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Secondary Prevention in School Sports – Does Teachers' First Aid Education Meet the Recommendations in Class?

Sekundärprävention im Schulsport – Erfüllen die Erste-Hilfe-Kenntnisse von Sportlehrern die Anforderungen bei Notfällen im Unterricht?

Summary

- ▶ **Objective:** The objective of this study was to investigate whether the actual First Aid (FA) knowledge of German physical education (PE) teachers in 2014 differed from a 2008 pilot study (PS) that revealed a lack of FA knowledge amongst German PE teachers. Additionally, a second objective was to identify whether or not the current FA knowledge is at an appropriate level to handle school sport injury incidents.
- ▶ **Material and methods:** A multiple-choice questionnaire was compiled based on a questionnaire of the PS and on actual analysis of school sport accidents in Germany. It was answered by secondary school PE teachers (n=92). The results were compared to the results of the pilot study in 2008 using non-parametric tests.
- ▶ **Results:** A general lack in FA knowledge was identified as only two of 54 statements were answered correctly by all participants, especially in basic topics such as positioning, limb fractures, back injuries and the effects of climatic influence like heat and cold.
- ▶ **Conclusions:** In order to improve PE teachers' FA knowledge and adapt it to the school sport accidents they face, it is recommended that PE teachers participate in sports-specific FA training and refresher courses every two years and that this training be part of their academic education and postgraduate training.

Zusammenfassung

- ▶ **Zielsetzung:** Ziel der Studie war es zu untersuchen, ob das aktuelle Erste Hilfe Wissen deutscher Sportlehrer in 2014 von den Ergebnissen einer Pilotstudie aus 2008, die ein mangelhaftes Wissen deutscher Sportlehrer offenbart hatte, unterscheidet. Außerdem war ein weiteres Ziel der Studie zu untersuchen, ob das aktuelle Erste Hilfe Wissen der Sportlehrer für die Behandlung typischer Verletzungen im Schulsport ausreichend ist.
- ▶ **Material und Methoden:** Basierend auf dem Fragebogen der Pilotstudie von 2008 und auf aktuellen Analysen bezüglich Sportverletzungen an deutschen Schulen wurde ein Multiple-Choice Fragebogen erstellt. Dieser Fragebogen wurde von Sportlehrern an Gymnasien (n=92) in Nordrhein-Westfalen beantwortet. Die Ergebnisse wurden mit den Ergebnissen der Pilotstudie 2008 mit Hilfe nicht-parametrischer Tests verglichen.
- ▶ **Ergebnis:** Es fanden sich generell Defizite im Erste Hilfe Wissen, nur 2 von 54 Aussagen wurden von allen Teilnehmern richtig beantwortet, insbesondere bezüglich grundlegender Themen wie Lagerung eines Verletzten, Extremitätenfrakturen, Rückenverletzungen und den Einfluss von Umweltfaktoren wie Hitze oder Kälte.
- ▶ **Fazit:** Um das Erste Hilfe Wissen von Sportlehrern zu verbessern und an die Anforderungen der Schulsportverletzungen anzupassen, ist es notwendig, dass sportsspezifische Erste Hilfe Kurse fester Bestandteil von akademischer Ausbildung und regelmäßiger Fortbildung werden und dass die Sportlehrer etwa alle 2 Jahre an entsprechenden Auffrischkursen teilnehmen.

