

1 **Original Article**

2 **Impact of sports participation on incidence of bone traumatic fractures and health care costs**
3 **among adolescents: ABCD – Growth Study**

4
5 **ABSTRACT**

6 *Objective:* To analyze the risk of bone traumatic fractures according to the engagement in
7 sports, as well as to identify the potential impact of sports participation and traumatic
8 fractures on health care costs among adolescents. *Methods:* This is a longitudinal 12-months
9 follow-up study of 285 adolescents of both sexes in Brazil. We assessed the occurrence of
10 traumatic fractures and health care services (hospitalizations, medicine use, medical
11 consultations and exams) by phone contact every single month for 12 months. Adolescents
12 were divided into four groups according to sport characteristics: non-sport (n= 104), non-
13 impact sport (swimming [n= 34]), martial arts (n= 49 [judo, karate, kung-Fu]) and impact sports
14 (n= 98 [track-and-field, basketball, gymnastics, tennis, and baseball]). *Results:* The incidence
15 of new fractures was 2.1%. The overall costs accounted during the 12-month follow-up were
16 US\$ 3,259.66. Swimmers (US\$ 13.86) had higher health care costs than non-sport (US\$ 1.82),
17 martial arts (US\$ 2.23) and impact sports (US\$ 2.32). *Conclusion:* swimming seems to be
18 related to higher health care costs among adolescents.

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20 **Keywords:** Athletic Injuries; Economics; Bone; Pediatrics

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1 **1. Introduction**

2 Physical activity has been pointed out as an important behavior leading to better
3 health and growth among pediatric groups [1]. Sports participation -a subset of leisure
4 physical activity- is the most relevant manifestation of exercise during adolescence, being a
5 valuable way to meet physical activity guidelines. In terms of health benefits, sports
6 participation is capable of promoting cardiovascular, metabolic and psychological aspects
7 during pediatric ages more significantly than other physical activity domains [1–4].

8 Another health aspect linked to sports participation is its osteogenic effect on skeleton,
9 which has been widely investigated in adolescence, mainly due to its potential role in the
10 prevention of osteoporosis later in life [2,5–7]. However, even with sports participation in
11 early life improving bone parameters during adulthood, the osteogenic effect creates a
12 complicated situation, mainly because mechanical load generated during sports (which is
13 essential to estimate bone formation) [2,8] can lead to stress and traumatic fractures.

14 It is not possible to ignore the fact that physical actions embraced by different sports
15 (e.g. running, jumping, physical contact with other players) can increase the risk of any adverse
16 event, such as injuries and fractures. An American survey investigating pediatric orthopedic
17 injuries showed that the highest total hospitalization charges were among children with femur
18 fractures and adolescents with vertebral fractures [9]. A study with rugby players found that
19 2% of the players need medical care after the tournament and for these players, average
20 treatment costs were high (US\$ 731 per visit), with fractures being the most expensive type
21 of injury [10].

22 However, recent studies also have shown that long-term exercise programs improve
23 bone mass and bone size among children and adolescents, without affecting the fracture risk

1 [11–13]. Actually, evidence confirms that participation in ball sports promote supplementary
2 bone health than other sports, reducing the risk of fractures [8,13].

3 In a background in which public health campaigns are developed to promote sports
4 participation among pediatric groups targeting health promotion, the burden of sports
5 participation and its side effects (e.g. injuries and fractures) on economic aspects need to be
6 considered as well. Among adults, the economic benefits of sports participation seem to be
7 easier to identify than in pediatric groups, mainly because chronic conditions linked to physical
8 inactivity are usually observed in this age group [14].

9 On the other hand, this relationship among the pediatric population is far from being
10 clear because the dynamics of health care costs in both age groups differ [15]. For instance, in
11 pediatric groups, the impact of sports participation on health care outcomes are more difficult
12 to identify than in adults, mainly because the main health benefits generated by sports
13 participation are observed later in life [6,16]. Therefore, potential economic benefits of sports
14 participation might be overshadowed by the costs generated by the treatment of outcomes
15 related to sports participation, such as fractures, injuries, and upper respiratory infections
16 (commonly observed in water sports) [15,17,18].

17 Therefore, this longitudinal study aimed to analyze the risk of traumatic fractures
18 according to the engagement in sports with different levels of physical impact, as well as to
19 identify the potential impact of sports participation and traumatic fractures on health care
20 costs among adolescents.

