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ORIGINAL

INJURIES IN PHYSICAL EDUCATION OF HIGH SCHOOL. A PROBLEM?

LESIONES EN LA EDUCACIÓN FÍSICA DE LA ESCUELA SECUNDARIA ¿UN PROBLEMA?

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ABSTRACT

The incidence of injuries in physical education class should be a priority factor for public health. The aim of this study is to analyze the incidence of injuries in Physical Education (PE) lessons and how they relate to lack of full student participation. Prospective cohort study. Conglomerate bi-stage sampling for a total of 637 students. Absence and injuries were recorded for the school year. Of 1463 lessons, only 4.58% were documented with identification of the absences caused by injury (0.33% of the total participation expected). The rate

of injuries produced in PE lessons was of 1.90 for every 1000 hours of participation. The frequency of absence of in PE lessons due to injury is very low compared to the overall expected participation; therefore it is not a factor that influences the rate of student participation significantly.

KEY WORDS: Injury, Physical education, Adolescent. High school.

RESUMEN

La incidencia de lesiones en la clase de educación física debe ser un factor prioritario para la salud pública. El objetivo de este estudio es analizar la incidencia de lesiones en las clases de Educación Física (PE) y cómo se relacionan con la falta de participación completa de los estudiantes. Estudio de cohortes prospectivo. Conglomerado de muestreo bi-etapa para un total de 637 estudiantes. La ausencia y las lesiones se registraron durante el año escolar. De 1.463 lecciones, solo el 4,58% se documentó con la identificación del incidente causal (0,33% de la participación total esperada). La tasa de lesiones producidas en las clases de educación física fue de 1,90 por cada 1.000 horas de participación. La frecuencia de ausencia en las clases de educación física debido a una lesión es muy baja en comparación con la participación general esperada; por lo tanto, no es un factor que influye significativamente en la tasa de participación de los estudiantes.

PALABRAS CLAVE: Lesión, Educación física, Adolescente, Educación secundaria.

INTRODUCTION

There is no unanimity regarding the relevance of injuries that occur during physical education (PE) lessons. Injuries produced during physical education lessons can be a priority factor for public health (Taylor & Attia, 2000) as they incise the educational process (Sosnowska & Kostka, 2003) and can become a serious economic problem derived from medical costs, loss of work days, etc. (Abernethy & MacAuley, 2003; Collard, Verhagen, van Mechelen, Heymans, & Chinapaw, 2011). Although some authors consider that sport injuries during the school years are not so relevant (Grimaud, Piette, Clappier, Deguen, & Pommier, 2007) and have minimal medium-to-long term effect.

Studies of school-related injuries are very limited and typically refer to injuries in general, without specifying those produced in PE class. This leads to a confusion of terms like school sports, physical education and exercise, which then complicate the data analysis to identify the real cause of the injuries.

Multiple studies have gathered data from hospital records, sport clinics and pediatric centers on sport related injuries in general and later catalogued them as school-related injuries for being associated with activities in school or due to the age in which they occur (Belechri, Petridou, Kedikoglou, Trichopoulos, & Sports Injuries European Union, 2001; Habelt, Hasler, Steinbruck, & Majewski, 2011; Loder & Abrams, 2011; Pakzad-Vaezi & Singhal, 2011; Roach & Maffulli, 2003). Others gather data in schools or school-related activities that mention physical activity, but do not differentiate the activities that contributed (Lenaway, Ambler, & Beaudoin, 1992; Spinks, Macpherson, Bain, & McClure, 2006). Studies that focus on physical activity or school sports do not establish differentiated records for PE lessons (Emery, 2010; Josse, MacKay, Osmond, & MacPherson, 2009).