KEY WORDS:

Physical Education, Accidents, First Aid

SCHLÜSSELWÖRTER:

Sportunterricht, Unfälle, Erste Hilfe

Introduction

Over the past decades recognition of the importance of physical education (PE) for the general public has increased. It is widely recognized that activity can prevent important risk factors for widespread diseases (3). The positive benefits of physical activity are best achieved if performed regularly and safely. It is recommended that sport and PE begin early during childhood (20) and that PE in schools teaches

appropriate knowledge, and attitude so students can participate in safe and injury-free activities (29). In Germany, PE in primary and secondary schools is performed for approximately two hours per week and provides the opportunity for children to improve their perception, to design new types of physical activity, to learn responsibility, health consciousness, and fair competition (26). To support this, it is

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imperative that the environment is safe and that PE teachers are prepared to convey safety knowledge and to perform sufficient First Aid (FA) in any case during their PE classes. An example of potential consequences of inappropriate FA and FA knowledge is the case of a 18 years old student at a High school in Germany who collapsed in a PE lesson and thereafter suffered dramatic brain injury due to inappropriate FA of the teachers who did not check the breathing (8). The literature suggests that appropriate intervention can influence outcome positively (4, 9, 34), therefore putting the focus on FA is reasonable.

In North-Rhine-Westphalia (NRW), the most populated province in Germany (23), over 2.5 million children attend school with a significant proportion of them attending "Gymnasium" – designated schools, which are comparable to a combination of secondary and high school 5th to 13th grades (27). Approximately 300,000 injury-accidents occur in NRW schools each year with almost 90,000 incidents occurring during PE (12). Compared to other school activities and locations, injury events during PE are the most common incident (16).

There are several factors which contribute to accidents and the severity of injury during PE at school. These are for example teacher's experience, the environment, and pupil's knowledge, preparation, and training, the time of day and sociodemographic factors (16). It should be noted that their degree of contribution is not yet clarified (16). Over 90% of the accidents are not related to any technical or construction deficiency (12). Most are recognized as errors made by teachers and/or pupils (12).

Injuries vary including strains and sprains, superficial wounds and fractures involving the upper and lower limbs, head and neck (Table 3). Injuries are influenced by individual diversity of pupils (12). That is why classical primary prevention techniques such as special assistance or using other materials for balls are limited (20).

Approximately 50% of teachers have standard and sport-specific FA training and about 90% state they are capable of FA in the event of an accident in their class (12). Standard FA courses recently became part of the academic education of PE teachers, but these courses do not yet provide sports specific FA. Standard FA courses focus on urban and traffic accidents and teach for example CPR, recovery position and especially self-protection (31). Appropriate FA can influence the outcome after injuries, therefore putting the focus on specific FA is reasonable (4,9,34).

As identified by a pilot study (PS) in 2008, there is an overall lack of FA knowledge (20). In the PS 25 PE teachers volunteered to answer the pilot questionnaire consisting of 11 questions and all in all 54 answers. The results of the PE teachers were compared with a control group of 25 persons with sports specific FA training (20). Due to the changes of the academic education of teachers in 2011 (39) some universities offered sportsspecific FA courses that are not mandatory but elective courses. Therefore, an investigation of the current FA knowledge is reasonable. This current study (CS) is intended to give an update of the PS with a larger population and with the direct intention to become the basis for a specific FA education programme for PE teachers which meets the needs of sufficient FA.

Material and Methods

The methodology was based on the methods utilized in the PS (20, 22). The original 2008 multiple-choice questionnaire, that had been validated by physicians with UIAA Mountain Medicine Diploma, was modified to include a fifth optional answer for one question and a twelfth question with the topic "rescue chain". The questions had different topics that were orientated

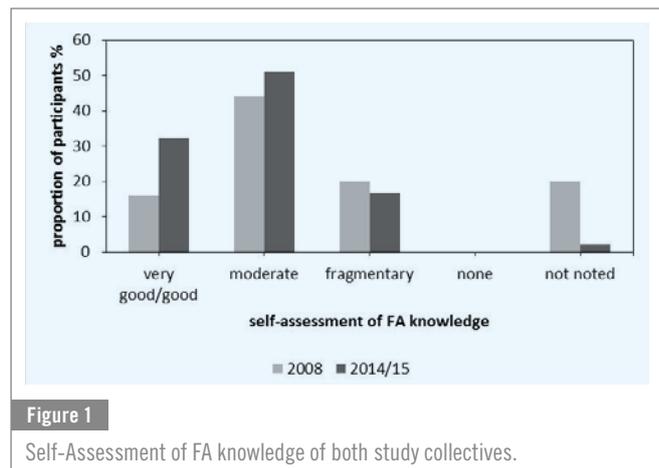


Figure 1

Self-Assessment of FA knowledge of both study collectives.