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1 **2. Methods**

2 The longitudinal research entitled "Analysis of Behaviors of Children During Growth"
3 (ABCD – Growth Study) is an ongoing study dedicated to identifying the impact of sports
4 participation on different health aspects of adolescents, including health care costs. The
5 present study is part of the ABCD – Growth Study, which is being carried out in Presidente
6 Prudente (~200,000 inhabitants and human development index 0.806), western state of São
7 Paulo, Brazil. Data collection and analyzes were performed at Laboratory xxxxxxxxxxxxxxxx in
8 2017 (baseline) and 2018 (12 months follow-up). The ethics committee of xxxxxx approved
9 the study (process number xxxxxxxxxxxx). All the parents/guardians signed the consent form,
10 and the coaches responsible for the adolescents engaged in organized sports signed an
11 authorization form too. Adolescents signed a form agreeing to participate in the longitudinal
12 study.

13 The sample was composed of 285 adolescents of both sexes (202 boys and 83 girls)
14 who were contacted by the researchers in eleven schools and sports clubs located in the
15 metropolitan region of the city (the contact has been previously authorized by the principals
16 [school] and coaches [sports clubs]). All 285 adolescents in all eleven places were invited,
17 considering the inclusion criteria 1) 10-18 years-old, 2) parents' consent form signed, 3) if
18 contacted in any sports club, at least one year of training experience in order to characterize
19 a consistent engagement; if contacted in any school unit, at least one year without regular
20 practice of sport or exercise.

21 The occurrence of traumatic fractures was assessed at baseline and during the 12-
22 months follow-up period. At baseline, the participants were asked the following yes or no
23 question: "During the past 12 months, have you experienced any broken bones?" [13]. During
24 the 12-months follow-up, once a month the researchers contacted the adolescents by phone

1 to register any occurrence of traumatic bone fracture, as well as the bone broken and date of
2 the event.

3 Health care costs were assessed during 12 months of follow-up by the researchers
4 throughout monthly phone contacts with adolescents and their parents/legal guardians.
5 Researchers asked adolescents monthly about the use of medication (name and dosage),
6 appointments (medical specialties [e.g. pediatrician, general practitioner, ophthalmologist,
7 orthopedist, ear, nose and throat specialist, dermatologist, pulmonologist, emergency doctor,
8 physiotherapist, speech therapist, psychotherapist, occupational therapist, homeopath and
9 others), hospitalizations and laboratory tests. The price of each of the components of health
10 care services was collected from pharmacies (when bought by the participant), private health
11 care plan (when paid by the participant) and National Health Service (when provided by the
12 government) [14,19]. In the case of pharmacies, three independent researchers contacted
13 three different pharmacies in the metropolitan region of the city, and the average price of the
14 medicine was considered. The prices were computed in Brazilian currency (Real [R\$]), and all
15 these values converted into American dollar (US\$), using the average quotation of the 12
16 months of follow-up (US\$ 1.00 equal to R\$ 3.193).

17 In terms of sports participation, adolescents were divided into four groups according
18 to sport characteristics: non-sport (n= 104), non-impact sport (swimming [n= 34]), martial arts
19 (n= 49 [judo, karate, kung Fu]) and impact sports (n= 98 [track and field, basketball,
20 gymnastics, tennis, and baseball]) [5,20].

21 In a face-to-face interview, the adolescents reported sex and birthday (chronological
22 age). Adolescents engaged in any sport reported the number of days per week involved in
23 practice, as well as the time (in minutes). Coaches confirmed this data.

1 Body weight (kg) was measured using a digital scale (Filizzola PL 150; Filizzola Ltda, São
2 Paulo, Brazil) and height (cm) was measured using a stadiometer with a precision of 0.1 cm.
3 Both measurements were collected using standard protocols. Analysis of the sitting height and
4 length of the legs were performed to calculate the maturity offset, which denotes the time
5 (years) from/to the age at the peak height velocity (PHV), an indicator of biological maturation
6 [21]. PHV is an important event of the biological maturation process, which can influence body
7 composition and bone variables.