Finally, the few studies that do focus specifically on PE, differ widely in their methodologies (Backx, Beijer, Bol, & Erich, 1991; Carmeli, Azencot, Wertheim, & coleman, 2003; Collard, Chinapaw, van Mechelen, & Verhagen, 2009; Sundblad, Saartok, Engstrom, & Renstrom, 2005; Videmsek, Karpljuk, Mlinar, Mesko, & Stihec, 2010), so the interpretation of their results must be done cautiously. On one hand, they have different sample sizes ranging from vast geographic regions (Nelson, Alhaji, Yard, Comstock, & McKenzie, 2009), to single school recollections, differences in time periods, from data gathered across 13-15 years (Pakzad-Vaezi & Singhal, 2011) to some gathered in one month (Grimaud et al., 2007), and additionally, great differences in the age groups of the populations studied, ranging from 5 to 19 year olds (Carmeli et al., 2003; de Loes, Jacobsson, & Goldie, 1990; Nelson et al., 2009; Spinks et al., 2006; Verhagen, Collard, Paw, & van Mechelen, 2009). On the other hand, differences exist in the instruments used, ranging from standardized measurements like NEISS in the United States (Nelson et al., 2009) and CHRIPP in Canada (Pakzad-Vaezi & Singhal, 2011), with great amounts of data, rapid classification and access but this data is inevitably biased towards more severe injuries due to the hospital and emergency nature of these, and studies based on surveys made at school (Emery, 2010; Sundblad et al., 2005), in many cases, studies are based on a combination of incident records and

surveys of sport habits (Verhagen et al., 2009) or journal data related to free time activities (Spinks et al., 2006). To these are added our studies (Gutiérrez-Castañón, E, 2014, 2008; Gutiérrez-Castañón, E et al., 2007).

The international classifications of reference, such as NOMESCO-NCECI (NOMESCO, 2007), and the International Classification of External Causes of Injuries (McKenzie, Fingerhut, Walker, Harrison, & Harrison, 2012) show great imprecision when determining the activities at the moment that the injuries occurred, as they group together PE classes and any school-related sport. Additionally, there are two other inconveniences, cited by some authors (Carter, Westerman, & Hunting, 2011): First of all, the calculation of the injury rate among a population of reference can include non-participants in the total population of a region or school. This problem can be solved by including the athlete exposure (AE) variable, however, it would still include periods of no risk exposure. In addition, we have the difficulty of determining the exact time of exposure to risk. This could be resolved through surveys of physical activity and exercise habits during free time, to at least have an approximate estimation of risk exposure time, even if it would still be imprecise (Spinks et al., 2006; Verhagen et al., 2009).

Therefore, considering the great variability of results previously obtained and the diversity of methods employed, the present article aims to obtain records that show, as objectively as possible, the reality of injury incidence during PE lessons. For this matter, the following objectives are proposed: 1. To know the incidence of injuries during PE lessons that keep students from actively participating in class, compared to other non-injury related health issues. 2. To analyze the nature of the injuries produced in PE lessons, their anatomical distribution, mechanism of occurrence and the treatment followed to recover from them.

METHOD

The sample included 26 groups of 4th level high school education centers of the Community of Madrid (Spain), for a total of 637 students with ages ranging from 15 to 17 years, which correspond to the last year of mandatory education.

A randomized conglomerate bi-stage sampling procedure was used for selecting the groups. The first stage randomly chose between all the high school mandatory centers of the Madrid community and the second stage selecting one randomly from all the fourth year groups available in the previously chosen centers. Absence records were made daily by the teachers in each group.

PE classes last one hour, the activity time was calculated on the total hours. Absence in PE lessons was registered during the school period (from the third week of September to the second week of June). These data were collected by EF professors from each school, previously agreed with the authors. The following criteria was used to determine lack of complete student participation:

- Participation was considered as the active presence of a student in each PE lesson, which is different than attendance, which just requires the student's presence without active engagement. The total of expected student class participations corresponds to the number of students in each group times the number of PE sessions for that same group.
- A lack of participation was considered to be the failure of the student to fully participate during PE class, including when the student was not present, and those where despite being present, the student did not participate with the rest of the group.

Causes of every absence were classified as a function of the following criteria:

- General lack of participation was differentiated by health reasons and other types of activities (including disciplinary sanctions, lack of proper equipment, etc.).
- Health-related absence was separated into illness-related and injury-related.
- Those classified as injury-related were separated into injuries during PE class and injuries that occurred outside of PE.