according to the accident occurrence in NRW (12). Additionally, the questionnaire asked for demographic data, education, work experience, education in FA and self-assessment of own FA knowledge. The latter was rated by a 5-point likert scale with 1 being very good and 5 being none (20). The study was anonymous (single blind design). We contacted the headmasters of 44 secondary schools located in different regions of NRW and got contact to the PE teachers of 16 of them. Ninety-two PE teachers voluntarily answered the questionnaire. All of them could be included into the evaluation. The Rasch model was used for analysing the questionnaire's validity and the data fitted the model (19). Statistics were performed using non-parametric tests (χ^2 -test) and the significance level was defined as $P < 0.05$ and $0.05 < P < 0.1$ was defined as a trend. The study has been approved by the ethics committee of RWTH Aachen University.

Results

The CS displayed a similar gender distribution as the PS but a dissimilar structure of age distribution (Table 1). 48.1% of the PS participants had attended a standard FA course within the previous 5 years whereas 81.2% of the participants in the CS had attended one within this period. One quarter of the teachers in the CS had an additional sports specific FA education including rescue swimming, 4.4% attended a sports specific FA course which was not rescue swimming. In their self-assessment, 32.3% participants rated their knowledge as "very good" or "good" compared to 16% in the 2008 PS. This is a significant difference. Another 50% rated their knowledge as moderate and 16% as fragmentary (Figure 1).

Each participant of the CS answered an average of 37.5 \pm 3.55 (69.4%) of the 54 statements included in the PS correctly. Two of 54 (3.7%) statements were answered by all participants correctly and 18 of 54 (33.3%) answered by more than 90% of the participants correctly. Compared to the results of the PS where three of 54 statements (5.5%) were answered by all participants correctly and 8 of 54 (14.8%) by more than 90% of the participants correctly, the knowledge level in the CS seems to have improved (Figure 2, Table 2). The difference between the both studies concerning the statements that were answered by 90% of the participants correctly is significant.

Hypovolaemic Shock

The symptoms of hypovolaemic shock are well-known without any difference between both studies (80%, 20/25 PS vs. 80%, 74/92 CS, statement 3a, Figure 2, Table 2). The awareness of a hypovolaemic shock without external bleeding has increased from 17/25 (68%) in PS to 72/92 (78.2%) (4a, n.s.).

Table 1

Additional data of the study collective, especially demographic data. y= years.

CATEGORIES	NUMBER OF PEOPLE (%)					
	FEMALE 39 (42.4%)			MALE 53 (57.6%)		
Age in y	<30		30-50	>50		n/a
	21 (22.8%)		41 (44.6%)	29 (31.5%)		1 (1.1%)
Year of Graduation	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019	n/a
	12 (13.0%)	14 (15.2%)	11 (12.0%)	21 (22.8%)	27 (29.4%)	7 (7.6%)
Years of Work Experience in y	<10		11-20	21-30		>30
	54 (58.7%)		12 (13.0%)	9 (9.8%)		16 (17.4%)
First Aid Course	Within last 2 years		Within last 5 years		>5 years before	
	28 (30.4%)		41 (44.6%)		19 (20.7%)	
Medical Knowledge (e.g. paramedic, lifeguard...)	Yes			No		
	12 (13.0%)			80 (87.0%)		
Self-Assessment	Very good	Good	Moderate	Fragmentary	None	n/a
	4 (4.4%)	25 (27,2%)	46 (50%)	15 (16.3%)	0	2 (2.2%)

Table 3

Percentage of certain types of injuries in total school sports injuries.

