 95 adolescents were tracked for 28 weeks to test the necessary changes in a post-pandemic scenario, targeting to resume the ABCD Growth Study in 2023.

Dependent variable: Pain

Adolescents were tracked weekly by the research team, reporting the occurrence of pain. The questionnaire used to assess pain was an adaptation of the Nordic Questionnaire (Kuorinka et al., 1987; Legault et al., 2014). Researchers contacted adolescents and coaching staff weekly to avoid recall bias, considering the positive pain report through week (Bahr, 2009). Adolescents received access to an online form, which should be completed throughout the week (the research team and coach staff worked closely to keep the reports updated). Coaches knew that the questionnaires were being completed but did not interfere in the process.

The questionnaire presents a scheme of the body subdivided into regions (neck, shoulder, upper back, elbows, wrists/hands, lower back, hip/thigh, knees, and ankles/feet) (supplement 1). For each body region, there are three yes/no questions: (i) the presence of any pain in the previous 7 days, (ii) impairment in daily activities over the previous 7 days due to pain, and (iii) consulting a health professional because of pain. The validation study presented satisfactory Kappa index values, ranging from 0.63 to 1.00 (de Barros & Alexandre, 2003). To ensure the quality of adolescents' responses, before the study, the researchers contacted parents/legal guardians and adolescents to provide instructions about the correct way to complete the questionnaire and answer any questions about the procedures. It was emphasized that the questionnaire should reflect only the teenager's perception. Coaches knew that the questionnaires were being completed but did not interfere in the process. All adolescents were followed weekly and even not reporting information in a specific week, the adolescent was contacted in the subsequent week. In our sample, the average number of weeks reporting pain was 21.7 weeks (95%CI: 20.1 to 23.3).

In the current study, "the presence of any pain in the previous 7 days" was self-reported weekly (every Friday), and the incidence of the outcomes (events after the baseline) were considered.

Independent variables

Participants were categorized into two groups considering the presence (or not) of sports participation: the "sports group" (n= 63 adolescents) and the "control group" (n= 32 adolescents). At baseline measures, the participants reported the previous time of engagement in the sport (months), the weekly frequency of training (days/week), and resistance training (days/week). For our a priori analyses during one whole week, researchers directly measured the time (training volume) spent in different intensities (light [60%-70% of HRmax], moderate [70%-80% of HRmax] and vigorous [80%-90% of HRmax]) during sports participation using a heart rate monitor (sensor attached to the chest at the height of the heart position [Polar H7 model]; POLAR software, Polar Team, Kempele, Finland).

Sex (boy/girl), anthropometric measures (body weight, height, and sitting height), and body composition (lean soft tissue and body fatness) were used as covariates. Body weight was measured using an electronic scale (Filizzola PL 150, model Filizzola Ltda, Brazil). In contrast, height and sitting height were measured using a wall-mounted stadiometer (Sanny, model American Medical of the Brazil Ltda, Brazil). Peak height velocity (PHV) was estimated as a marker of somatic maturation, using mathematical models based on anthropometric measures to calculate the time (in years) remaining (negative values) or past (positive) to PHV, which is an important biological event that follows the human maturation process: Years from age of PHV for males = -7.999994 + [0.0036124 x (Age x Stature)] and Years from age of PHV for females = -7.709133 + [0.0036124 x (Age x Stature)] (Moore et al., 2015). Body mass (kg), body fatness (%), and whole body lean soft tissue were assessed using a dual-energy x-ray absorptiometry (DXA) scanner (Lunar DPX-NT; General Electric Healthcare, Little Chalfont, Buckinghamshire, UK) with GE Medical System Lunar software (version 4.7). DXA measurements were performed in the morning after a light breakfast, and the scanner quality was tested by a trained researcher before each measurement day, following the manufacturer's recommendations.

Habitual physical activity (sedentary time, light, moderate and vigorous physical activity) was monitored over five days, including two weekdays and one weekend day, using a POLAR® accelerometer (model V800 – Kempele, Finland). Adolescents were instructed to wear the accelerometer throughout the entire day, even during sleep and showers (since the device is a waterproof watch), removing it only during either sports practice or other activities with risk of damaging the device. The device's software provided information on these activity levels (https://www.polar.com/en/img/static/whitepapers/pdf/polar-activity-tracking-white-paper.pdf). In this study, sedentary time (min/day) was considered to adjust the multivariate models.

Statistical Analysis

Measures of central tendency, dispersion, and frequency were used as descriptive statistics. The student’s t-test (continuous data) and chi-square

(categorical data) were used to compare means and assess associations' existence between the “sports group” and “control group" respectively. Bivariate correlation was used to observe the relationship between sedentary behavior, intensity of physical activity (moderate, vigorous), and total time week training time with the appearance of pain in each segment, expressed as r and its 95% confidence interval. Correlations were adopted as measures of effect-size and graded as small effect-size <= 0.10, medium effect-size >0.10 to <= 0.49 and large effect-size >= 0.50 to <= 0.70 and very large effect-size >0.70 (MAHER et al. 2013). The variables that present a correlation will enter the linear regression analysis model. Subsequently, the associations (Pain and sports participation) were expressed as β and its 95% confidence intervals (95%CIs) using Linear Regression, adjusted by sex, somatic maturation, lean soft tissue, sports modality, and sedentary behaviour. The occurrence was calculated with 95% CIs. Kaplan-Meier plots and risk of pain through 28 weeks were calculated for the absence of pain during the 28-week follow-up. Analyses were carried out on the statistical software SPSS (version 29.0), and the significance level was set as 5%.

Results

During the 28-week weekly follow-up, the research team tracked 95 adolescents (63 athletes and 32 controls). Both groups shared similarities in age, body mass, and height, while athletes participated more in resistance training. The percentage of adolescents reporting at least one pain event (in all body segments) during the follow-up period did not differ between the two groups **(Table 1)**, however, during the follow-up period there were 1621 reports of pain, while the number of pain events reported in athletes was higher (**Table 1**). A steeper slope indicates a higher event rate risk to report pain over the 28 weeks was higher for shoulders (P = 0.001), elbows (P = 0.013), hips (P = 0.031), and ankles/feet (P = 0.038) mostly in the sports participation group than the control group **(Figure 1)**.

During the follow-up period, the weekly time spent with sports participation was positively correlated with pain in most of body segments (small to medium

effect-size [>0.10 to <= 0.49]) , including neck (*r*= 0.240 [95%CI: 0.022; 0.437]), shoulders (*r*= 0.441 [95%CI: 0.243; 0.601]), trunk (*r*= 0.231 [95%CI: 0.011; 0.428]), elbows (*r*= 0.334 [95%CI: 0.123; 0.516]), wrists/hands (*r*= 0.228 [95%CI: 0.009; 0.426]), hips (*r*= 0.263 [95%CI: 0.046; 0.456]), and ankles/feet (*r*= 0.231 [95%CI: 0.011; 0.428]) **(Table 2)**. Similarly, the time spent in sports participation at vigorous intensity was related to more pain events in wrists/hands (*r*= 0.295 [95%CI: 0.098; 0.469]), knees (*r*= 0.214 [95%CI: 0.011; 0.399]) and ankles/feet (*r*= 0.361 [95%CI: 0.171; 0.525]). The time spent in sports participation at moderate intensity and sedentary behaviour (assessed outside sports practice) was unrelated to pain events.

The weekly time spent with sports participation remained significantly related to pain events even after adjusting by potential confounders (sex, somatic maturation, lean soft tissue, sports modality, and sedentary behaviour). All segments showed a relationship mainly with total volume per week (min) and vigorous intensity, unlike the hip segment that did not show an association with total weekly time (β= 0.003 [95%CI: -0.001 to 0.008]), intensity (β= 0.004 [95%CI: -0.135 to 0.143]), sex (β= 3.315 [95%CI: -1.037 to 7.668]) and somatic maturation (β= -0.377 [95%CI: -1.392 to 0.639]). The positive association within the model showed that, every increase of one minute per week of sports participation resulted in more than 0.004 pain events in the neck (95%CI: 0.001 to 0.007), 0.011 events in shoulders (95%CI: 0.006 to 0.014), 0.004 events on the trunk (95%CI: 0.001 to 0.007) and 0.002 events on elbows (95%CI: 0.001 to 0.004) **(Table 3)**. Additionally, the time spent on sports participation at vigorous intensity positively related the number of pain events on wrists/hands (β= 0.066 [95%CI: 0.009 to 0.124]) and ankles/feet (β= 0.153 [95%CI: 0.021 to 0.284]), while negatively related to pain events on shoulders (β= -0.148 [95%CI: (-0.265 to -0.031]) **(Table 3),** tending to decrease painful events in the segment regarding vigorous intensity.

Sex and somatic maturation were not related to any outcome, while the models described in small magnitude the number of pain events in our sample (variance explained from 10.1% to 33.5%).

Discussion

This longitudinal study assessed the complex relationship between sports participation and pain among adolescents and identified that sports participation is related to a higher number of pain events, while this relationship seems to rely mostly on weekly volume of practice. Moreover, sex differences and somatic maturation were not relevant variables affecting pain in those adolescents.

The first finding of this longitudinal study suggests that pain is a common health issue among adolescents, regardless of their engagement in sports. In fact, adolescents engaged in sports had increased risk to report more pain events, but its occurrence was widespread in the whole sample. There are reports in the literature linking the occurrence of pain events to sedentary activities commonly present in the adolescents' life in our society, such as television and computer use (Kelly et al., 2009; Silva et al., 2016). Therefore, pain seems to be a clinical outcome commonly observed in adolescents, deserving attention from health professionals and parents due to its impact on quality of life.

The most affected body segments were shoulders, elbows, hips, and ankles during all 28 weeks of follow-up. Close to our results, Kamada et al. (2016) in their dose-response sports monitoring system, found that of the 374 adolescents monitored for 30 weeks, they reported a higher frequency of pain in the upper limbs, shoulders (6.9%) and elbows (2.1%), while in lower limbs, knees (7.9%) and ankles (4.0%) were the most affected (Kamada et al., 2016). Another epidemiological survey in Norway recorded 7596 Norwegian adolescents identified neck and shoulder pain as the most prevalent symptom (17%) (Guddal et al., 2019). Although some methodological issues such as the definition of pain for each monitoring system, the monitoring time, and even the associated results in physical activity, can vary, the upper body structures tend to be affected when it comes to pain.

