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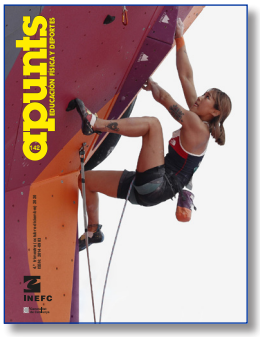

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Analysis of the Safety of Sports Equipment in Compulsory Secondary Education

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Abstract

The purpose of this study was to analyse compliance with the safety requirements of the sports equipment used in physical education classes in secondary schools in the Region of Murcia, Spain, based on the NIDE and UNE-EN standards and handbooks of best practices. The data were recorded through a series of ad-hoc checklists with dichotomous responses (0=does not comply/1=complies), analysing a total of 582 pieces of equipment owned by the schools in the sample (n=45). The results presented an overall compliance percentage of 70.94±8.44, with hoops presenting the highest rating, with 72.18±12.20, and volleyball standards the lowest, with 65.79±18.34. There were also statistically significant differences according to the ownership of the spaces where the equipment was located and depending on location, i.e. indoors or outdoors. Numerous risks were found in the equipment evaluated, and we therefore recommend that these risks be eliminated or reduced, together with a better monitoring of and compliance with the applicable regulations in order to keep them in a proper state of repair.

Keyword: sport, sports facility, risk management, evaluation, physical education.

Introduction

School sports spaces are the ideal setting for students to acquire physical activity habits (Gil et al., 2010). Therefore, it is essential to have appropriate, high-quality sports facilities and equipment (United Nations Education, Science and Culture Organisation, UNESCO, 2015; Tamayo & Ibáñez, 2006). In physical education (PE), these locations play a fundamental role in the future educational process and are the key tools available to teaching staff (Montalvo et al., 2010; Soriano, 2014).

One fundamental aspect is attending to the safety of this equipment, since although the majority of accidents that take place in school sports facilities are fortuitous, many of them are caused by the improper condition of the spaces and equipment used to practise sport (Barcala & García, 2006). This is inadmissible in today's society if we are to guarantee a quality education (Cabello & Cabra, 2006; Cavnar et al., 2004) and observe the regulatory framework (Instituto de Biomecánica de Valencia, IBV, 2010). Hence, the solution should encompass not only a classification of possible risks but also a better understanding of the aspects that can help to prevent them (Schwebel & Barton, 2005).

In this vein, most of these accidents could be averted if proper safety measures were followed (Adams et al., 2016), and which are needed to preserve not only students' but also instructors' physical integrity to the greatest extent possible (Gallardo et al., 2009; Gómez & López, 2019) through preventive actions (Soriano, 2014). For this purpose, the requirements set forth in the regulations in force must be borne in mind when sports equipment is acquired in order to guarantee passive safety, which is related to compliance with the applicable conditions.

In this regard, Spain has historically lacked regulations on sports equipment, which has influenced both the quality and the practice of sport in general (Durá et al., 2004). Despite this, Lucio (2003) states that in the last decade, considerable legal regulatory developments have been implemented in the field of physical-sport activity, and that while some of these regulations do not specifically correspond to education, their influence in this area is undeniable (IBV, 2010).

Nationally, and while attempts have been made to create a common framework of regulations and conditions to be fulfilled by sports equipment through the "Draft decree regulating the basic safety requirements of sports equipment with multisport courts and multisport pitches" (Consejo Superior de Deportes, CSD, 2009), the actual Decree never materialised. Only the region of Navarre has regulations on the measures required to use sports equipment, through its Regional Decree 38/2009, dated 20 April 2009, regulating the basic requirements and safety measures of sports facilities and equipment.