PROPORTION OF CERTAIN KINDS OF INJURIES	
Fractures	13%
Strains and sprains	42%
Rupture, deep wounds	5%
Bruise, concussion	34%
Superficial wounds	3%
Other	3%

Bedding

The knowledge of the appropriate bedding decreased from 21/25 (84%) in PS to 70/92 (76%) (3c, n.s.) in the CS. Compared to other types of bedding, the suggested bedding for shock and the recovery position (22/25, 88% PS vs. 85/92, 92.3% CS; 9e, n.s.) were still well-known. The bedding for stomach ache was less known in CS (52/92, 56%) than in PS (18/25, 72%, 9d, n.s.). The fact that the patient could perform whichever position he or she wants if there is no medical reason for another positioning was rather known in CS (70/92, 76%) than in PS (14/25, 56%; 9a, P=0.075). The knowledge of how to handle thoracic trauma was even in the CS (59% (54/92) CS vs 52% (13/25) PS, 7b, n.s.). The knowledge of positioning the patient with thoracic trauma on the injured side was still marginally represented (8% PS vs. 15% CS, 7a, n.s.). In terms of head injury, a bearing with a slightly higher head is advantageous was also not well-known (11/25, 44% PS vs. 52/92, 57% CS, 5a, n.s.).

Fractures

The ability to handle fractures was significantly less known in PS (17/25, 68%) than in CS (89/92, 93.5%; 4d, P <0.005). The possibility of pain-reduction through gentle traction and immobilization was less well known in both studies (6/25, 24% PS vs. 8/92, 8.7% CS; 4b, P<0.1), while the collective in CS showed a trend to more unawareness. Sterile covering of an open fracture was well-known in both studies (21/25, 84% PS vs. 76/92, 83% CS, 11c, n.s.).

Spinal and Head Injury

The knowledge of the importance of immobilization for a patient suspected of having a spinal injury remained similar (21/25, 84% PS vs. 71/92, 77% CS, 2d, n.s.), but the diagnosis was not always recognized in PS (22/25, 88%) unlike the CS (92/92, 100%, 2e, P<0.01). The immediate diagnostic techniques, namely the check of sensibility and muscle strength of the legs (12/25, 48% PS vs. 56/92, 61% CS, 2b, n.s.), the enuresis as a sign of spinal cord injury (13/25, 52% PS vs. 39/92, 42.4% CS, 2c, n.s.), were hardly mastered by the PE teachers. Considerably unknown was the particular risk of hypothermia in such injuries (6/25, 24% PS vs. 27/92, 29.3% CS, 2a, n.s.) which might be relevant if the lesson is held outside. That cervical trauma may occur as an accompanying injury in a head injury was frequently known (23/25, 92% PS vs. 74/92, 80% CS; 5d, n.s.). A soft pad does not preclude a brain injury (24/25, 96% PS vs. 89/92, 97% CS, 5b, n.s.) and dilated pupils are a sign of brain damage (17/25, 68% PS vs. 89/92, 97% CS, 5e, P<0.01). In both topics there was a significantly better result in the CS.

Climatic Influence

The diagnosis of hypothermia was provided correctly by 84% (21/25) in PS and 93.5% (86/92) in CS (1a, n.s.). The consequences of this diagnosis were still unknown. 24% (6/25) in PS and 48.9% (45/92) in CS (1e, P<0.05) were aware of the risk of death as consequence of mobilization while the CS collective showed a significantly better result. 36% (9/25) in PS and 55.4% (51/92) in CS (1d, n.s.) knew the risk of windchill effect and moisture. The symptoms of heat stroke were known by most of the subjects (19/25, 76% PS vs. 65/92, 71% CS; 6a, n.s.), the possibility to improve the situation by cooling as well (18/25, 72% PS vs. 63/92, 68% CS; 6b, n.s.). 47.8% of the collective (44/92) knew (vs. 20/25, 80% PS; 6d, P<0.01) that heat stroke, unlike sunstroke, cannot be prevented by wearing a hat.