8 Body fatness (in percentage [%]), and BMD (g/cm²) of the whole body were assessed
9 using a dual-energy x-ray absorptiometry (DXA) scanner (Lunar DPX-NT; General Electric
10 Healthcare, Little Chalfont, Buckinghamshire, UK) with GE Medical System Lunar software
11 (version 4.7). DXA measurements were performed in the morning after a light breakfast, and
12 the scanner quality was tested by a trained researcher before each day of measurement,
13 following the manufacturer's recommendations. The participants wore light clothing, without
14 shoes and remained in the supine position on the machine (approximately 15 min).

15 The self-report of musculoskeletal symptoms in any body segment (neck, shoulder,
16 upper back, low back, elbows, wrists/hands, hips/thighs, knees and ankles/feet) over the last
17 week before the face-to-face interview has been assessed using the Nordic Musculoskeletal
18 Questionnaire [22]. Finally, the adolescents' blood was collected by a nurse in an independent
19 laboratory (which meets all the guidelines of the Brazilian Ministry of Health), and C-reactive
20 protein (CRP) levels (mg/L) were assessed as an inflammatory marker.

21 Descriptive statistics were expressed in values of percentage (%), mean, median, 95%
22 confidence interval (95%CI) and interquartile range (IR) because some data showed non-
23 normal distribution. Mann-Whitney test was used to compare continuous data according to

1 the presence of traumatic fractures (**Table 1**). Kruskal-Wallis test was used to compare health
2 care costs according to different sports.

3 Some variables adjusted multivariate models (general linear model and cox
4 regression), while these variables were identified as potential correlates due to its impact on
5 either health care costs or fractures [23,24]. We assessed the risk of traumatic fractures
6 according to the sports participation and controlling for covariates (sex, age, body fatness,
7 somatic maturation, BMD and CRP) using Cox Regression (Hazard Ratio [HR] and its 95%CI).
8 Analysis of covariance (ANCOVA) was used to investigate the relationship between overall
9 health care costs and sports participation adjusted by sex, age, PHV, BMD, body fatness, CRP,
10 occurrence of fractures, previous engagement in sports and minutes of practice per week
11 (**Table 2**). In ANCOVA model, health care costs were converted into a logarithm transformed
12 variable due non-parametric distribution, Levene's test assessed how fit the ANCOVA model
13 was (model was adequately fit) and measures of effect-size were expressed as Eta-squared
14 values (ES-r). Finally, a generalized linear model using gamma distribution with a log-link
15 function ([GLM-Gamma], expressed as β and its 95%CI) has been created in which overall
16 health care costs was the dependent variables and all other variables were treated as
17 independent variables (**Table 3**). GLM-Gamma multivariate model considered only
18 significant covariates at univariate analysis (Pearson correlation) and values of relative chi-
19 squared (χ^2) were adopted as measures of goodness-of-fit of the model. Statistical
20 significance was set at $p < 0.05$ and all analyzes were performed using BioEstat software
21 (version 5.2 [BioEstat, Teffe, Brazil]).

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3. Results

The sample was composed of 202 boys and 83 girls. Adolescents engaged in sports trained an average of 112.5 minutes per day (95%CI: 104.6 to 120.4) in 2.9 days per week (95%CI: 2.7 to 3.2). There was the incidence of six new fractures during the follow-up period (n= 1 in the elbow, n= 2 in the toe, n= 1 in radius and n= 1 in right arm; n= 1 in the finger). There was no traumatic fracture caused by a car accident during the 12-month follow-up. The overall costs accounted during the 12-month follow-up were U\$ 3,259.66 (medication: US\$ 1,671.80 [52.9%], appointments: US\$ 948.46 [28.7%] and laboratory tests: US\$ 639.41 [18.4%]). When comparing the adolescents according to the incidence of new fractures, the group with fracture presented significant higher health care costs (**Table 1**). Sports participation did not show any significant association with the occurrence of traumatic fractures during 12-months [Non-sport HR= 1.00; Swimming HR= 1.58 (95%CI: 0.13 to 19.06); Martial arts HR= 2.97 (95%CI: 0.37 to 23.30); Impact sports HR= 1.24 (95%CI: 0.15 to 10.21)].