This lack of regulation has jeopardised not only users, because of the risks posed by the apparatuses, but also the manufacturers of sporting equipment, who face a problem when designing and distributing their products depending on their destination (Durá et al., 2004). However, now, pursuant to the Directive 2001/95/EC of the European Parliament and of the Council of 3 December 2001 on general product safety, all companies must guarantee that the items they sell are safe, meaning that they fulfil the specific national requirements or European Union standards, otherwise they have to take corrective measures. In Spain, this directive was transposed as Royal Decree 1801/2003, of 26 December 2003, on general product safety, which specifies that public administrations must oversee compliance.

In the case of school sports facilities, the minimum requirements of schools that teach the second cycle of preschool, primary and compulsory secondary education are regulated by Royal Decree 132/2010, of 12 February 2010, stipulating that sports facilities at schools must meet minimum safety conditions, just like other teaching infrastructures, although it leaves the specific definition of the requirements up to the applicable legislation.

The requirements for sports equipment are described in the NIDE and UNE standards, which are not obligatory unless thus specified by the authorised administration by law, decree or regulation, or if the competent Administration requires compliance with them in the form of technical specifications in construction projects or procurement contracts. However, given the above, they must be taken into consideration in order to guarantee risk-free sports practice.

Despite this, in recent years several studies have analysed the safety of sports equipment and facilities in schools in Spain, finding numerous cases of noncompliance with the safety requirements (Luis del Campo & Hernández, 2016; Gallardo et al., 2009; Gil et al., 2010; Latorre et al., 2010; Lucio, 2003; Montalvo et al., 2010; Sánchez et al., 2012; Soriano, 2014).

More specifically, in the autonomous community of the Region of Murcia, no studies addressing the safety of sports equipment used in compulsory secondary education were found. However, the studies previously conducted in Spain, as well as the fact that this region is among the lowest-ranked in terms of quality of sports facilities (Burillo et al., 2010), shed some light on a situation that evinces the need to analyse this equipment in Murcia.

With this purpose in mind, the overarching objective of this study was to analyse compliance with the safety requirements stipulated by the NIDE and UNE-EN standards and handbooks of best practices of the sports equipment used in PE classes in public secondary schools in the Region of Murcia.

Methodology

This study was framed within the descriptive, nonexperimental and transversal quantitative methodology through in-situ data collection by means of systematic observation.

Participants

The population of this study ($n = 112$) were public secondary schools in the region of Murcia during the 2015-16 academic year. The participant sample ($n = 45$) was chosen through simple random sampling without replacement for a confidence level of 95% and an error of 5%. It should be noted that seven of the schools initially extracted did not authorise the study, hence sampling was resumed among the remaining schools until the sample size initially determined was reached. The reasons for not participating were, in one school, that they did not have sports facilities, in another that the research staff had no affiliation with the school, while the remaining five simply stated that they were not interested in the study.

Of the schools in the sample, the sports equipment located in their sports facilities and/or the equipment used in affiliated municipal sports venues when they lacked own facilities were examined. In choosing the equipment, we bore in mind the most common types found in conventional sports spaces (goals, baskets and volleyball and badminton standards) and did not analyse the gymnastics equipment since there is hardly, or none at all, in these schools and the use thereof is waning in modern educational programmes (Lucio, 2003). Nor did we examine equipment related to tennis or football, as virtually all of the school sports facilities lacked them, as observed in previous reference studies.

We ultimately analysed a total of 582 pieces of sports equipment, 160 goals, 289 baskets, 95 volleyball standards and 38 badminton standards.

Materials and instruments

For this study, we developed a total of four ad-hoc checklists according to the type of equipment to be analysed, with dichotomous responses (0=in noncompliance, 1= compliance). The items were based on the safety requirements of the NIDE and UNE-ES standards, as well as on tools created in previous reference studies (Cabello & Cabra, 2006; CSD/IBV, 2009; Latorre, 2008; Lucio, 2003) and handbooks of best practices (CSD, 2009), choosing only the aspects involving a real and objective risk and which corresponded to use in education.