This resulted in five possible categories for participation: normal participation, lack of participation due to illness, lack of participation due to injury in PE, lack of participation due to injury outside of PE, and lack of participation due to other reasons.

Authors personally "compiled" the injuries using a registration sheet that reflects the categories previously stated and includes sections for the researcher to write down observations was used for the recollection of data, adding questions concerning physical activity during free time and the weekly frequency of each, to further classify these as structured or non-structured physical activities and an estimation of the number of hours dedicated to these activities.

Injuries were defined and classified following the UEFA Football Safety Model (Hagglund, Walden, Bahr, & Ekstrand, 2005) and the FIFA Injury Consensus Group (Fuller et al., 2006). The type of injury was classified according to the type of mechanism that produced it: direct trauma (concussions, fractures), indirect trauma (sprains, muscle injury of varying degree) and overuse injuries (tendinopathy, chondropathy, etc.).

The SPSS 20.0 software was used to process the data. Frequency counts were held for the whole sample and the subgroups established in each section of the study, according to the causes of students' incomplete involvement. Contrast tests of frequency and goodness of fit tests were also carried out using chi-square analysis at a 0.05 level of significance.

RESULTS

Out of the total sample size, 335 students (52.6%) were male and 302 (47.4%) were female. A total of 52 students (8.16%) registered no circumstances of absence throughout the study and 241 (37.84%) registered incomplete participation / absence due to some type of injury, of which 64 (10.04%) resulted from a PE lesson. The total number of sessions analyzed was 1463 and 67 of these registered as injury incidents (4.58%), with a total of expected participations of 35191.

This data corresponds to a rate of injury of 1.90 per every 1000 hours of PE class exposure. On the other hand, the rate of injury outside of PE lessons was 2.09 per every 1000 hours of structured physical activity and 2.13 for every 1000 hours of non-structured physical activity.

Participation and absence in PE lessons

Figure 1 summarizes the total injuries that originated in PE class and the corresponding lack of participation that resulted, in relation to the cause of the injuries.