When splitting the groups down by sport, track and field [median: US\$ 4.45 (IR: 27.67)], gymnastics [median: US\$ 11.08 (IR: 23.90)], judo [median: US\$ 4.56 (IR: 6.96)], and swimming [median: US\$ 24.98 (IR: 46.50)] presented higher costs when compared to the non-sport group [median: US\$ 0.31 (IR: 0.0)] [Kruskal-Wallis test with p-value= 0.001]. Karate [median: US\$ 0.31 (IR: 6.40)], kung-Fu [median: US\$ 0.31 (IR: 4.49)], tennis [median: US\$ 0.31 (IR: 12.41)], basketball [median: US\$ 0.31 (IR: 0.0)] and baseball [median: US\$ 0.31 (IR: 0.55)] did not show significant differences for costs when compared to the non-sport group.

Even after adjustment by confounders, swimmers (US\$ 13.86 [95%CI: 8.55 to 22.54]; p-value= 0.001) had higher health care costs than non-sport (US\$ 1.82 [95%CI: 1.35 to 2.47];

1 p-value= 0.001), martial arts (US\$ 2.23 [95%CI: 1.44 to 3.45]; p-value= 0.001) and impact
2 sports (US\$ 2.32 [95%CI: 1.68 to 3.19]; p-value= 0.001) (**Table 2**).

3 Swimmers accumulated an average US\$ 2.09 more health care costs than other
4 adolescents of this cohort (independently of the engagement in other sports). Moreover, girls
5 accumulated an average US\$ 0.45 less health care costs than boys, while every single fracture
6 sustained by the adolescent accounted an average US\$ 1.06 more health care costs (**Table 3**).
7 The final model was significant (p-value= 0.001) and satisfactorily adjusted (goodness-of-fit).

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10 **4. Discussion**

11 In this longitudinal study, we found that engagement in weight-bearing sports did not
12 increase the risk of fractures, while adolescents engaged in swimming (mainly), track and field,
13 gymnastics, and judo presented higher health care costs when compared to the non-sport
14 group.

15 The incidence of new fractures during the follow-up period was low (2.1%), which is
16 similar to other longitudinal studies considering young athletes [13, 25]. In statistical terms,
17 the low incidence of fractures might be one of the reasons behind the absence of significant
18 associations between sports participation and traumatic fracture. However, this information
19 denoting the absence of significant associations between sports participation and traumatic
20 fractures seems relevant because sport injuries persist in adulthood [26].

21 Even with no association with sports participation, we found that the incidence of new
22 fractures significantly increased health care costs among adolescents. Previous survey

1 reported similar findings, in which the occurrence of fractures is the cause of high health care
2 costs in adolescents engaged in sports like rugby [10]. It is also relevant to identify that the
3 incidence of new fractures affected significantly all components of overall health care costs
4 (medication, appointment, and tests), reflecting the steps of treatment and healing of the
5 traumatic event. Moreover, it is pertinent to recognize that small changes in training (e.g.
6 replacing regular warm-up by neuromuscular training) are able to mitigate costs attributed to
7 sport injuries [17], denoting the relevance of having highly qualified coaches and trainers
8 assisting the athletes.

9 Another variable affecting costs among these adolescents was sex, in which girls
10 accumulated higher health care costs than boys. Among adults, women usually accumulate
11 more annual health care costs than men [14], mainly due to social and cultural aspects. This
12 finding is supported by the fact that women are more prone to be regularly engaged in
13 preventive medicine than men since early age (e.g. birth control, gynecologist) [27]. Therefore,
14 cost-effective interventions involving exercise targeting the mitigation of costs among
15 adolescents should be designed focusing on sex-related particularities, because the dynamic
16 of economic variables seems to be sex-dependent.

17 Regarding health care cost among different sports, we found that track and field,
18 gymnastics, judo, and swimming presented significant higher costs when compared to the
19 non-sport group. In all sports above mentioned, this finding could be justified by the high
20 amount of repetitive movements required by these sports during practice, plus the high
21 volume of training and inflammation, which could lead to damage to the muscle and joints
22 and weakening of the immune system [28]. Moreover, each of these sports have its inherent
23 aspects that could affect health care costs. For example, judo athletes are constantly reducing

1 body weight using dehydration and food restriction in order to be able to compete in specific
2 weight classes (sometimes using medicines for that), leading to harmful health implications
3 (e.g. anxiety, eating disorders) which have worse consequences in young judo athletes [29].
4 Eating disorders and anxiety symptoms are outcomes commonly observed in gymnasts as well
5 [30] due to the necessity of having less body weight for better performance. Moreover,
6 symptoms of anxiety and depression are identified in young athletes of track and field [31].
7 All these health outcomes happening during a calendar year might influence significantly
8 health care costs among these adolescents.