Depending on the type of equipment to be evaluated, the items were grouped into different areas for each one of the physical parts of the equipment, as well as by aspects related to their stability and sturdiness, and finally by the existence of labelling according to the reference UNE standard.

Once the checklists had been produced, four PhDs in Physical Activity and Sport Sciences, specialised in sports management from three different universities with prior experience in studies similar to this one proceeded to check content validity. Two safety experts from the engineering and architecture disciplines with experience in sports facilities also participated in this study.

Similarly, before the data were collected, the chief researcher participated in a 9-hour training course provided by a specialised company between 11 and 15 April 2016 on the proper use of the measurement instruments used in this study, in the course of which the calibration of the equipment was also checked.

The observers were also trained between 18 and 22 April 2016, beginning with a detailed analysis of the checklists and an introduction to the measurement instruments and procedures. Finally, practical exercises were conducted using images, and interobserver agreement was checked with the Kappa coefficient in the last two sessions, yielding $k > .9$, denoting almost perfect concordance.

A pilot study was subsequently held by the three observers at five schools, after which three items were rewritten to make them easier to understand and two were eliminated since it was ultimately determined that their practical application was irrelevant.

Finally, the definitive checklists comprised a total of 20 items about goals, 26 items about baskets, 20 items about volleyball standards and 15 items about badminton standards.

Procedure

The schools in the sample were contacted by email to explain the rationale, reasons and characteristics of the study and how they would participate. They were

also provided with the contact details of the principal investigator and the institution.

One week later, they were contacted by telephone and furnished with a detailed explanation of the study and to schedule the visits, as well as to appoint the school's contact person.

Data were collected on site by at least two observers exclusively by means of a visual inspection of the sports equipment. The tests for sturdiness and stability provided for in the UNE standards were not performed because of the possibility of damaging or breaking the equipment. Furthermore, these more exhaustive inspections had to be conducted with specific instrumentation by companies approved by the National Accreditation Entity (ENAC).

The evaluation was conducted without interfering in the normal course of teaching in the period spanning 16 May and 2 December 2016.

Data analysis

The data collected during the visits, which came from the printed checklists, were entered into Microsoft® Excel 2007 for Windows spreadsheets on the same day as the visit.

Once the fieldwork had been completed, the data were coded for analysis by means of the SPSS Statistics® v.21 statistical programme. The data matrix was cleaned in order to detect potential recording or coding errors.

Normality tests were subsequently conducted depending on sample size or observations using the Kolmogorov-Smirnov test in cases in which the data obtained were ≥50 and the Shapiro-Wilk test when they were lower, in addition to the evaluation of asymmetry and kurtosis; a non-normal distribution was detected and non-parametric statistics were therefore used to analyse the results.

The relational analysis to detect whether possible statistically significant differences according to the ownership of the spaces where the equipment was located and their indoor/outdoor location was conducted by means of the corresponding contingency tables and Pearson's chi-squared.

Results

With regard to the overall results according to the equipment analysed, none of the volleyball or badminton standards met all the requirements, whereas some goals and baskets met all of them.

Regarding the percentage of compliance in each area, the highest rating in goals was for stability, with 92.81%, with only 3.1% not being securely attached. Conversely, labelling-related aspects presented the lowest percentage, with 10.52%, mainly because 12.5% of them only had warning labels and 11.9% markings according to UNE-EN 749.

In baskets, the area with the highest compliance was the hoop, with 93.03%, although this figure fell to 8.89% in labelling requirements, as only 1.4% carried labelling and warnings and 12.6% markings according to UNE-EN 1270.

In the case of the volleyball standards, the aspects related to the sturdiness of the equipment presented a compliance of 95.79%, whereas, as had also been the case in goals and baskets analysed above, only 6.32% carried the proper labelling.

Finally, regarding the badminton standards, sturdiness yielded the highest percentage of compliance, 97.37%, while the net scored only 21.05%, since more than 80% of the equipment evaluated did not have one (Table 1).