Type of Immediate Care

The possibility of avoiding pain and swelling of closed injuries by external cooling was commonly known (24/25, 96% PS vs. 85/92, 92.4% CS; 10b, n.s.). 95% of PE teachers (87/92) in the CS tended to send the student to a physician in the first question (10d)

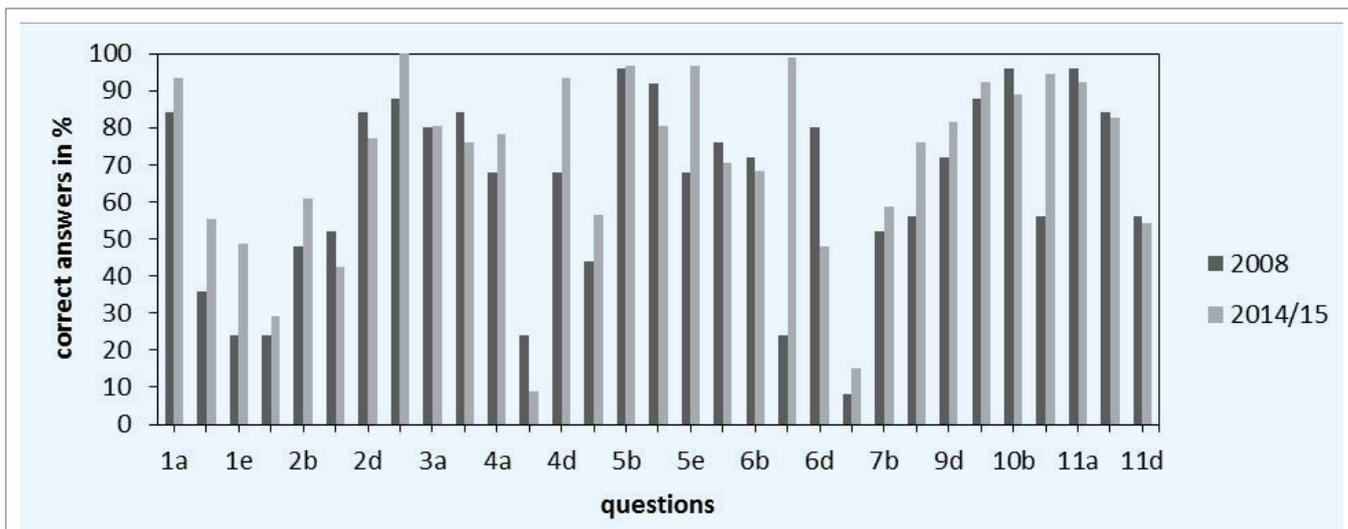


Figure 2

Correct Answers per Question in % of both study collectives.

concerning this object. In the second question (11d) just 54.4% (50/92) did so, but here a case with improvement of symptoms was described. In the PS there were only 56% (14/25) of the PE teachers who tended to send the injured student to a physician, so that in the case of lacking improvement of symptoms the difference between the two collectives was significant ($P < 0.01$).

Significant Differences

A significant difference or a trend in comparison with the PS was noted in nine of 54 statements. In seven of them the CS achieved better results concerning the risk of death caused by mobilization in patients with hypothermia (1e, Figure 2, Table 2), the treatment of spinal injuries (2e, Figure 2, Table 2), fractures (4d, Figure 2, Table 2), distinguishing between a cardiac disease and heatstroke (6c, Figure 2, Table 2), large pupils being a sign of brain damage (5e, Figure 2, Table 2) and the position desired by the patient in the absence of objective reasons for a particular bedding (9a, Figure 2, Table 2) by trend. The collective of the PS showed a trend of better knowledge of the analgesic effect of gentle traction at the end of a fractured limb (4b, Figure 2, Table 2) and a significantly better knowledge of the fact that a heat stroke cannot be prevented by a covering of the head (6d, Figure 2, Table 2). The collective of the CS showed a significantly better knowledge about the need for medical evaluation by a doctor if there is no improvement of the symptoms (10d, Figure 2, Table 2).