The impact of sports participation in the increase of pain events may seem controversial because physical exercise is a common element of many interventions to treat / prevent pain (Shourie et al., 2024). On the other hand, the physical exercise offered by these clinical interventions are delivered in controlled environments and under strict supervision, conditions not applicable to sports

participation in the real world, in which sprains and swellings are common and not prone to be controlled. Moreover, the way athletes deal with pain (e.g. seek for treatment, medicine use) is different from the general population because there are other elements involved (e.g. agents, coaches, clubs) (Nelis et al., 2024) and, in many cases, these athlete adolescents feel pushed to keep the practice in painful conditions.

Our results showed that physically active adolescents, those who spend more time immersed in some type of sports participation reported more pain events. Moreover, a relevant aspect to be highlighted is the fact that higher intensity was less harmful to pain events than weekly time of engagement. The literature shows results like those of our study, Hulsegge et al. (2011) studied the association between physical activity and musculoskeletal complaints in a large adolescent cohort (Hulsegge et al., 2011). The authors found that being physically active at least 5 days a week for one hour or more was associated with a significantly higher risk of recording complaints (Hulsegge et al., 2011). Another study by Shan et al. (2013) found that adolescent athletes who practice an inadequately high volume of physical activity have an increased risk of developing either injuries or symptoms, especially affecting lower body extremities (Shan et al., 2013). These findings affirm that higher levels of competition and training mistakes, such as unsuitably high training volumes, and inadequate training methods are risk factors for injuries and complaints in the adolescent athlete population (Caine et al., 2006, 2008; Dalton, 1992).

Even controlling the role of potential confounders, the models explained poorly the report of pain, and the relationships were small in magnitude, denoting the multifactorial and complex nature of complaints and injuries arising not from the linear combination of isolated factors. There is considerable uncertainty regarding the aetiological role of maturation and growth in adolescent pain conditions, and highlights the knowledge gaps (Bittencourt et al., 2016). The role of sex, body composition, sports variables, and physical activity domains is still to be determined.

Our study has strengths, such as the longitudinal design and weekly pain monitoring, as well as the direct measure of relevant variables, such as intensity,

non-sportive physical activities and body composition. However, this study has also some limitations. First, pain is a sign that can be overestimated or underestimated by the perception of each adolescent, which could also influence the results. Another limitation is that we did not collect data on psychosomatic complaints and sleep quality. The evidence suggests these factors may be associated with adolescent multisite complains (Morris et al., 2022).

Pain and components of sports participation were essentially related in a small magnitude and our models explained poorly pain among these adolescents, denoting the participation of other non-controlled variables. Thus, assuming the natural intrinsic variability inserted into pain, future studies should focus on clarify the main determinants of pain among adolescents

Conclusion

In summary, weekly volume of sports participation was associated with an increase in pain events, while exercise intensity was a less relevant component affecting pain in athlete adolescents. Furthermore, this relationship is not influenced by sex or maturity.

Availability of data and materials: The data used to support the findings of this study are available from the corresponding author upon request.

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Ethics approval and consent to participate: Adolescents must provide informed consent forms signed by a parent or guardian to participate in the study. The Ethical Board of the Sao Paulo State University (UNESP) approved the investigation (Process number: 02891112.6.0000.5402) and all procedures performed in this study were conducted in accordance with the 1964 Declaration of Helsinki for Human Studies by the World Medical Association.

Conflict of interest: None.

Declaration of Generative AI and AI-assisted technologies in the writing process: The authors declare that no AI and AI-assisted tools were used in the writing of this manuscript.

1606 **Table 1.** General sample characteristics (ABCD – Growth Study; n= 95).

Variables	Control (*n*= 32) Mean (95%CI)	Sports participation (*n*= 63) Mean (95%CI)	*P*
General characteristics			
Boys / Girls	18 / 14	36 / 27	0.931
Age (years)	14.1 (13.1 to 14.9)	14.8 (14.3 to 15.3)	0.111
PHV (years)	0.9 (0.3 to 1.6)	1.7 (1.3 to 2.2)	0.731
Body mass(kg)	61.2 (54.6 to 67.7)	64.3 (59.7 to 68.9)	0.694
Height (cm)	1.6 (1.5 to 1.7)	1.7 (1.6 to 1.8)	0.271
Whole LST (Kg)	42.3 (37.7 to 46.8)	47.1 (44.1 to 50.3)	0.151
Sedentary behavior (min/week)	523.9 (478 to 569)	493.7 (467 to 519)	0.217
Sports participation			
Previous practice (months)	--	54.4 (41.4 to 67.5)	**--**
Moderate (min/ week)	--	35.5 (31.2 to 39.7)	
Vigorous (min/week)	--	3.4 (2.5 to 4.2)	**--**
Total time (min/week)*	--	115 (104 to 125)	**--**
Resistance training			
RT (yes)	22.6%	81.1%	**0.001**
RT (≥3 days/week)	15.4%	84.6%	**0.001**
RT (≥1 year)	7.1%	92.9%	**0.001**
Pain (%)			
Neck (Yes)	48.5%	41.3%	0.645
Shoulders (Yes)	45.5%	63.5%	0.139
Trunk (Yes)	27.3%	33.3%	0.706
Elbows (Yes)	18.2%	33.3%	0.184
Low back (Yes)	51.5%	65.1%	0.284
Wrists/hands (Yes)	24.2%	22.2%	0.911
Hips (Yes)	45.5%	65.1%	0.102
Knees (Yes)	45.5%	52.4%	0.667
Ankles/feet (Yes)	42.2%	63.5%	0.078
Pain (number of events)			
Neck	1.1 (0.6 to 1.7)	1.6 (0.6 to 2.6)	0.546
Shoulders	**1.1 (0.3 to 1.7)**	**3.5 (2.2 to 4.9)**	**0.001**
Trunk	1.1 (0.1 to 2.1)	1.3 (0.3 to 2.2)	0.751
Elbows	**0.2 (0.1 to 0.4)**	**1.1 (0.4 to 1.8)**	**0.013**
Low back	2.6 (1.1 to 4.1)	2.6 (1.4 to 3.9)	0.866
Wrists/hands	0.2 (0.1 to 0.3)	0.8 (0.2 to 1.4)	0.071
Hips	**1.3 (0.3 to 2.3)**	**3.5 (2.1 to 4.8)**	**0.031**
Knees	1.4 (0.5 to 2.3)	2.4 (1.1 to 3.7)	0.320
Ankles/feet	**1.1 (0.2 to 1.9)**	**3.1 (1.8 to 4.4)**	**0.038**

1607 95%CI: confidence interval; LST= lean soft tissue; PHV= peak of height velocity; and RT=
1608 resistance training; *= light, moderate and vigorous.

1609

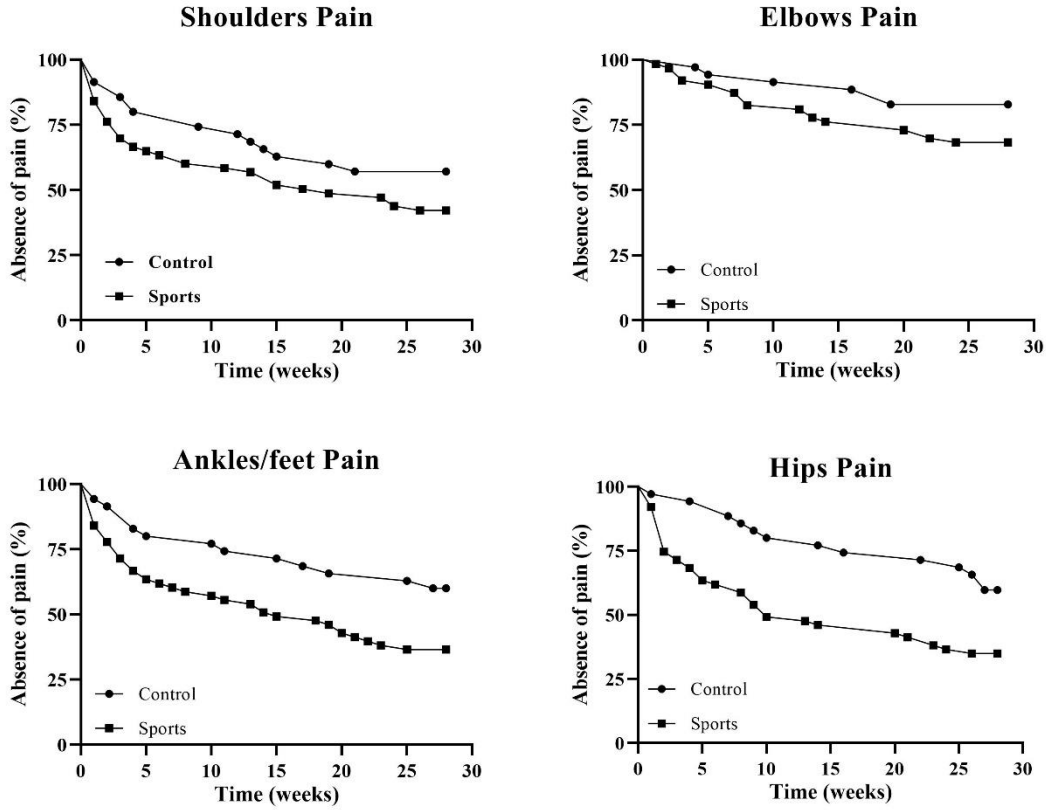

Figure 1. Kaplan-Meier plots and risk of pain through 28 weeks among adolescents (ABCD—Growth Study; n = 95).