Table 1
Percentages of compliance according to type of sports equipment.

n	$\bar{x}$ (SD)	Max	Min	Area	$\bar{x}$ (SD)
Goals					
160	70.38 (12.01)	100	28.57	Frame	80.31 (20.29)
				Net	35.42 (44.18)
				Net attachment	87.67 (16.04)
				Stability	92.81 (21.61)
				Sturdiness	80.63 (36.34)
				Labelling	10.52 (24.98)

Note. [a] No tightener available. [b] Only one item applies, as there are no reinforcement items. Own data.

Table 1 *(Continuation)*
Percentages of compliance according to type of sports equipment.

n	$\bar{x}$ (SD)	Max	Min	Area	$\bar{x}$ (SD)
Baskets					
289	72.18 (12.22)	100	23.08	Support structure	79.53 (19.52)
				Board	43.10 (26.56)
				Hoop	93.03 (19.26)
				Net	56.21 (47.62)
				Net attachment	92.57 (16.36)
				Stability	87.02 (23.85)
				Sturdiness	90.31 (27.19)
				Labelling	8.89 (23.71)
Volleyball standards					
95	65.79 (18.34)	93.75	25	Standards	64.84 (23.10)
				Net	54.74 (50.04)
				Tightener	76.59 (31.49)
				Stability	65.30 (30.24)
				Sturdiness	95.79 (17.36)
				Labelling	6.32 (24.45)
Badminton standards					
38	71.97 (13.84)	90.91	44.44	Standards	77.63 (19.96)
				Net	21.05 (41.32)
				Tightener	No aplica [a]
				Stability	86.84 (32.22)
				Sturdiness	97.4 [b]
				Labelling	26.32 (44.63)

Note. [a] No tightener available. [b] Only one item applies, as there are no reinforcement items. Own data.

Statistically significant differences were found in both goals and baskets, depending on the ownership of the sports space where the equipment was located. More specifically, municipally-owned equipment presented better compliance in terms of the possibility of entrapment; the existence, condition and secure attachment of the net; stability; the state of the structure and the hoop; and the presence and condition of padding. Conversely, there were more anti-tip systems in school-owned goals (Table 2).

Table 2
Significant differences according to ownership of the facility.

Equipment	Item	$\bar{x}$ Ownership		*p*
		Municipal	School	
Goals	6.1.3 No risk of entrapment.	100.0	78.2	.025
	6.2.1 Has a net.	100.0	33.1	<.001
	6.2.2 Net in good condition.	88.9	51.1	.005
	6.3.1 Net attached to post and crossbar.	77.8	46.8	.025
	6.4.1 Has anti-tip system.	77.8	99.3	.001
Baskets	7.1.1 Support structure in good condition.	100.0	81.4	.001
	7.1.7 Open space, obstacle-free.	98.1	86.5	.017
	7.2.1 Board in good condition.	94.2	74.2	.002
	7.2.2 Board protected with padding.	40.4	2.6	<.001
	7.2.3 Pad in good condition.	95.2	33.3	.004
	7.3.1 Hoop in good condition.	100.0	88.1	.009
	7.4.1 Has a net.	100.0	50.2	<.001
	7.4.2 Net in good condition.	100.0	78.0	<.001
	7.5.1 Net attached to hoop.	96.2	65.3	<.001
	7.6.2 Attachment or ballast system in good condition.	100.0	72.8	<.001

Note. Own data.

Table 3
Significant differences according to the location of the equipment.