The “rescue chain” and corresponding actions like emergency calls are well-known in CS, except from the urgency of immediate care of the injured students compared to the supervision of the others.

Discussion

Approximately 72% to 98% of all school sport accidents take place in the sports hall where the majority of PE classes are held (12,35). Therefore, there is a high probability that PE teachers will be the first responders to an emergency (20). There is adequate contemporary data reporting accidents that occurred in schools in NRW (12,16). Therefore, putting the focus of the CS on the PE teachers in “Gymnasium” designated schools in Germany, is reasonable.

Approximately 20% of teachers face a life-threatening emergency situation during their time at work (14,15). Therefore, a sufficient knowledge of FA is necessary. Different investigations found an average of about 50% of teachers having attended a standard FA course within the last 5 years and 30% not at all (12,20). In contrast to that, in our CS 81.2% of teachers stated that they have attended a FA course which may arise from a possible selection bias. To improve the FA knowledge of PE teachers it is necessary to know which kind of FA is provided most often. Dieterich et al. found that in most cases (59.5%) immediate actions were performed and in 44.6% the teacher suggested a visit to a physician (12). This is similar to our results. PS and CS both identified that sprains, contusions, and traumatic brain injuries seem to be manageable for PE teachers (12). The uncertainty that the teachers stated concerning fractures (12) cannot be supported by our CS in which 93.5% set the correct diagnosis.

Psychological barriers are challenges to train people in FA (22) and those with higher individual risk do not tend to be interested in FA training (24). Lay people are able to learn basic life support, but refreshing is necessary (37,38), due to a significant decrease in knowledge and skills one year afterwards (32). Every 1 to 2 years should be the appropriate time for refresher courses (20,37). Methods include TV-based (33), audio-based, manikin-based courses (6) or online-courses (36). The best form of education should consist of theoretical and practical information. Students need to realize the problem, must be given a solution and explanation for the solution (13).

Comparing our CS to international investigations concerning FA knowledge of teachers is limited because of methodical differences and various organizational structures of PE classes in other countries. Appropriate FA knowledge of PE teachers can be compared with the necessary knowledge of high schools athletic coaches for example. Bull and Almquist et al. did some research and introduced some guidelines (2,7). In NRW, Germany, the requirements concerning healthy physical activity are summarized in the decree “Sicherheitsförderung im Schulsport” – “Safety promotion in school sports” (28). All of the investigations found a lack of FA knowledge in general and a need for improved FA education. There is a need for better knowledge about traumatic-brain-damage and concussions in high school coaches (17) and only one-third of Ransone’s collective of high school athletic coaches capable of sufficient knowledge in

concussion, sprained ankle, bleeding wounds, collapse, and dental injuries (30). A lack of training and knowledge in PE teachers in the Midwest of the US was found by Gagliardi (15). Cunningham et al. also stated that many of the football coaches he investigated do not dare to perform sufficient FA (11), a statement that does not apply to the data of the self-assessment in our studies. Abernethy et al. did the most similar investigation of PE teachers knowledge in post-primary schools in Ireland using a multiple-choice questionnaire with several scenarios (1).

The research centre "Mehr Sicherheit im Schulsport" (MSIS, engl.: more safety in school sports) provides data on school sport accidents in NRW and supports schools in self-evaluation and to improve safety (18), focussing on primary prevention first. Nevertheless the evaluation of accident occurrence can also be convenient for secondary prevention as is known from other sports like alpine skiing (21). Any change in accident occurrence should lead to an adjustment in sport specific FA education (5, 21). This should include not only the PE teachers' knowledge but also the necessary equipment such as an appropriate FA box and a phone to make emergency calls (14, 25). In 13 of 16 schools of our investigation the answers concerning the refilling of the FA box were so diverse that the integrity of the FA box was uncertain. Compared with arrangements in other countries that frequently have emergency action plans (10, 14), there is room for improvement in Germany, the evaluation of accidents is often too focused on primary prevention.