Table 2. Bivariate correlation between intensity of physical activity behaviours and pain (ABCD – Growth Study; n= 95)

	Intensity of sports participation (minutes/week)		
Pain (number of events)	Moderate* *r* (CI 95%)	Vigorous* *r* (CI 95%)	Total time*;** *r* (CI 95%)
Neck	0.062 (-0.153 to 0.271)	0.071 (-0.134 to 0.269)	**0.240 (0.022 to 0.437)**
Shoulders	-0.051 (-0.261 to 0.165)	0.067 (-0.138 to 0.266)	**0.441 (0.243 to 0.601)**
Trunk	0.115 (-0.101 to 0.320)	0.077 (-0.128 to 0.275)	**0.231 (0.011 to 0.428)**
Elbows	0.046 (-0.169 to 0.257)	0.185 (-0.018 to 0.374)	**0.334 (0.123 to 0.516)**
Low back	0.089 (-0.127 to 0.296)	0.127 (-0.078 to 0.321)	0.157 (-0.065 to 0.364)
Wrists/hands	0.047 (-0.168 to 0.257)	**0.295 (0.098 to 0.469)**	**0.228 (0.009 to 0.426)**
Hips	0.078 (-0.138 to 0.286)	0.178 (-0.026 to 0.367)	**0.263 (0.046 to 0.456)**
Knees	0.078 (-0.138 to 0.286)	**0.214 (0.011 to 0.399)**	0.156 (-0.066 to 0.364)
Ankles/feet	0.067 (-0.148 to 0.276)	**0.361 (0.171 to 0.525)**	**0.231 (0.011 to 0.428)**

*= intensity measured by heart rate; **= sum of light, moderate and vigorous

Table 3. Relationship between pain, sports participation and other covariates (ABCD – Growth Study; n= 95).

	Linear regression (outcome: number of pain events) Unstandardized coefficient				
Pain *(events/wk)*	Standardized (r)	β*	95%CI	*P*	Model R^2
Neck					0.184
Total time (min week)	**0.341**	**0.004**	**(0.001 to 0.007)**	**0.027**	
Vigorous (min/week)	-0.042	-0.013	(-0.114 to 0.088)	0.803	
Sex	0.279	2.126	(-1.033 to 5.285)	0.184	
Maturation (PHV)	0.027	0.054	(-0.683 to 0.791)	0.884	
Shoulders					0.335
Total time (min week)	**0.678**	**0.011**	**(0.006 to 0.014)**	**0.001**	
Vigorous (min/week)	**-0.378**	**-0.148**	**(-0.265 to -0.031)**	**0.014**	
Sex	0.325	3.195	(-0.461 to 6.852)	0.086	
Maturation (PHV)	0.023	0.059	(-0.794 to 0.912)	**0.890**	
Trunk					0.140
Total time (min week)	**0.297**	**0.004**	**(0.001 to 0.007)**	**0.051**	
Vigorous (min/week)	-0.037	-0.012	(-0.122 to 0.098)	0.432	
Sex	0.201	1.625	(-1.824 to 5.073)	0.350	
Maturation (PHV)	-0.008	-0.017	(-0.822 to 0.787)	0.966	
Elbows					0.129
Total time (min week)	**0.316**	**0.002**	**(0.001 to 0.004)**	**0.046**	
Vigorous (min/week)	0.117	0.019	(-0.037 to 0.076)	0.502	
Sex	-0.011	-0.041	(-1.808 to 1.728)	0.964	
Maturation (PHV)	0.207	-0.011	(-0.423 to 0.402)	0.959	
Wrists/hands					0.141
Total time (min week)	0.009	5.934	(-0.002 to 0.002)	0.951	
Vigorous (min/week)	**0.393**	**0.066**	**(0.009 to 0.124)**	**0.025**	
Sex	0.148	0.626	(-1.171 to 2.423)	0.489	
Maturation (PHV)	-0.061	-0.066	(-0.485 to 0.353)	0.753	
Hips					0.101
Total time (min week)	0.221	0.003	(-0.001 to 0.008)	0.166	
Vigorous (min/week)	0.011	0.004	(-0.135 to 0.143)	0.953	
Sex	0.332	3.315	(-1.037 to 7.668)	0.133	
Maturation (PHV)	-0.144	-0.377	(-1.392 to 0.639)	0.461	
Ankles/feet					0.201
Total time (min week)	-0.096	-0.001	(-0.006 to 0.003)	0.522	
Vigorous (min/week)	**0.384**	**0.153**	**(0.021 to 0.284)**	**0.023**	
Sex	0.199	1.989	(-2.119 to 6.097)	0.337	
Maturation (PHV)	-0.131	-0.341	(-1.301 to 0.617)	0.481	

Note: *= model adjusted by sex, somatic maturity, lean soft tissue, sport modality and sedentary behavior.

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5 THESIS CONCLUSIONS

- Confirming our initial hypothesis, sports participation affected the incidence of pain among adolescents, in which adolescents engaged in sports reported more pain events than those adolescents not engaged in;

- Partially confirming our initial hypothesis, the harmful association observed between sports participation and incidence of pain relied more on weekly volume of training than physical exercise intensity (the initial hypothesis supported the role of both volume and intensity);

- Partially confirming our initial hypothesis, sex did not affect the occurrence of pain and the association between sports participation and pain in adolescents;

- Partially confirming our initial hypothesis, biological maturation did not affect the occurrence of pain and the association between sports participation and pain in adolescents;

- Additionally, there are certain particularities among different sports, in which some sports seem more prone to promote pain events than others;

- This thesis presents innovative aspects in the development and implementation of a pain surveillance system related to the adolescent growth and development process, finding that the relationship between pain continues to have a close relationship with sports participation, even considering the somatic growth factor adjustment variable.

- Finally, as main message of the document, in the context of sports participation in adolescence training volume is shown to be a relevant variable affecting the appearance of pain. Although sports in the first two decades of life is strongly recommended, there is a limit that must be respected to preserve the physical integrity of the adolescent.

6 THESIS REFERENCES

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7 DESCRIPTIONS OF ACADEMIC ATIVITIES (COURSES, PUBLICATIONS, CONFERENCES) DURING THE DOCTORATE COURSE

Official date of enrollment in the postgraduate program: 05//07/2019

Courses (n= 5)

5 courses during doctorate and 8 during master's gree; Total of credits: 93

1) Biostatistics: 2º semester - 2019 / Grade: A (excellent)

2) Exercício com restrição de fluxo sanguíneo e sua aplicabilidade na reabilitação musculoesquelética: 2º semester - 2019 / Grade: A (excellent)

3) Seminários de Pesquisas: Avaliação e Intervenção em Fisioterapia no sistema neuro-músculo esquelético: 2º semester - 2019 / Grade: A (excellent)

4) Tópico Especial - Advances topics in sedentary behaviors and bone health in pediatric populations: 2º semester - 2019 / Grade: A (excellent)

5) Tópico Especial - Busca científica compreensiva, revisão sistemática e meta-análise: 2º semester - 2019 / Grade: A (excellent)

Complementary activity:

"Estágio de docência": Course "Biomecânica". 1º semester- 2022.

Participation in scientific conferences/publications on books abstract (n= 6):

IX Congresso Brasileiro de Metabolismo, Nutrição e Exercício, 2023:

1- **S Maillane-Vanegas**; Correa, V. A. ; Fortaleza, J. V. S. ; Torres, W. ; Polidoro, V. A. ; Grillo, A. L. C. P. ; Picchi, P. H. N. ; Fernandes, R. A. . Dor musculoesquelética e sua associação com a prática em modalidades esportivas de impacto em adolescentes: abcd growth study, análise transversal. In: IX Congresso Brasileiro de Metabolismo, Nutrição e Exercício, 2023, Londrina. Anais IX Congresso Brasileiro de Metabolismo, Nutrição e Exercício. v. 1. p. 1-577.

2- Correa, V. A. ; Fortaleza, J. V. S.; Silva, J. C. M.; Polidoro, V. A.; Grillo, A. L. C. P.; Narciso, P. H.; **S Maillane-Vanegas**; Fernandes, R. A. . Comparação da densidade e conteúdo mineral ósseo nos membros inferiores entre adolescentes esportistas e não esportistas, estudo transversal: abcd growth study. In: IX Congresso Brasileiro de Metabolismo, Nutrição e Exercício, 2023, Londrina. Anais IX Congresso Brasileiro de Metabolismo, Nutrição e Exercício, 2023. v. 1. p. 1-577.

3- Fortaleza, J. V. S.; Correa, V. A.; Grillo, A. L. C. P.; Polidoro, V. A.; Narciso, P. H.; **S Maillane-Vanegas**; Agostinete R. R.; Fernandes, R. A. . Comparação da densidade mineral óssea entre nadadores adolescentes praticantes e não praticantes de treinamento resistido: abcd growth study. In: IX Congresso Brasileiro de Metabolismo, Nutrição e Exercício, 2023, Londrina. Anais IX Congresso Brasileiro de Metabolismo, Nutrição e Exercício, 2023. v. 1. p. 1-577.

4- Torres, W. ; Urban, J. B. ; **S Maillane-Vanegas** ; Mesquita, E. D. ; Pereira-De-Jesus A.W. ; Dias, J. S. ; Morano, A. E. V. A. ; Fernandes, R. A. . Relação entre participação esportiva e aspectos cardiovasculares de adolescentes: abcd growth study. In: IX Congresso Brasileiro de Metabolismo, Nutrição e Exercício, 2023, Londrina. Anais IX Congresso Brasileiro de Metabolismo, Nutrição e Exercício, 2023. v. 1. p. 1-577.

5- Picchi, P. H. N. ; Agostinete, R. ; **S Maillane-Vanegas** ; Silva, J. C. M. ; Polidoro, V. A. ; Faustino Da Silva Y. S. ; De-Marco L.R. ; Fernandes, R. A. . Correlação entre os domínios de atividade física, bem-estar mental e ansiedade esportiva de adolescentes atletas - abcd growth study.. In: IX Congresso Brasileiro de Metabolismo, Nutrição e Exercício, 2023. Anais IX Congresso Brasileiro de Metabolismo, Nutrição e Exercício. v. 1. p. 1-577.

Bone Research Society Annual meeting BRS-2021

1- The mediating role of lean soft tissue in the relationship between somatic maturation and bone density in adolescent practitioners and non-practitioners of sports. Ricardo Ribeiro Agostinete, André O Werneck, **Santiago Maillane-Vanegas**, Luís Gracia-Marco, Esther Ubago-Guisado, Annie M Constable, Romulo Araujo Fernandes, Dimitris Vlachopoulos. Online meeting (hosted in UK), Bone Research Society Abstracts, 2021, p. 29.

Bone Research Society Annual meeting BRS-2020

1- Categorizing ten sports according to bone and soft tissue profiles in adolescents. Ricardo Ribeiro Agostinete, Romulo Araujo Fernandes, Pedro H. Narciso, **Santiago Maillane-Vanegas**, André o Werneck, Dimitris Vlachopoulos. Online meeting (hosted in UK) 2020, BRS Poster abstract book.