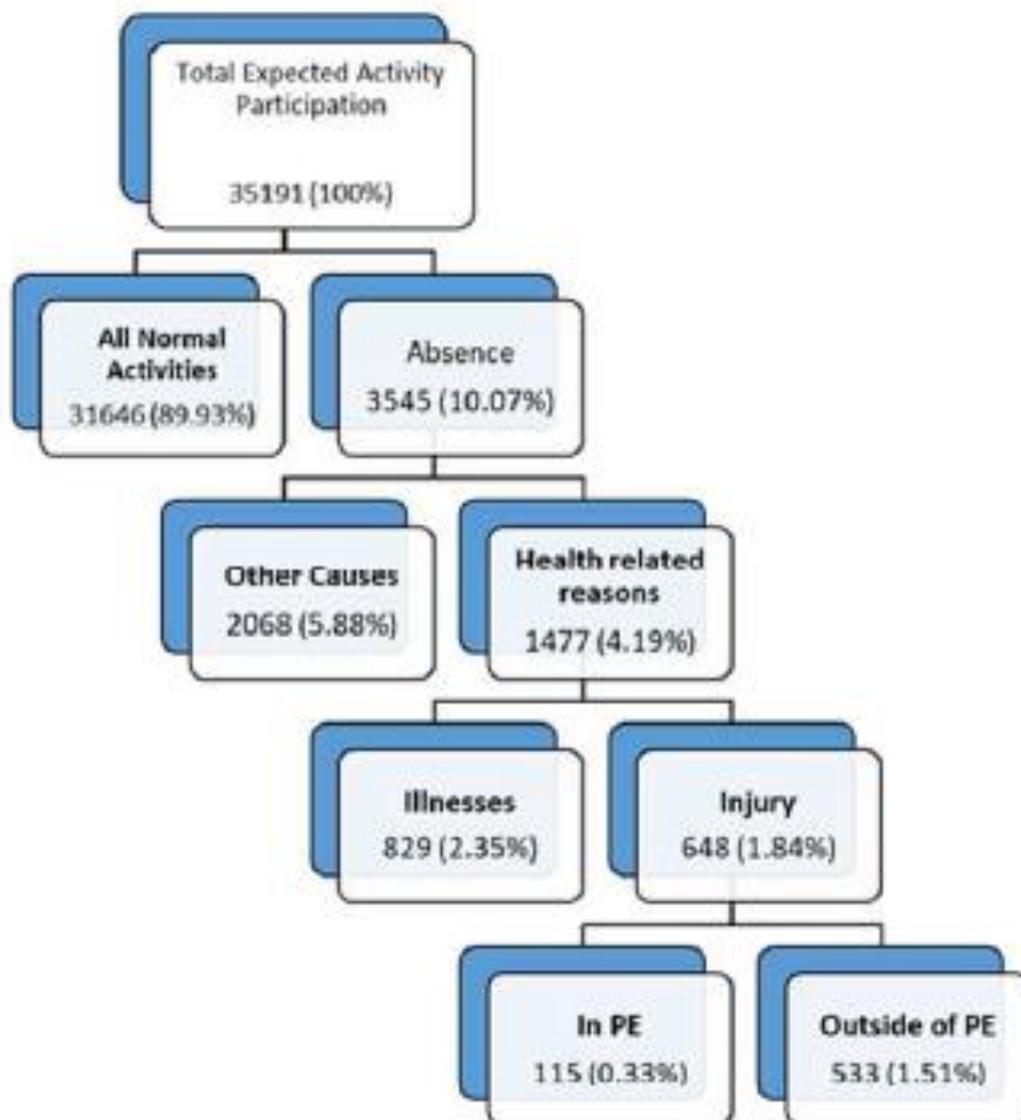


Figura 1. Participations and absences according to the causes

Types of injuries registered

Figure 2 shows the type of injuries that originated in PE lessons and the absence that results.