Equipment	Item	$\bar{x}$ Location		*p*
		Indoors	Outdoors	
Goals	6.2.1 Has a net.	90.0	29.2	<.001
	6.2.2 Net in good condition.	81.5	47.4	.005
	6.4.1 Has anti-tip system.	86.7	99.2	.005
	6.4.2 Attachment system in good condition.	65.4	96.9	<.001
Baskets	7.1.1 Support structure in good condition.	98.3	75.7	<.001
	7.1.7 Open space, obstacle-free.	75.9	97.1	<.001
	7.2.1 Board in good condition.	97.3	65.3	<.001
	7.2.2 Board protected with padding	24.1	.0	<.001
	7.3.1 Hoop in good condition.	100.0	83.6	<.001
	7.4.1 Has a net	94.0	35.7	<.001
	7.4.2 Net in good condition.	94.5	67.2	<.001
	7.5.1 Net attached to hoop.	90.8	45.9	<.001
	7.6.1 Has an attachment or ballast system.	100.0	94.8	.012
	7.6.2 Attachment or ballast system in good condition.	100.0	62.6	<.001
	7.8.3 UNE-EN 1270 marking.	21.4	6.9	<.001
Volleyball standards	8.1.1 Standard in good condition.	94.1	39.5	<.001
	8.1.2 Lack of edges or rims.	100.0	58.1	<.001
	8.1.3 No risk of entrapment.	94.1	62.8	<.001
	8.2.1 Has a net.	76.5	27.9	<.001
	8.3.1 Corrosion-resistant tightener.	92.3	46.2	<.001
	8.6.1 UNE-EN 1271 marking.	17.6	.0	.004

Note. Own data.

Furthermore, statistically significant differences were found in goals, baskets and volleyball standards according to indoor/outdoor location. In this case, equipment located indoors presented a higher percentage of compliance, except in relation to the existence of an anti-tip system, the state of the goal attachment system and the absence of obstacles in the open spaces around the baskets analysed, which was higher in equipment located outdoors (Table 3).

Discussion

The overall mean percentage of compliance of the sports equipment analysed with the regulations was 70.94%. This result is higher than previous reference studies, the majority of which did not reach 50% (Cabello & Cabra, 2006; Herrador & Latorre, 2005; Lucio, 2003; Sánchez et al., 2012), as well as the figures from the study conducted by Montalvo et al. (2010), which did not state specific percentages but did mention poor compliance with the regulations.

In terms of the overall results of each type of sports equipment analysed, two goals were found to meet all the requirements evaluated, while in the study by Lucio (2003), none met all the requirements, although this number rose to seven exclusively in terms of safety criteria. The overall mean percentage of compliance was 70.38%, higher than that of previous studies, which did not reach 50% (Luis del Campo & Hernández, 2016; Sánchez et al., 2012), although the analysis tool and geographic scope were different. It should be emphasised that while 96.9% of the goals are equipped with anti-tip systems and 91.6% of them are in good condition, compliance with these requirements is mandatory, since according to the UNE-EN 15567 standard, an omission may lead to serious injury. Moreover, compliance also precludes regulatory inspection demerits based on the UNE 1920001-1 standard.

In the baskets, as occurred with the goals, two fulfilled all the requirements evaluated, compared to none in the study by Lucio's (2003), although this number rises to 29 if purely safety criteria are considered. The overall mean percentage of compliance was 72.18%, much higher than the mean found in previous studies conducted in other communities, such as the one by Sánchez et al. (2012) which found 40%, and by Luis del Campo and Hernández

(2016), with 53%. However, the findings of our study concur with the latter in that basket equipment presents the highest level of compliance.

With regard to volleyball standards, unlike goals and baskets, none of them met all the requirements evaluated, in consonance with the results of Lucio (2003). The overall mean percentage of compliance was 65.79%, higher than what Sánchez et al. (2012) found, which was under 50%, and amply surpassing the 14% found by Luis del Campo and Hernández (2016), although the findings of our study concur with the latter in that volleyball standards present the lowest percentage of equipment compliance.

Finally, like their volleyball counterparts, no badminton standards met all the requirements evaluated, matching the results of Lucio (2003). The overall mean percentage of compliance was 71.97%, higher than the 62% found in the study by Sánchez et al. (2012), in which badminton standards earned the highest score, although the analysis tools used are different.