31st Pediatric Work Physiology Children & Exercise-PWP 2019

1- Combined impact f resistance training and sports participation on bone mineral density accrual in adolescents: ABCD-Growth Study. Ricardo Ribeiro Agostinete, André O. Werneck, Pedro H. Narciso, **Santiago Maillane-Vanegas**, Rafael Luiz de Marco, Yuri Faustino da Silva, Romulo Araújo Fernandes. Umea-Suécia: 2019, v.32 p.S1-s12.

2- Fat mass does not mediate the positive impact of lean mass on bone density accrual in adolescents engaged in different sports: ABCD Growth Study. Romulo Araújo Fernandes, Rafael Luiz de Marco, **Santiago Maillane Vanegas**, Yuri Faustino-da-Silva, Isabella Neto Exuperio, Ricardo Ribeiro Agostinete. Umea-Suécia: 2019, v.32 p.S1-S2.

XI Congresso Brasileiro de Atividade Física e Saúde

1- Prática Esportiva e arquitetura vascular em jovens: ABCD Growth study. Suziane Ungari Cayres, Jacqueline Bexiga Urban, **Santiago Maillane Vanegas**, Ricardo Ribeiro Agostinete, Lucas Gabriel Moraes Chagas, Bruna Camilo Turi Lynch , Romulo Araujo Fernandes. Florianópolis: 2017. v.22 p. s603-s603.

VII Congresso Brasileiro de Metabolismo, Nutrição e Exercício

1- Ganho percentual de densidade mineral óssea de adolescentes praticantes de modalidades esportivas com e sem impacto ao longo de 18 meses. Ricardo Ribeiro Agostinete, **Santiago Maillane Vanegas**, Igor Hideki Ito, Rafael Luiz de Marco, Yuri S. Ventura Faustino da Silva, Romulo Araújo Fernandes. Londrina: 2018. v.1 p.232-232.

2- Ginástica Artística e desenvolvimento ósseo em meninas: ABCD- Growth Study. Isabela Neto Exupério, Romulo Araújo Fernandes, Igor H. Ito, Ricardo Ribeiro Agostinete, **Santiago Maillane Vanegas**, Rafael Luiz de Marco, Andréa W Pereira-de-Jesus, Yuri S Faustino da Silva. Londrina: 2018 v.1 p.232.

Written book chapters (n=01)

1- **Santiago Maillane-Vanegas**, Fábio Santos Lira, Pedro Narciso, Ricardo Ribeiro Agostinete. Atividade Física em diferentes fases da vida. Parte de: Crescimento, Desenvolvimento e Vida Adulta: papel da Nutrição e

Atividade Física. Published on: Nutrição e atividade física na saúde e na doença: do experimento ao clínico- Volume II Ciclo da Vida. Santos: Nutrafis Educação, 2021.

Manuscripts under construction/submitted (n=4)

1- Musculoskeletal pain in adolescents engaged in impact and non-impact sports – ABCD Growth Study. **Santiago Maillane-Vanegas**, Wesley Torres, Jefferson Rosa Cardoso, Marta Gimunová, Evert Verhagen, Rômulo A. Fernandes. Submitted on Journal Pediatric Exercise Science

2- The role of intensity in the association between sports participation and musculoskeletal pain in adolescents: ABCD Growth Study. **Santiago Maillane-Vanengas**, Wesley Torres, C. B. Oliveira, Vanderlei FM, Roald Bahr, Rômulo A. Fernandes. Under construction.

3- Mediating role of organized sports participation on the relationship between body fatness and arterial wall thickness among adolescents: ABCD Growth Study. Wésley Torres, **Santiago Maillane-Vanegas**, Jacqueline Bexiga Urban, Danilo Rodrigues Pereira da Silva, Ricardo Santos Oliveira, Eero A. Haapala, Rômulo Araújo Fernandes. Submitted on Journal of Science and Medicine in Sport.

4- Effects of Muay Thai training compared to circuit training on vascular health of the carotid arteries in the elderly: A randomized clinical trial. Bruna Thamyres Ciccotti Saraiva, Emerson Franchini, Alex Silva Ribeiro, Luis Alberto Gobbo, Marília de Almeida Correia, Luiz Carlos Marques Vanderlei, **Santiago Maillane Vanegas**, Raphael Mendes Ritti-Dias, Rômulo Araújo Fernandes, Diego Giulliano Destro Christofaro. Sumitted on Journal of Science and Medicine in Sport.

Manuscripts accepted and published during PhD course (n=15):

1- Torres, W.; Chagas, L. G. M.; Fernandes, R. A.; Monique Yndawe Castanho Araujo; Jacqueline Bexiga Urban; **Maillane-Vanegas, Santiago**; LYNCH, B.; Sanches C. J.; Nana Kwame Anokye . Relationship between vigorous physical activity and health care costs among adolescents: ABCD Growth Study. BMC Pediatrics, v. 22, p. 141, 2022.

2- **Maillane-Vanegas, Santiago**; Fatoye, F.; Luiz-De-Marco, Rafael; Sanches C. J.; Silva, D. A. S.; Pastre, C. M.; Fernandes, Rômulo A. Low occurrence of musculoskeletal symptoms in swimming? Musculoskeletal symptoms and sports participation in adoles-cents: cross sectional study (ABCD? Growth Study). International Journal of Environmental Research and Public Health, v. 19, p. 3694, 2022. Qualis (ISSN: 1660-4601)2020: A1.

3- Mesquita, E. D.; Exuperio, I. N.; Agostinete R. R.; Luiz-De-Marco, Rafael; Silva, J. C. M.; **Maillane-Vanegas, Santiago**; Kemper C. G. Kemper; Fernandes, Rômulo A. The Combined Relationship of Vitamin D and Weight-Bearing Sports Participation on Areal Bone Density and Geometry Among Adolescents: ABCD - Growth Study. JOURNAL OF CLINICAL DENSITOMETRY, v. 25, p. 674-681, 2022. Citações:4|5 Qualis (ISSN: 1094-6950)2020: A4

4- Torres, W.; **Maillane-Vanegas, Santiago**; Jacqueline Bexiga Urban; Fernandes, R. A. Impact of sports participation on cardiovascular health markers of children and adolescents: Systematic review and meta-

analysis. World Journal of Clinical Pediatrics, v. 11, p. 375-384, 2022. Citações:2 Qualis (ISSN: 2219-2808)2020: C.

5- Agostinete, Ricardo R.; Werneck, André Oliveira; **Maillane-Vanegas, Santiago**; Gracia-Marco, L.; Ubago-Guisado, E.; Constable, A. M.; Fernandes, R. A.; Vlachopoulos, D. The Mediating Role of Lean Soft Tissue in the Relationship between Somatic Maturation and Bone Density in Adolescent Practitioners and Non-Practitioners of Sports. International Journal of Environmental Research and Public Health, v. 18, p. 3008, 2021. Citações:5|5 Qualis (ISSN: 1660-4601)2020: A1.

6- **Maillane-Vanegas, Santiago**; Luiz-De-Marco, Rafael; Narciso, P. H.; Faustino Da Silva Y. S.; Kemper C. G. Kemper; Agostinete, Ricardo R.; Fernandes, Rômulo A. More than Sports Participation: The Role of Ground Reaction Force, Osteocalcin and Lean Soft Tissue on Bone Density Accrual in Adolescents: ABCD Growth Study. JOURNAL OF CLINICAL DENSITOMETRY, v. 25, p. 61-72, 2021. Citações:2|2 Qualis (ISSN: 1094-6950)2020: A4.

7- Luiz-De-Marco, Rafael; Gobbo, Luis Alberto; Castoldi, Robson Chacon; **Maillane-Vanegas, Santiago**; Da Silva Ventura Faustino-Da-Silva, Yuri; Exupério, Isabela Neto; Agostinete, Ricardo Ribeiro; Fernandes, Romulo A. Impact of changes in fat mass and lean soft tissue on bone mineral density accrual in adolescents engaged in different sports: ABCD Growth Study. Archives of Osteoporosis, v. 15, p. 1-8, 2020. Citações:7|8 Qualis (ISSN: 1862-3522)2020: A3.

8- Agostinete, R.; Vlachopoulos, D.; Werneck, A. O.; **Maillane-Vanegas, Santiago**; R. Lynch, Kyle ; Naughton, G; Fernandes, Romulo A. Bone

accrual over 18 months of participation in different loading sports during adolescence. Archives of Osteoporosis, v. 15, p. 1-10, 2020. Citações:9|9 Qualis (ISSN: 1862-3522)2020: A3.

9- Agostinete R. R.; Fernandes, R. A.; Narciso, P. H.; **Maillane-Vanegas, Santiago**; Werneck, A. O.; Vlachopoulos, D. Categorizing ten sports according to bone and soft tissue profiles in adolescents. Medicine and Science in Sports and Exercise, v. 52, p. 2673-2681, 2020. Citações:17|17 Qualis (ISSN: 0195-9131)2020: A1.

10- Maillane-Vanegas, Santiago; Agostinete, Ricardo R.; Lynch, Kyle R.; Ito, Igor H.; Luiz-De-Marco, Rafael; Rodrigues-Junior, Mario A.; Turi-Lynch, Bruna Camilo; Fernandes, Rômulo A. Bone Mineral Density and Sports Participation. Journal Of Clinical Densitometry, v. 23, p. 294-302, 2020. Citações:21|24 Qualis (ISSN: 1094-6950)2020: A4.

11- Narciso, P. H.; Werneck, André Oliveira; De-Marco L.R.; Faustino V. Y.; **Maillane-Vanegas, Santiago**; Agostinete R. R.; Fernandes, R. A. Influential role of lean soft tissue in the association between training volume and bone mineral density among male adolescent practitioners of impact-loading sports: ABCD Growth Study Running title: Training volume, lean soft tissue and bone density. BMC Pediatrics, v. 20, p. 496, 2020. Citações:4|5 Qualis (ISSN: 1471-2431)2020: A1.

12- Luiz-De-Marco, Rafael; Kemper C. G. Kemper; Agostinete, Ricardo R.; Werneck, André Oliveira; **Maillane-Vanegas, Santiago**; Faustino Da Silva Y. S.; Exuperio, I. N. ; Fernandes, Rômulo A. Sports participation and muscle mass affect sex-related differences in bone mineral density in male and female adolescents: A longitudinal study. Sao Paulo Medical

Journal, v. 137, p. 75, 2019. Citações:6|7 Qualis (ISSN: 1516-3180)2020: A4.