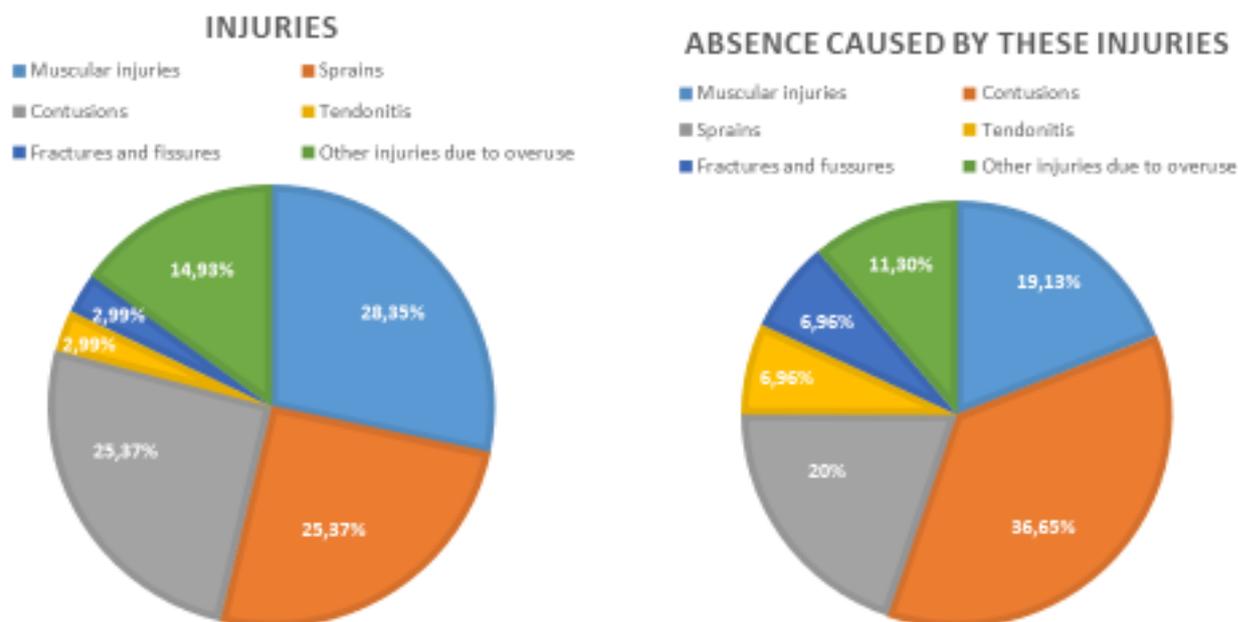


Figura 2. Injuries occurred in class and absences that produce

Injuries and absence according to anatomical region, mechanism of production and treatment received

Given the low incidence of injuries registered, only three anatomical regions were considered: head and trunk, upper limbs and lower limbs (Table 1).

Anatomical region	Injuries		Absence	
	n	%	n	%
Head and Torso	4	5.97%	6	5.22%
Upper Limbs	14	20.90%	26	22.61%
Lower Limbs	49	73.13%	83	72.17%
Total	67	100%	115	100 %

	Chi-square	df	Asymptotic Significance
Adjustment Injuries	50.000	2	.000
Adjustment Injuries- Participation	0.292	2	0.864

Table 1. Injuries with origins in PE lessons and lack of complete involvement according to anatomical region. Test results for Goodness of Fit adjustments in a homogenous distribution and in consideration of injury to participation.

In Table 2 all injuries are classified according to the mechanism by which they were produced. In regards to the treatment received, only two situations were considered, including the presence of medical care (physician, nurse or physical therapist) or the absence of treatment (Table 3).

Injury Mechanism	Injuries		Absence	
	n	%	n	%
Direct Trauma	19	28.36%	31	29.96%
Indirect Trauma	32	47.76%	59	51.30%

Overuse	16	23.88%	25	21.74%
Total	67	100 %	115	100 %

	Chi-square	df	Asymptotic Significance
Adjustment Injuries	6.478	2	.039
Adjustment Injuries- Participation	.605	2	.739

Table 2. Injuries with origins in PE lessons and absence according to cause. Test results for Goodness of Fit adjustments in a homogenous distribution and in consideration of injury to participation.

Treatment received	Injuries		Absence	
	n	%	n	%
Without Treatment	40	59.70%	46	40 %
Medical Treatment	27	40.30%	69	60 %
Total	67	100 %	115	100 %

	Chi-square	df	Asymptotic Significance
Adjustment Injuries	2.522	1	.112
Adjustment Injuries- Participation	18.550	1	.000

Table 3. Injuries originated in PE lessons and lack of complete involvement according to treatment received. Test results for Goodness of fit adjustments in a homogenous distribution and in the relation injuries-participations.

DISCUSSION

The rate of absence in PE class resulted was quite low (below 0.04%) when compared to participation numbers. However, findings from this study coincide with those conducted over shorter periods of time, in the fact that injury incidence in PE lessons appears lower than the injuries produced in other types of physical activity (Abernethy & MacAuley, 2003; Sosnowska & Kostka, 2003). Due to the great variability in data collection methods and sample sizes, there is still no unanimity regarding the rate of injury and the time exposed to risk conditions.

The present study only considered high school students between the ages of 15 and 17 years, who from a developmental perspective, share common musculoskeletal and developmental characteristics. This allows the comparison

among the results obtained to be more feasible since teenagers can be highly sensible to the traction forces exerted upon them (Alexander, 1976; Arkin & Katz, 1956; Sward, 1992).

Few studies gather injury incidence rates based on hours of exposure in either PE or in other physical activities in school age. The present study found a rate of incidence was equal to 1.90 for every 1000 hours of exposure in PE lessons; 2.09 for every 1000 hours of structured physical activity and 2.13 for every 1000 hours of non-structured physical activity. These numbers are higher than those obtained by Verhanen et al. (Verhagen et al., 2009) (0.50) in PE lessons, although the sample for that study was between 10 and 12 years of age. At the same time, the incidence found in De Loes et al. (de Loes et al., 1990) was higher (3.20) for PE lessons in a similar age group (14-19 years) although these authors only considered time in PE lessons. Spinks et al. (Spinks et al., 2006) reported an incidence between 1.19 and 2.18 for every 1000 hours, depending on the sport.