9 Swimmers accumulated the highest health care costs in this study. In fact, the
10 consumption of medicines to relieve cold symptoms was the most frequently reported by our
11 swimmers. Concerning the highest health care costs among swimmers, it could be explained
12 by the highest training load observed among this particular group, as well as the humid
13 environment where practice takes place [15,18]. Similarly, a 4-year longitudinal study found
14 that the risk of upper respiratory tract and pulmonary infections and muscular affections
15 among swimmers increased significantly with higher training loads [32]. Additionally, it is
16 already established that swimming does not prevent fractures despite absence of impact (in
17 our study there was 1 fracture among swimmers, which happened in activities not related to
18 swimming) [5,13].

19 In this survey, some sports increased health care cost among adolescents, but health
20 professional should interpret these findings with caution. First, most of health care costs
21 observed in this study came from primary care services, while more complex health
22 procedures were not observed. Sports participation prevent the development of a large
23 variety of diseases that significantly increase costs in a more complex level, such as childhood

1 obesity and high blood pressure. Second, even with higher costs among adolescents engaged
2 in some sports, the amount of money accounted over the last 12 months was low (US\$
3 3,259.66), while in adults, the mitigation attributed to physical activity in developing settings
4 is accounted in US\$ 26 million [33]. Finally, sports participation tracks from adolescence to
5 adulthood more than exercise [34], and affects health in adolescence and adulthood [3,16],
6 representing a huge potential to mitigate health care costs throughout life. However, it is also
7 relevant to highlight that some sports had similar costs to the non-sport group (e.g. basketball,
8 baseball, karate and tennis), denoting potential alternatives to improve health aspects in
9 pediatric groups with apparently low impact on health care costs.

10 National Health Service in Brazil is an organizational structure similar to the observed
11 in other nations with universal health care, such as UK, New Zealand, Spain, Australia and
12 Canada. Therefore, extrapolations of our findings would be not impossible to these scenarios
13 (of course, accounting due particularities in each nation). However, the most relevant aspect
14 of our study is not to describe absolute monetary values, but mainly patterns of this barely
15 explored aspect of sports participation, which happens for sure in all nations where sports
16 participation is stimulated among pediatric groups.

17 The assessment of health care costs among these adolescents is a challenging aspect
18 of this survey [14,19], but also a strong methodology aspect. As limitations, we recognize the
19 absence of clinical records to assess more details about the traumatic fracture reported, as
20 well as the absence of data about stress fractures. Additionally, the use of health care services
21 was self-reported monthly by the participants, which it is prone to bias recall, even being
22 assessed every month. Lastly, the short period of follow-up could be considered a limitation.

23 **5. Conclusions**

1 In summary, sports participation did not increase the risk of fracture, while sports
2 participation (mainly swimming), traumatic fracture and gender were determinants of health
3 care costs among these adolescents.

4 **Practical implications**

- 5 • Engagement in sports raised the health care costs among adolescents.
- 6 • The amount of money attributed to sports participation was few, while its
7 maintenance has potential to mitigate costs throughout life, preventing the
8 development of a large variety of diseases that significantly increase costs in a more
9 complex level.
- 10 • Engagement in sports should be encouraged and the health care costs of those
11 participants closely monitored.
- 12 • **Conflict of interest**

13 None

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Table 1. General characteristics according to the occurrence of traumatic fracture in adolescents (ABCD – Growth Study; n= 285).

Independent variables	Traumatic Fracture 12 months*		<i>p</i> -value**
	No (n= 279)	Yes (n= 6)	
	Median (IR)	Median (IR)	
General information			
Sex (boys / girls)	197 / 82	5 / 1	---
Ethnicity (White [%])	53.4%	50.0%	0.289
Age (years)	14.88 (3.5)	16.89 (3.3)	0.055
Body mass (kg)	57.8 (18.6)	62.5 (16.9)	0.170
Height (cm)	167.3 (15.9)	172.6 (12.2)	1.110
BMD (g/cm ²)	1.122 (0.169)	1.137 (0.144)	0.783
BMC (g)	2,496.8 (812.1)	2,690.2 (855.6)	0.291
Body fatness (%)	21.4 (16.3)	13.85 (8.8)	0.067
Sports (min/wk)	240 (720)	360 (607.5)	0.490
Maturity offset (years)	1.44 (2.14)	2.62 (2.23)	0.092
C-reactive protein (mg/L)	2.50 (2.2)	2.15 (5.2)	0.779
MSK last week (sum)	0.0 (1.0)	0.0 (1.5)	0.962
Health care costs (US\$)			
Medicines	0.31 (4.64)	12.43 (26.40)	0.028