13- Exupério, Isabella Neto; Agostinete, Ricardo Ribeiro; Werneck, André Oliveira; **Vanegas, S. M**.; Luiz-De-Marco, Rafael; Mesquita, E. D. L.; Kemper, Han C.G.; Fernandes, Rômulo Araújo. Impact of Artistic Gymnastics on Bone Formation Marker, Density and Geometry in Female Adolescents: ABCD-Growth Study. Journal of Bone Metabolism, v. 26, p. 75, 2019. Citações:11 Qualis (ISSN: 2287-6375)2020: B1.

14- Faustino-Da-Silva, Yuri Da Silva Ventura; Agostinete, Ricardo Ribeiro; Werneck, André Oliveira; **Maillane-Vanegas, Santiago**; Lynch, Kyle Robinson; Exupério, Isabella Neto; Ito, Igor Hideki; Fernandes, Romulo Araújo. Track and Field Practice and Bone Outcomes among Adolescents: A Pilot Study (ABCD-Growth Study). Journal of Bone Metabolism, v. 25, p. 35-42, 2018. Qualis (ISSN: 2287-6375)2020: B1.

15- Maillane-Vanegas, Santiago; Sanches C. J.; Lynch, B.; Christofaro, D. G. D.; Fernandes, Romulo Araújo. Prevalence of sports participation among Brazilian adolescents: a systematic review. RBCDH, v. 20, p. 388, 2018. Citações:2 Qualis (ISSN: 1989-3531)2020: undefined]

8 APPENDICES

Ethical Approvals

UNESP - FACULDADE DE CIÊNCIAS E TECNOLOGIA DO CAMPUS DE PRESIDENTE

Plataforma Brasil

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: ANÁLISE DE COMPORTAMENTOS DE ADOLESCENTES DURANTE O
Pesquisador: ROMULO ARAÚJO FERNANDES
Área Temática:
Versão: 2
CAAE: 57585416.4.0000.5402
Instituição Proponente: UNIVERSIDADE ESTADUAL PAULISTA JULIO DE MESQUITA FILHO
Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 1.677.938

Apresentação do Projeto:
Vide 1º parecer.

Objetivo da Pesquisa:
Vide 1º parecer.

Avaliação dos Riscos e Benefícios:
Vide 1º parecer.

Comentários e Considerações sobre a Pesquisa:
Os pesquisadores esclareceram que ainda não iniciaram a pesquisa, pois estão aguardando o auxílio pesquisa da FAPESP e alteraram o cronograma para início da coleta de dados para 05 de setembro de 2016.

Considerações sobre os Termos de apresentação obrigatória:
O Termo de compromisso foi enviado, conforme solicitado, e está correto.

Recomendações:
Não há.

Conclusões ou Pendências e Lista de Inadequações:
O presente estudo não fere princípios éticos segundo a Resolução CNS 466/2012.

Endereço: Rua Roberto Simonsen, 305
Bairro: Centro Educacional **CEP:** 19.060-900
UF: SP **Município:** PRESIDENTE PRUDENTE
Telefone: (18)3229-5315 **Fax:** (18)3229-5353 **E-mail:** cep@fct.unesp.br

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UNESP - FACULDADE DE CIÊNCIAS E TECNOLOGIA DO CAMPUS DE PRESIDENTE

Continuação do Parecer: 1.677.938

Considerações Finais a critério do CEP:

Em reunião realizada no dia 12.08.2016, o Comitê de Ética em Pesquisa da Faculdade de Ciências e Tecnologia - Unesp - Presidente Prudente, em concordância com o parecerista, considerou o projeto APROVADO.

Obs: Lembramos que ao finalizar a pesquisa, o (a) pesquisador (a) deverá apresentar o relatório final.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_717347.pdf	05/08/2016 10:35:59		Aceito
Cronograma	EsclarecimentoCEPc.pdf	05/08/2016 10:33:14	Alessandra Madia Mantovani	Aceito
Outros	TermoCompromisso.pdf	05/08/2016 10:15:25	Alessandra Madia Mantovani	Aceito
Outros	CEP_UNILAB.pdf	05/07/2016 08:39:32	Alessandra Madia Mantovani	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE.doc	22/06/2016 09:37:33	Alessandra Madia Mantovani	Aceito
Folha de Rosto	Termo_CEP.pdf	21/05/2016 12:55:37	Alessandra Madia Mantovani	Aceito
Cronograma	CRONOGRAMA.docx	17/05/2016 15:26:57	Alessandra Madia Mantovani	Aceito
Outros	Termos.pdf	17/05/2016 15:23:45	Alessandra Madia Mantovani	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	termo_assentimento.doc	17/05/2016 15:19:32	Alessandra Madia Mantovani	Aceito
Declaração de Instituição e Infraestrutura	Declaracao_LIVE.pdf	17/05/2016 15:18:53	Alessandra Madia Mantovani	Aceito
Projeto Detalhado / Brochura Investigador	projeto_adolescentes.doc	17/05/2016 15:17:40	Alessandra Madia Mantovani	Aceito

Situação do Parecer:

Aprovado

Endereço: Rua Roberto Simonsen, 305
Bairro: Centro Educacional **CEP:** 19.060-900
UF: SP **Município:** PRESIDENTE PRUDENTE
Telefone: (18)3229-5315 **Fax:** (18)3229-5353 **E-mail:** cep@fct.unesp.br

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UNESP - FACULDADE DE CIÊNCIAS E TECNOLOGIA DO CAMPUS DE PRESIDENTE

Continuação do Parecer: 1.677.938

Necessita Apreciação da CONEP:
Não

PRESIDENTE PRUDENTE, 15 de Agosto de 2016

Assinado por:
Edna Maria do Carmo
(Coordenador)

Endereço: Rua Roberto Simonsen, 305
Bairro: Centro Educacional **CEP:** 19.060-900
UF: SP **Município:** PRESIDENTE PRUDENTE
Telefone: (18)3229-5315 **Fax:** (18)3229-5353 **E-mail:** cep@fct.unesp.br

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UNESP - FACULDADE DE CIÊNCIAS E TECNOLOGIA DO CAMPUS DE PRESIDENTE

Plataforma Brasil

Continuação do Parecer: 1.677.938

Necessita Apreciação da CONEP:
Não

PRESIDENTE PRUDENTE, 15 de Agosto de 2016

Assinado por:
Edna Maria do Carmo
(Coordenador)

Endereço: Rua Roberto Simonsen, 305
Bairro: Centro Educacional **CEP:** 19.060-900
UF: SP **Município:** PRESIDENTE PRUDENTE
Telefone: (18)3229-5315 **Fax:** (18)3229-5353 **E-mail:** cep@fct.unesp.br

Público | Pesquisador | Alterar Meus Dados

ROMULO ARAÚJO FERNANDES - *Pesquisador* | V5.0

Cadastros

sua sessão expira em: 31min 01

DETALHAR NOTIFICAÇÃO

DADOS DA VERSÃO DO PROJETO DE PESQUISA

Título da Pesquisa: Prática do voleibol e densidade mineral óssea em jovens da cidade de Presidente Prudente ¿ SP
Pesquisador Responsável: ROMULO ARAÚJO FERNANDES
Área Temática:
Versão: 1
CAAE: 02891112.6.0000.5402
Submetido em: 07/05/2012
Instituição Proponente: UNIVERSIDADE ESTADUAL PAULISTA JULIO DE MESQUITA FILHO
Situação da Versão do Projeto: Aprovado
Localização atual da Versão do Projeto: Pesquisador Responsável
Patrocinador Principal: UNIVERSIDADE ESTADUAL PAULISTA JULIO DE MESQUITA FILHO

NOTIFICAÇÃO COORDENADOR

Comprovante de Recepção: PB_COMPROVANTE_RECEPCAO_28911

DADOS DA NOTIFICAÇÃO

Tipo de Notificação: Envio de Relatório Parcial
Detalhe:
Justificativa: Relatório parcial das atividades.
Data do Envio: 18/02/2013
Situação da Notificação: Aprovado

DOCUMENTOS DO PROJETO DE PESQUISA

- Versão Atual Aprovada (PO) - Versão 1
- Projeto Completo

Tipo de Documento	Situação	Arquivo	Postagem	Ações

HISTÓRICO DE TRÂMITES

2185 Invitation letter

UNIVERSIDADE ESTADUAL PAULISTA
"JÚLIO DE MESQUITA FILHO"
Câmpus de Presidente Prudente

CARTA CONVITE

Caro Pai, Mãe ou Responsável legal,

Meu nome é Rômulo Fernandes, Professor de Educação Física da Universidade Estadual Paulista – UNESP, em Presidente Prudente. O motivo do senhor(a) receber esta carta convite é porque o adolescente sob sua reponsabilidade foi convidado a participar de nossa pesquisa: "Análise do comportamento de crianças ao longo do crescimento".

Nesta pesquisa, nossas avaliações serão realizadas apenas uma vez no ano (a próxima avaliação será dentro de doze meses), envolvem medidas de ganho de peso corporal e altura, crescimento do esqueleto e do sistema cardiovascular, bem como coleta de sangue feita por enfermeira. Estas medidas são realizadas dentro da UNESP por pessoal treinado, tomando total cuidado para não causar qualquer tipo de desconforto ao adolescente. Após as análises nos comprometemos a preparar um relatório individual do jovem, que será entregue ao senhor(a). Este relatório é muito interessante para acompanhar o crescimento e desenvolvimento do jovem, bem como, se ele pratica atividade física suficiente. Destaco que não cobraremos nada por tais avaliações, pois somos uma universidade pública, mantida com impostos estaduais.

Maiores informações sobre como nos contatar sobre qualquer dúvida podem ser encontradas nos documentos que foram entregues aos jovens. Por favor, nos contate sobre qualquer dúvida.

Obrigado,

Rômulo Araújo Fernandes

Professor de Crescimento e Desenvolvimento da UNESP

Faculdade de Ciências e Tecnologia
Departamento de Educação Física
Rua Roberto Simonsen, 305 CEP 19060-900 Presidente Prudente SP
Tel 18 3229-5710 fax 18 3221-5681 depedfisica@fct.unesp.br

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2188 Declaration of Interest

UNIVERSIDADE ESTADUAL PAULISTA
"JÚLIO DE MESQUITA FILHO"
Câmpus de Presidente Prudente

DECLARAÇÃO DE INTERESSE

O grupo de investigações cientificas relacionadas a atividade física (GICRAF), vem por meio deste demonstrar interesse em realizar avaliações física nos atletas da Secretária Municipal de Esportes de Presidente Prudente.