The most frequent injuries that occur during PE were found to be muscular related, followed by sprains (specifically in the ankle) and concussions, with similar percentages for each type (28.35%, 25.37%, and 25.37%, respectively). There is no unanimity in the data obtained across different studies. Some authors suggest sprains are the most common, like Nelson et al (Nelson et al., 2009), who reported a 40% incidence against 19% for both muscular and fracture injuries. Carmeli et al (Carmeli et al., 2003) reported a 61% proportion of injury due to sprains and 23% due to fractures, while Sundblad and colleagues (Sundblad et al., 2005) reported a frequency distribution of 48% of sprains and muscular injuries followed by 14% of concussions. Still, other studies have found higher percentages in muscular related injuries and concussions (Backx et al., 1991; Grimaud et al., 2007).

The most frequent injuries that occur during PE are in the lower limb (73,13%), in the upper limb (20,90%) and from head and trunk (5,97%). The majority of findings reported by other authors are consistent with these findings, except some have reported lower percentages, ranging from 39% to 68% for lower limb injuries (Backx et al., 1991; Carmeli et al., 2003; Grimaud et al., 2007; Nelson et al., 2009; Sundblad et al., 2005; Verhagen et al., 2009). In regards to the mechanism that originated the injuries, indirect trauma was found to be the most frequent cause (47.76%), followed by direct trauma (28.36%) and overuse (23.88%).

No studies were found that associated type of injury, anatomical region and mechanism with lack of participation in PE classes. The present study showed that sprains were the major reason for not participating in PE classes (35.65%), followed by fractures and tendinopathies, which reflect the severity of these injuries when compared to other causes. People with injuries of the lower limbs accumulate a frequency of absences (72.17%) much higher than people with injuries in the upper limbs (22.61%), and head and trunk (5.22%), simply because that percentage corresponds to a higher incidence, it does not correspond to a greater severity.

The percentage of injuries that occur during PE and do not receive medical treatment (59.70%) is greater than the percentage of injuries that do receive medical treatment (40.30%). It becomes evident that the latter are more severe and will account for more circumstances of absence in class lessons. These findings agree with those in the scientific literature that indicate 40 to 50% of injuries in PE require medical attention, and represent lower values than the injuries that occur outside of PE lessons (Backx et al., 1991; Grimaud et al., 2007).

Limitations of the study

As limitations of this study, it can be mentioned that although random sampling was applied, the population still belongs to one single community (Madrid) and it would be recommended to extend the study to wider populations. There has been no opportunity to find an appropriate control group since in Spain PE classes are mandatory for this age group.

CONCLUSION

Absence in PE lessons due to injuries originated in class is very low (0.03%) in comparison to the expected participation of students, therefore it cannot be established as a significant source of student noninvolvement in instruction. The injury incidence rate in PE lessons is 1.90 for every 1000 hours, which is lower than the rate for structured and non-structured physical activity (2.09 and 2.13, respectively).

Lack of complete participation in PE lessons are generally caused by motives that are not health-related, and among those that are related to health conditions, illness is more frequent than injury. Additionally, injury outside of PE lessons is more frequent than those occurring during lessons. The most frequent type of injuries are muscle injuries, sprains and concussions, which are typically of a less serious degree than tendinopathies and fractures and which require longer periods of inactivity as part of their recovery.

Injuries that occur in PE lessons are most frequently located in the lower limb portion of the body and indirect trauma represents a higher percentage than direct trauma and overuse injuries. However, regarding absence in class, there is no significant difference between the different production mechanisms and anatomical regions. The injuries that do not require medical attention are more frequent in PE class, with no significant difference over those that do require it, whereas are the injuries that do require medical attention those that have a significantly greater proportion of lack of participation.

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