Appointments	0.31 (0.00)	10.49 (12.72)	0.007
Tests	0.31 (0.00)	3.13 (6.39)	0.001
Overall	0.93 (8.96)	23.99 (29.12)	0.005

1 *= incidence of new traumatic fractures that happened during the 12-month follow-up; **= Mann-Whitney
2 test; IR= interquartile range; BMD= bone mineral density; BMC= bone mineral content; MKS=
3 musculoskeletal symptoms.

Table 2. Overall health care costs (US\$) in adolescents according to sports participation (ABCD – Growth Study; n= 285).

	Non-sport	Martial Arts	Impact Sports	Swimming	
Health care costs	(n= 104)	(n= 49)	(n= 98)	(n= 34)	<i>Sport participation</i>
	Mean (95%CI)	Mean (95%CI)	Mean (95%CI)	Mean (95%CI)	<i>p-value (ES-r^{magnitude})</i>
ANCOVA _{crude model}					0.001 (0.186 ^{High})
Overall _{log10}	0.270	0.429	0.343	1.189 ^{a,b,c}	
	(0.158 to 0.383)	(0.271 to 0.588)	(0.229 to 0.457)	(0.916 to 1.455)	
ANCOVA _{adjusted model} *					0.001 (0.186 ^{High})
Overall _{log10}	0.262	0.350	0.366	1.142 ^{a,b,c}	
	(0.131 to 0.393)	(0.161 to 0.539)	(0.227 to 0.505)	(0.932 to 1.353)	
Overall (US\$)**	1.82	2.23	2.32	13.86	---
	(1.35 to 2.47)	(1.44 to 3.45)	(1.68 to 3.19)	(8.55 to 22.54)	

95%CI= 95% confidence interval; ES-r= eta-squared; ANCOVA= analysis of covariance; log10= variable converted into logarithm base 10; a= denotes difference (*p*-value <0.05) compared to non-sport; b= denotes difference (*p*-value <0.05) compared to Martial Arts; c= denotes difference (*p*-value <0.05) compared to Impact sports;

*=ANCOVA adjusted by sex (ES-r= 0.020 [p-value < 0.05]), age (ES-r= 0.007), peak of height velocity (ES-r= 0.003), whole body bone mineral density (ES-r= 0.001), body fatness (ES-r= 0.001), C-reactive protein (ES-r= 0.015), fracture 12-months follow-up (ES-r= 0.019 [p-value < 0.05]) and musculoskeletal symptoms (ES-r= 0.004).

**= logarithm variable converted back into natural number by exponentiation.

Table 3. Relationship between health care costs and its potential correlates among adolescents (ABCD – Growth Study; n= 285).

Independent variables	Dependent variable: Overall Health Care Costs (US\$)				Model - Goodness-of-fit	
	Pearson		GLM - Gamma		x ² relative	
	correlation (<i>r</i>)	p-value	β (β 95%CI)	p-value	(x ² / <i>df</i>)	Satisfactory
					4.512	<5.0
Sex (girls)*	-0.161	0.004	-0.459 (-0.798 to -0.121)	0.008		
Age (years)	0.130	>0.050	---	---		
Maturation (years)	-0.113	>0.050	---	---		
BMD (g/cm ²)	0.019	>0.050	---	---		
Body fatness (%)	-0.006	>0.050	---	---		
CRP (mg/L)	0.110	>0.050	---	---		
Fractures (yes/no)	0.171	0.007	1.066 (0.001 to 2.130)	0.049		
MKS (number of events)	-0.058	>0.050	---	---		
Sport (swimming)**	0.423	0.001	2.091 (1.617 to 2.564)	0.001		

X²= chi-squared test; *df*= degree of freedom; 95%CI= 95% confidence interval; BMD= bone mineral density; MKS= musculoskeletal symptoms; CRP= C-reactive protein; *= dichotomous variable (girls= 0 and boys= 1); **= dichotomous variable (non-sport and other sports= 0 and swimming= 1).