Se trata de uma pesquisa sob orientação do Professor Dr. Romulo Araújo Fernandes, com o objetivo de analisar o efeito de diversas modalidades esportivas no crescimento ósseo de adolescentes entre 11 e 17 anos. As modalidades engajadas no estudo são: Basquete, Futebol, Vôlei, Natação, Caratê, Kung Fu.

Vale ressaltar que as avalições ocorrerão somente em dois momentos no período de um ano, não atrapalhando assim a logística de treinamento, através da absortiometria de Raio-X de dupla energia (DEXA) sendo considerado um dos melhores métodos para avaliação de composição corporal.

Acreditamos que os resultados fornecidos, podem ser utilizados para periodizações e treinamentos individualizados dos atletas, colocando assim os membros do GICRAF a disposição para sanar dúvidas e interpretar resultados juntamente com os treinadores e professores.

Contamos com apoio e compreensão de vossa senhoria.

Atenciosamente,

Prof. Dr. Romulo Araújo Fernandes
Professor Responsável

GRUPO DE INVESTIGAÇÕES CIENTÍFICAS RELACIONADAS A ATIVIDADE FÍSICA
Departamento de Educação Física -Centro Educacional
Rua Roberto Simonsen, 305 CEP: 19060-050 Presidente Prudente – SP
Contato: 3229-5712

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Cover Sheet

Prezados pais e/ou responsáveis

Venho por meio desta convidar seu (sua) filho(a) para participar da pesquisa intitulada ***'Análise de comportamentos de adolescentes durante o crescimento'*** desenvolvida pelo Laboratório de Investigação em Exercício (LIVE), do Departamento de Educação Física da UNESP, Presidente Prudente.

Seguem os documentos que apresentam maiores detalhes do projeto de pesquisa. Se o (a) senhor (a) consentir na participação de seu filho (a), peço a gentileza de fazer o preenchimento dos mesmos.

Qualquer dúvida a respeito desta pesquisa, por favor, entre em contato com os pesquisadores responsáveis.

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2194 Consent form

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Título da Pesquisa: "Análise de Comportamentos de Adolescentes Durante o Crescimento"

Nome do Pesquisador: Prof. Dr. Rômulo Araújo Fernandes

O seu filho(a) está sendo convidado (a) a participar desta pesquisa que tem como finalidade **identificar a relação da atividade física com a saúde e o crescimento de jovens**. Participarão da pesquisa, adolescentes de ambos os sexos e idade entre 11 e 20 anos. Ao participar deste estudo, o sr(a) permitirá que o seu filho (a): seja entrevistado (preencha questionários), tenha a pressão arterial aferida, peso / estatura medidos, participe de uma coleta sanguínea, exame de ultrassom e uma espécie de radiografia de todos os ossos do corpo realizado na UNESP. Além disso, o jovem utilizará um relógio por um período de sete dias, o qual contará o número de passos dados ao longo do dia. Todas estas avaliações e entrevistas serão realizadas em, no máximo, três dias (máximo 30 minutos por dia) e serão feitas apenas uma vez por ano. Pretende-se acompanhá-lo anualmente. O jovem sob sua responsabilidade tem total liberdade de se recusar a participar do estudo, sem sofrer qualquer tipo de prejuízo. Além disso, sempre que quiser, poderá pedir mais informações sobre a pesquisa através do telefone do pesquisador do projeto e, se necessário, através do telefone do Comitê de Ética em Pesquisa.

O (a) sr(a) não terá nenhum tipo de despesa para participar desta pesquisa, bem como, nada será pago pela participação do jovem. Os únicos riscos envolvidos na participação deste estudo estão relacionados à possibilidade de desconforto durante a coleta de sangue. Os procedimentos adotados nesta pesquisa obedecem aos Critérios da Ética em Pesquisa com Seres Humanos conforme Resolução no. 196/96 do Conselho Nacional de Saúde. Nenhum dos procedimentos usados oferece riscos à sua dignidade.

Todas as informações coletadas neste estudo são estritamente confidenciais. Somente o pesquisador e seu orientador terão conhecimento da identidade do jovem e nos comprometemos a mantê-la em sigilo ao publicar os resultados dessa pesquisa. O sr(a) receberá posteriormente os resultados de todos os exames feitos pelo jovem. O pesquisador se compromete a divulgar os resultados obtidos, respeitando-se o sigilo das informações coletadas, conforme previsto no item anterior.

Após estes esclarecimentos, solicitamos o seu consentimento de forma livre permitindo a participação do jovem sob sua responsabilidade na pesquisa. Portanto preencha, por favor, os itens que se seguem: Confirmo que recebi cópia deste termo de consentimento, e autorizo a execução do trabalho de pesquisa e a divulgação dos dados obtidos neste estudo. Por favor, **não assine esse termo se ainda tiver dúvida a respeito**.

Consentimento Livre e Esclarecido

Tendo em vista os itens acima apresentados, eu, de forma livre e esclarecida, manifesto meu consentimento em participar da pesquisa:

Adolescente: _____ DATA: ____ / ___ / _____

TELEFONE RESIDENCIAL: _____ CELULAR: _____ E-MAIL: _____

Assinaturas:

_____	_____	_____
Responsável pelo Participante	**Pesquisador**	**Orientador**

Pesquisador: Prof. Dr. Rômulo Araújo Fernandes **Telefone:** 3229-5712

Coordenadora do Comitê de Ética em Pesquisa: Profa. Dra. Edna Maria do Carmo

Vice-Coordenadora: Profa. Dra. Andréia Cristiane Silva Wiezzel

Telefone do Comitê: 3229-5315 ou 3229-5526

E-mail cep@fct.unesp.br

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2196 Assent form

UNIVERSIDADE ESTADUAL PAULISTA
"JÚLIO DE MESQUITA FILHO"
Câmpus de Presidente Prudente

TERMO DE ASSENTIMENTO

(No caso do menor entre 12 a 18 anos)

Você está sendo convidado (a) como voluntário (a) a participar da pesquisa **"ANÁLISE DE COMPORTAMENTOS DE ADOLESCENTES DURANTE O CRESCIMENTO"**. Nesta pesquisa pretendemos **identificar a relação da atividade física com a saúde e o crescimento de jovens**. O motivo que nos leva a estudar esse assunto são decorrentes aos **benefícios que a prática esportiva entre crianças e adolescentes pode proporcionar a saúde, e evitar também a adoção de comportamentos de risco durante a juventude.** Para esta pesquisa adotaremos o(s) seguinte(s) procedimento(s): entrevista (preenchimento de questionários), medida a pressão arterial, peso / estatura, coleta sanguínea, exame de ultrassom e uma espécie de radiografia de todos os ossos do corpo realizado na UNESP. Além disso, o jovem utilizará um relógio por um período de sete dias, o qual contará o número de passos dados ao longo do dia. Todas estas avaliações e entrevistas serão realizadas em, no máximo, três dias (máximo 30 minutos por dia) e serão feitas apenas uma vez por ano. Pretende-se acompanha-lo anualmente.

Para participar desta pesquisa, o responsável por você deverá autorizar e assinar o termo de consentimento livre e esclarecido. Você não terá nenhum custo, nem receberá qualquer vantagem financeira. Você será esclarecido (a) em qualquer aspecto que desejar e estará livre para participar ou recusar-se. O responsável por você poderá retirar o consentimento ou interromper a sua participação a qualquer momento. A sua participação é voluntária e a recusa em participar não acarretará qualquer penalidade ou modificação na forma em que é atendido (a) pelo pesquisador que irá tratar a sua identidade com padrões profissionais de sigilo. Esta pesquisa não apresenta **risco** ao voluntário. Os resultados estarão à sua disposição quando finalizada. Os dados e instrumentos utilizados na pesquisa ficarão arquivados com o pesquisador responsável por um período de 5 anos, e após esse tempo serão destruídos. Este termo de consentimento encontra-se impresso em duas vias: uma via será arquivada pelo pesquisador responsável, e a outra será fornecida a você. Os pesquisadores tratarão a sua identidade com padrões profissionais de sigilo, atendendo a legislação brasileira (Resolução Nº 466/12 do Conselho Nacional de Saúde), utilizando as informações somente para os fins acadêmicos e científicos.

Eu, _____, portador (a) do documento de Identidade _____ **(se já tiver documento),** fui informado (a) dos objetivos da

presente pesquisa, de maneira clara e detalhada e esclareci minhas dúvidas. Sei que a qualquer momento o meu responsável poderá modificar a decisão de participar se assim o desejar. Tendo o

consentimento do meu responsável já assinado, declaro que concordo em participar dessa pesquisa. Recebi uma cópia deste termo de assentimento e me foi dada a oportunidade de ler e esclarecer as minhas *dúvidas.*

Presidente Prudente, ____ de _____ de 20___.

_____ _____

Assinatura do (a) menor Assinatura do (a) pesquisador (a)

Em caso de dúvidas com respeito aos aspectos éticos desta pesquisa, você poderá consultar:

Pesquisador Responsável: Prof. Dr. Romulo Araújo Fernandes
Fone: 3229-5712
E-mail: romulo@fct.unesp.br

Coordenadora do Comitê de Ética em Pesquisa: Profa. Dra. Edna Maria do Carmo

Vice-Coordenadora: Profa. Dra. Andreia Cristiane Silva Wiezzel

Telefone do Comitê: 3229-5315 ou 3229-5526

E-mail cep@fct.unesp.br

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UNIVERSIDADE ESTADUAL PAULISTA "JÚLIO DE MESQUITA FILHO" Campus de Presidente Prudente

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Laboratório de Investigação em Exercício – LIVE

Cadastro

Nome completo (sem abreviações e letra legível): **Data da avaliação:** ___/___/____

_____

Data de nascimento:___/___/____ Idade:_____ Sexo: (_)feminino ( )masculino

Etnia: (_) branco ( ) negro ( ) oriental ( ) outros

Ano escolar: ( ) 6° ( )7° ( )8° ( )9° Ensino Médio: ( ) 1° ( )2° ( )3°

Período: ( ) Manhã ( ) Tarde ( ) Noite ( ) Integral

Turma: ( )A ( )B ( )C ( )D ( )E ( )F

Modalidade _____ Posição _____ Destro ( ) Canhoto ( )

Principal prova: _____

Estilo: _____

Endereço_____

Celular_____ Telefone fixo_____ e-mail:_____

2° Contato

Nome do responsável pelo contato _____ ( ) Pai ( ) Mãe ( ) Outros? _____

Endereço_____

Celular_____ Telefone fixo_____ e-mail:_____

Altura dos pais (_____ cm) pai (_____ cm) mãe

Avaliação física

Peso:_____Kg Estatura:_____cm ATC:_____ cm

PAS:_____/_____/_____ PAD:_____/_____/_____ FC:_____/_____/_____

HÁBITOS ALIMENTARES

Questão 1. Em uma semana normal, quantos dias da semana você faz as seguintes refeições?				
	Nenhum	**1 a 2 dias**	**3 a 5 dias**	**Todos os dias**
Café da manhã	( )	( )	( )	( )
Lanche da manhã	( )	( )	( )	( )
Almoço	( )	( )	( )	( )
Lanche da tarde	( )	( )	( )	( )
Jantar	( )	( )	( )	( )
Lanche antes de dormir	( )	( )	( )	( )

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Durante a última semana você comeu...