Considering ownership of the spaces where the equipment analysed was located, higher compliance was found outside schools. In this regard, Zagel et al. (2019) also detected a higher likelihood of sustaining sport-related injuries at schools compared to outside facilities, citing the higher quality of the sports equipment at the latter as one of the possible explanations.

Despite the existence of regulations and recommendations on equipment safety, noncompliance was detected at all the schools analysed. For this reason, previous studies suggest mandatorily including compliance with the regulations at school sports facilities in order to achieve high-quality sports spaces and equipment (Gallardo et al., 2009; Gil et al., 2010; Montalvo et al., 2010).

In this regard, Luis del Campo and Hernández (2016) argue that while this recommendation would be ideal, the problem would be in adapting all the existing school sports facilities and equipment to these criteria, which would require the competent Administration to provide the relevant economic and human resources, and if they could not do so, the issue of the use of these facilities such would have to be addressed. However, certain criteria contained in the NIDE and UNE-EN standards provide for regulations related to the practice of federation sports and may be partly modified to adapt to schools; nevertheless, safety requirements should be met regardless of the type of sports equipment.

Regardless of initial compliance with the applicable regulations, a periodic check of the condition of sports spaces and equipment is needed (Luis del Campo & Hernández, 2016; Gallardo et al., 2009; Herrador & García-Tascón, 2016; Latorre, 2008; Lucio, 2003; Montalvo et al., 2010; Sánchez et al., 2012) for preventive purposes (Montalvo et al., 2010; Soriano, 2014; Zagel et al., 2019). To achieve this, the teachers of these activities, who are ultimately responsible, must participate in training actions and periodical retraining (Gambau, 2015; López, 2014). Students should also be involved through awareness-raising programmes addressing the risks encountered in physical-sport activities in schools (Latorre et al., 2014).

Conclusions

The objective of this study was to analyse compliance with the safety requirements provided for by the NIDE and UNE-EN standards and handbooks of best practices of the most common sports equipment (goals, baskets and volleyball and badminton standards) used in PE classes in secondary school.

In this regard, numerous safety defects were found in the sports equipment analysed, which could pose risks when they are used. Indeed, none of the equipment at any of the schools analysed met all the requirements.

Similarly, by and large there was greater compliance with the regulations in municipal facilities, and adherence to these regulations is rigorously enforced in facilities intended for public use or for competitive sports, whereas such compliance takes something of a back seat in equipment in schools. Despite the non-competitive nature of the PE subject, safety criteria must be exhaustively fulfilled, as they seek integral student development, which serves as the foundation for future sports practice.

In terms of equipment location, generally speaking greater compliance was observed in indoor sports facilities compared to outdoor venues, as well as better maintenance, hence solutions that offer greater resistance to weather and vandalism should be pursued and equipment checks and maintenance be improved to prevent accidents.

Therefore, according to our results, and by way of a final reflection, we propose the following actions to improve the current situation:

1) A protocol and record of inspections of sports equipment and facilities should be created to facilitate exhaustive, unified monitoring of compliance with the regulations.

2) Training and awareness-raising actions in good practices in the use of sports material and equipment for the entire educational community should be conducted.

3) Actions should be implemented to invest in replacing and purchasing new sports equipment, particularly outdoor equipment.

4) Compliance with the UNE or UNE-EN standards should always be required by the public administration and in the submission of technical specifications for the procurement of sports material or equipment.

Finally, regarding the limitations of this study, and with future interventions in mind, we would highlight the need for it to be conducted systematically at all schools in order to obtain a true picture of the problem.

Similarly, the differences between certain autonomous communities table the need to establish common nationwide protocols and take the relevant regulations into account. By doing so, state-wide data could be obtained through a larger study and actions with a broader scope could be undertaken.

Finally, in addition to the training required to address a problem of this magnitude and the resources needed to be able to act accordingly, it would be worthwhile to focus on investigating new designs of sports material which could at least partly solve the main safety problems and adapt it properly for use in PE classes.

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