1.Banana	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )
2.Biscoito doce?	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )
3.Leite integral?	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )
4.Bolos?	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )
5.Bebidas lácteas (leite, iogurte, etc.)?	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )
6.Milho e outros pratos com milho?	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )
7.Salgados fritos e assados?	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )
8.Ovos?	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )
9.Macarrão?	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )
10.Doces?	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )
11.Frango/Aves?	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )
12.Refrigerantes?	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )
13. Comidas gordurosas?	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )
14.Sucos e refrescos?	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )
15. Carne bovina?	Não comeu ( )	Poucas vezes ( )	Quase todos os dias ( )

Em uma semana normal, com qual frequência você consome esses alimentos no seu dia a dia?			
Salmão	Nunca ( )	As vezes ( )	Quase todos os dias ( )
Sardinha	Nunca ( )	As vezes ( )	Quase todos os dias ( )
Gema do ovo	Nunca ( )	As vezes ( )	Quase todos os dias ( )
Queijo cheddar	Nunca ( )	As vezes ( )	Quase todos os dias ( )
Fígado	Nunca ( )	As vezes ( )	Quase todos os dias ( )
Cogumelo	Nunca ( )	As vezes ( )	Quase todos os dias ( )
Manteiga	Nunca ( )	As vezes ( )	Quase todos os dias ( )
Iogurte desnatado	Nunca ( )	As vezes ( )	Quase todos os dias ( )

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Sobre ingestão de café da manhã, em uma semana normal

Quantos dias da semana (Segunda a Sexta) você faz ingestão de café da manhã? _____

Quantos dias do final de semana (Sabado e Domingo) você faz ingestão de café da manhã? _____

Qual o tipo de alimento geralmente consumido? (Segunda a Sexta) OBS: Estimar a quantidade

Exemplo: 1 xícara de café, e 1 pão com manteiga
1 copo de refrigerante e 1 maçã ou um copo de água

_____

Qual o tipo de alimento geralmente consumido? (Sabado e Domingo) OBS: Estimar a quantidade

Exemplo: 1 xícara de café, e 1 pão com manteiga
1 copo de refrigerante e 1 maçã ou um copo de água

_____

Durante a semana (Segunda a Sexta) você faz ingestão do café da manhã?
( ) em casa ( ) na escola ( ) em outro local? Onde _____ ( ) Não consome café da manhã

Quando você não ingere café da manhã, qual é o motivo? Deixar que o adolescente descreva o motivo. Exemplo: Não tenho tempo pela manhã, Não gosto de tomar café da manhã, Não quero engordar etc.

_____

Escolaridade do pai

Ensino fundamental completo? ( ) sim ( ) não

Ensino médio completo? ( ) sim ( ) não

Ensino superior completo ? ( ) sim ( ) não

Pós-graduação ? ( ) sim ( ) não

Escolaridade da mãe

Ensino fundamental completo? ( ) sim ( ) não

Ensino médio completo? ( ) sim ( ) não

Ensino superior completo ? ( ) sim ( ) não

Pós-graduação ? ( ) sim ( ) não

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QUESTIONÁRIO DO SONO

Por favor, assinale o número que melhor descreva sua resposta:	Nunca	Muito rara-mente	Rara-mente	Às vezes	Freqüente-mente	Muito freqüente-mente	Sempre
1 – Você tem dificuldade em adormecer à noite?	1	2	3	4	5	6	7
2 – Você acorda de madrugada e não consegue adormecer e novo?	1	2	3	4	5	6	7
3 – Você toma remédios para dormir ou tranqüilizantes?	1	2	3	4	5	6	7
4 – Você dorme durante o dia? (sem contar cochilos ou sonecas programadas)	1	2	3	4	5	6	7
5 – Ao acordar de manhã, você ainda se sente cansado (a)?	1	2	3	4	5	6	7
6 – Você ronca à noite? (que você saiba)	1	2	3	4	5	6	7
7 – Você acorda durante a noite?	1	2	3	4	5	6	7
8 – Você acorda com dor de cabeça?	1	2	3	4	5	6	7
9 – Você sente cansaço sem ter nenhum motivo aparente?	1	2	3	4	5	6	7
10 – Você tem sono agitado? (mudanças constantes de posição ou movimentos de pernas/braços)	1	2	3	4	5	6	7

Geralmente, durante a semana (segunda a sexta), qual o horário que você vai dormir? _____

Geralmente, durante a semana (segunda a sexta), qual o horário que você acorda? _____

Geralmente aos finais de semana (sábado e domingo), qual o horário que você vai dormir? _____

Geralmente aos finais de semana (sábado e domingo), qual o horário que você acorda? _____

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1. Você estuda? ( ) Sim ( ) Não				
Na Escola:				
2. Você permanece sentado: (1) Nunca (2) Raramente (3) Algumas vezes (4) Frequentemente (5) Sempre				
3. Você fica em pé parado: (1) Nunca (2) Raramente (3) Algumas vezes (4) Frequentemente (5) Sempre				
4. Você necessita caminhar: (1) Nunca (2) Raramente (3) Algumas vezes (4) Frequentemente (5) Sempre				
5. Você necessita carregar algo: (1)Nunca (2) Raramente (3) Algumas vezes (4) Frequentemente (5) Sempre				
6. Após um dia de estudo você se sente cansado (fisicamente):				
(1) – nunca	(2) – raramente	(3) – algumas vezes	(4) – frequentemente	(5) – muito frequentemente
7. Para realizar as atividades na escola você transpira (por esforço):				
(1) – nunca	(2) – raramente	(3) – algumas vezes	(4) – frequentemente	(5) – muito frequentemente
8. Na escola, você acredita que suas atividades são fisicamente:				
(1) – muito leve	(2) – leve	(3) – moderado	(4) – intenso	(5) – muito intenso
Atividades esportivas e programa de exercícios físicos				
9. Você prática algum tipo de esporte, vai à academia ou faz caminhada/corrida?				
(1) – sim		(2) – não		
9.1 Este esporte/programa de exercícios físicos apresenta uma intensidade:				
(1) – baixa	(2) – moderada		(3) – elevada	
9.2 Durante quantas horas por SEMANA você pratica esse esporte/programa de exercícios?				
(1) <1 h	(2) 1 – 2 h	(3) 2 – 3 h	(4) 3 – 4 h	(5) > 4 h
9.3 A quanto tempo você já prática esse esporte/programa de exercícios físicos?				
(1) <1 mês	(2) 1 – 3 meses	(3) 4 – 6 meses	(4) 7 – 9 meses	(5) > 9 meses

Em comparação com pessoas de mesma idade, você acredita que as atividades que realiza durante seu tempo livre são fisicamente:
(5) - muito elevadas (4) – elevadas (3) – iguais (2) – baixas (1) – muito baixas

Nas atividades de lazer e de ocupação de tempo livre você transpira:
(5) - muito frequentemente (4) – frequentemente (3) – algumas vezes (2) – raramente (1) – nunca

Nas atividades de lazer e de ocupação de tempo livre você pratica esporte:
(1) – nunca (2) – raramente (3) – algumas vezes (4) – frequentemente (5) – sempre

<u>Atividades de ocupação do tempo livre</u>

Nas atividades de lazer você assiste à TV:
(1) – nunca (2) – raramente (3) – algumas vezes (4) – frequentemente (5) – sempre
Nas atividades de lazer com qual frequência você faz caminhada:
(1) – nunca (2) – 1 dia (3) – 2 a 3 dias (4) – 4 a 5 dias (5) – todos os dias
Nas atividades de lazer você anda de bicicleta:
(1) – nunca (2) – raramente (3) – algumas vezes (4) – frequentemente (5) – sempre

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Durante quanto tempo ao dia você caminha e/ou anda de bicicleta para ir ao trabalho e/ou à escola e/ou às compras e/ou ao treino?
(1) < 5 minutos (2) 5 – 15 minutos (3) 15 – 30 minutos (4) 30 – 45 minutos (5) > 45 minutos

1. Você trabalha? ( ) Sim ( ) Não				
No trabalho:				
2. Você permanece sentado: (1) Nunca (2) Raramente (3) Algumas vezes (4) Frequentemente (5) Sempre				
3. Você fica em pé parado: (1) Nunca (2) Raramente (3) Algumas vezes (4) Frequentemente (5) Sempre				
4. Você necessita caminhar: (1) Nunca (2) Raramente (3) Algumas vezes (4) Frequentemente (5) Sempre				
5. Você necessita carregar algo: (1)Nunca (2) Raramente (3) Algumas vezes (4) Frequentemente (5) Sempre				
6. Após um dia de trabalho você se sente cansado (fisicamente):				
(1) – nunca	(2) – raramente	(3) – algumas vezes	(4) – frequentemente	(5) – muito frequentemente
7. Para realizar as atividades no trabalho você transpira (por esforço):				
(1) – nunca	(2) – raramente	(3) – algumas vezes	(4) – frequentemente	(5) – muito frequentemente
8. No trabalho, você acredita que suas atividades são fisicamente:				
(1) – muito leve	(2) – leve	(3) – moderado	(4) – intenso	(5) – muito intenso
Atividades esportivas e programa de exercícios físicos				
9. Você prática algum tipo de esporte, vai à academia ou faz caminhada/corrida?				
(1) – sim		(2) – não		
9.1 Este esporte/programa de exercícios físicos apresenta uma intensidade:				
(1) – baixa	(2) – moderada		(3) – elevada	
9.2 Durante quantas horas por SEMANA você prática esse esporte/programa de exercícios?				
(1) <1 h	(2) 1 – 2 h	(3) 2 – 3 h	(4) 3 – 4 h	(5) > 4 h
9.3 A quanto tempo você já prática esse esporte/programa de exercícios físicos?				
(1) <1 mês	(2) 1 – 3 meses	(3) 4 – 6 meses	(4) 7 – 9 meses	(5) > 9 meses

(1) Você faz alguma suplementação?
Não ( ) Sim ( ).
Se sim, qual finalidade? ( ) Crescimento ( ) Ganho de massa muscular ( ) Emagrecimento

Se for atleta, continue respondendo abaixo
(2) Há quanto tempo você prática esta modalidade esportiva?
Anos: _____ e Meses: _____
(3) A quantidade semanal (horas por semana) de treino:
Quantos dias na semana você treina? _____
Quanto tempo por dia você treina? Horas: _____ Minutos: _____
(4) Você já praticou alguma outra atividade esportiva por mais de doze meses?
Não ( ) Sim ( )
Se sim, qual? _____

(5) Você tem praticado/praticou Musculação nesse período? Sim ( ) Não ( )
Caso sim: Quantos tempo: ____ meses Geralmente, quantos dias na semana ____

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Sobre fratura óssea

(6) Fratura óssea últimos 12 meses? Sim ( ) Não ( ) Data aproximada ___ / ___ / 20__
Causa:
Acidente carro/moto-( ) Queda/plano-( ) Queda/descida-( ) Em escadas/sarjeta ( ) Esporte-( )
Contato-Sim ( ) ou Não ( ) Como-Competição ( ) ou Treino ( )
Lugar: Dedo dos pés ( ), pés ( ), tornozelo ( ), perna ( ), joelho ( ), quadril ( ), tronco ( ), dedo das mãos ( ), mão ( ), pulso ( ), braço e antebraço ( ), cotovelo ( ), ombro ( ), outro. Qual? _____

(6.1) Fratura óssea últimos 12 meses? Sim ( ) Não ( ) Data aproximada ___ / ___ / 20__
Causa:
Acidente carro/moto-( ) Queda/plano-( ) Queda/descida-( ) Em escadas/sarjeta ( ) Esporte-( )
Contato-Sim ( ) ou Não ( ) Como-Competição ( ) ou Treino ( )
Lugar: Dedo dos pés ( ), pés ( ), tornozelo ( ), perna ( ), joelho ( ), quadril ( ), tronco ( ), dedo das mãos ( ), mão ( ), pulso ( ), braço e antebraço ( ), cotovelo ( ), ombro ( ), outro. Qual? _____

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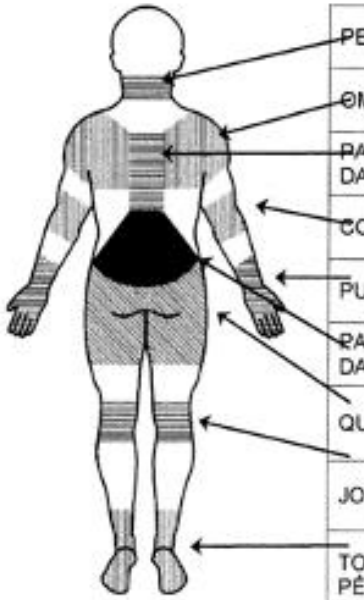

	Nos últimos 12 meses, você teve problemas (como dor, formigamento/ dormência) em:	Nos últimos 12 meses, você foi impedido(a) de realizar atividades normais (por exemplo: trabalho, atividades domésticas e de lazer) por causa desse problema em:	Nos últimos 12 meses, você consultou algum profissional da área da saúde (médico, fisioterapeuta) por causa dessa condição em:	Nos últimos 7 dias, você teve algum problema em?
PESCOÇO	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim
OMBROS	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim
PARTE SUPERIOR DAS COSTAS	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim
COTOVELOS	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim
PUNHOS/MÃOS	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim
PARTE INFERIOR DAS COSTAS	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim
QUADRIL/ COXAS	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim
JOELHOS	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim
TORNOZELOS/ PÉS	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim	☐ Não ☐ Sim

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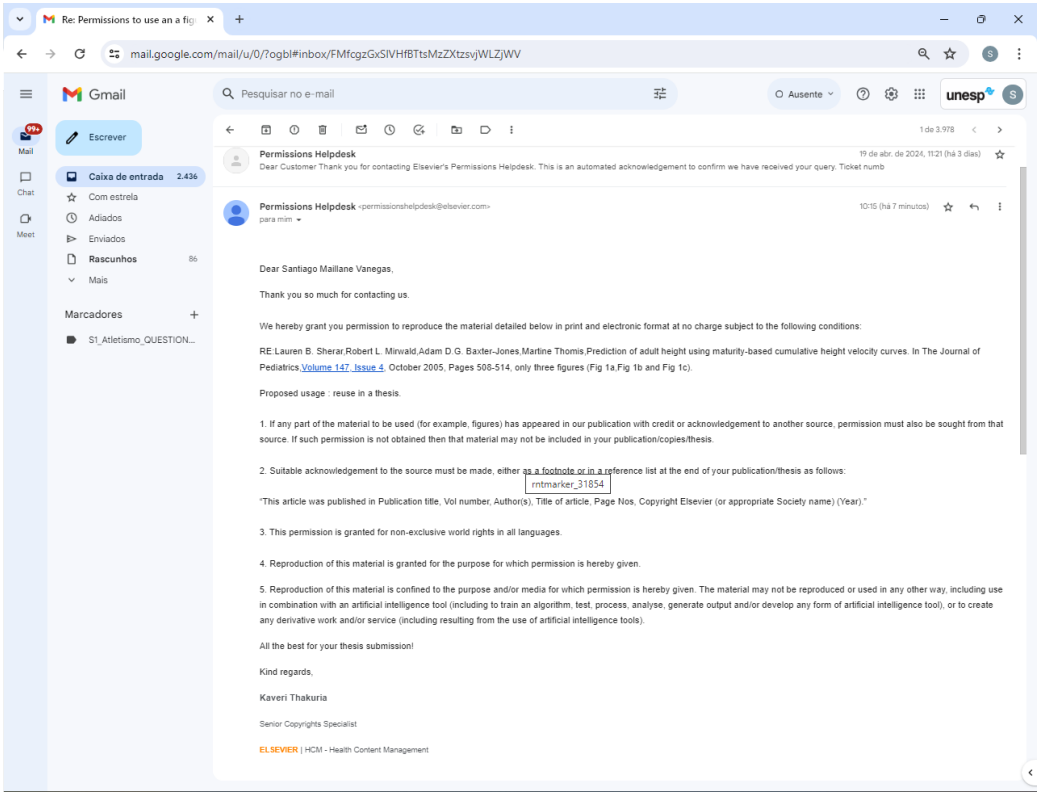

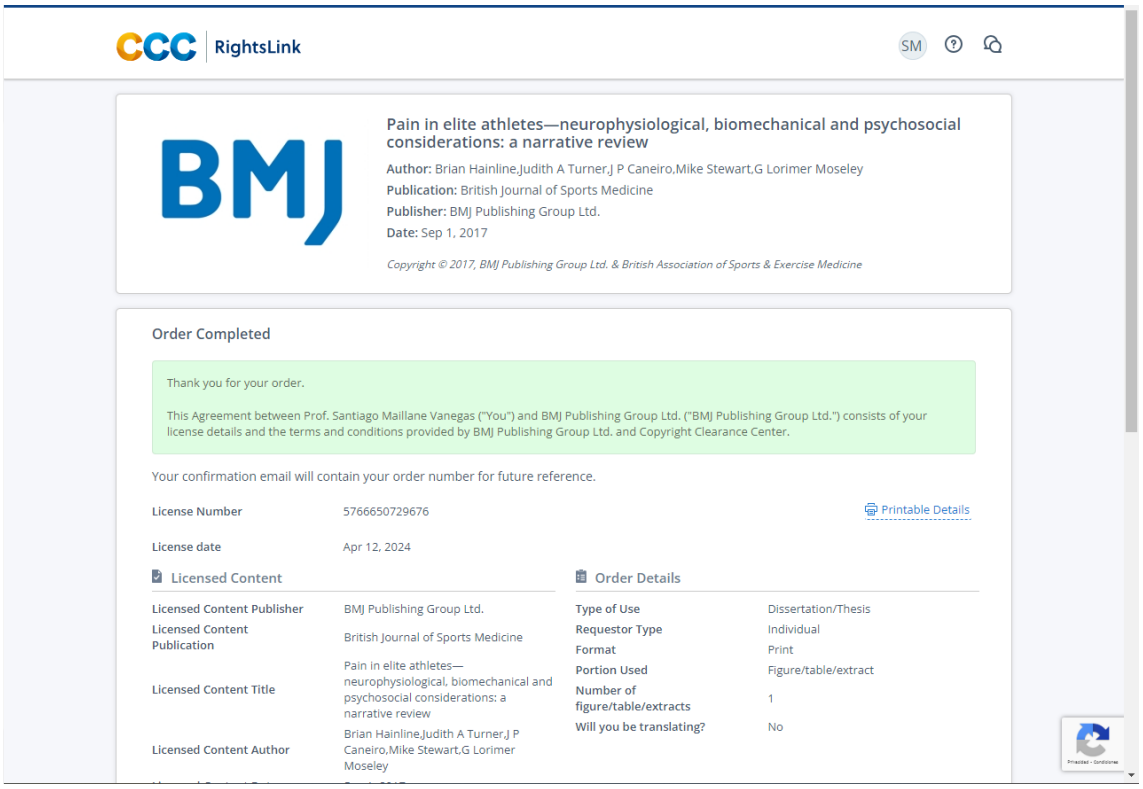

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Pain in elite athletes—neurophysiological, biomechanical and psychosocial considerations: a narrative review

Author: Brian Hainline,Judith A Turner,J P Caneiro,Mike Stewart,G Lorimer Moseley
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