Limitations

A great proportion of contacted schools did not respond to our invitation, since only headmasters were contacted, it is difficult to say whether the PE teachers knew anything about our investigation. To minimize the selection bias we conducted the survey in combination with the periodic meetings of all PE teachers of one school in our CS as well as in the PS. Another potential bias is provoked by the choice of two different populations which are compared, but having the same population as in the PS was inconvenient and the population would have been too small.

Conclusions

There is a lack of FA education in PE teachers concerning typical and possible injuries in PE classes. A specific education program should maintain basic FA like basic life support or the immediate treatment of specific injuries that occur often in school sports. The most important topics are bedding, limb fractures, back injuries and environmental influence. A more aggressive approach to training PE teachers and providing refresher courses is also recommended. ■

Acknowledgements

The authors would like to acknowledge all the schools and teachers who participated in the study and strive to improve FA in school sports.

Conflict of Interest

The authors have no conflict of interest.

Table 2

Special statements and the proportion of correct answers in both studies. Some statements had to be excluded because they did not appear in the PS questionnaire or the original data of the PS got lost. Abbreviations: pilot study (PS), current study (CS). Dark grey=correct answers in CS<30%; light grey=correct answers in CS<50%.

STATEMENT	CORRECT ANSWERS IN % PS	CORRECT ANSWERS IN % CS	P-WERT χ^2	P-WERT MAN-WHITNEY-U
1 During an outdoor sports lesson in autumn a student is suddenly missing. You find him eventually without apparent injury. He cannot stand or walk and is dizzy.				
1a The student does not suffer from hypothermia.	84	93,5	0,27	0,14
1d If evacuation will take a longer period of time, moisture will be more harmful than windchill	36	55,4	0,13	0,09
1e The student should not be moved.	24	48,9	0,05	0,03
2 A student complains of backpain localized in the chest after an accident.				
2a If such an accidents takes place outdoors, there is a great risk of hypothermia.	24	29,3	0,78	0,60
2b One should check wether there is a lack in sense of touch or a lack of motility in leg muscles.	48	60,9	0,35	0,25
2c Enuresis may be a sign for a severe back injury.	52	42,4	0,53	0,40
2d Every movement should be avoided until a diagnosis can be made in hospital.	84	77,2	0,64	0,47
2e It is easy to spot back injuries because of the pain they cause.	88	100,0	0,01	0,00
3 An injured student lost a lot of blood.				
3a The following signs may appear: paleness, accelerated pulse.	80	80,4	1,00	0,97
3c The injured student should be positioned with raised legs	84	76,1	0,57	0,40
4 A student complains of huge pain in his thigh after a fall. He cannot put weight onto it and cannot move it.				
4a There is a risk for a shock without external bleeding..	68	78,3	0,42	0,29
4b Fixation and gentle train may reduce pain.	24	8,7	0,08	0,04
4d It is most likely a severe contusion	68	93,5	0,00	0,00
5 A student has fallen at a run outdoors and is unconscious now.				
5a Patients with head injuries should be positioned flat.	44	56,5	0,37	0,27
5b A fall on a smooth surface (e.g. soft pat) excludes a cerebral trauma.	96	96,7	1,00	0,87
5d In case of a traumatic brain injury there may be also an injury of the cervical spine.	92	80,4	0,29	0,18
5e Enlarged pupils show that there is no brain damage.	68	96,7	0,00	0,00
6 A student collapsed red-faced during a lesson of soccer held outside in sunny weather.				
6a He suffered from a heatstroke, if he has dry and hot skin.	76	70,7	0,78	0,60
6b The quickest recovery may be achieved by cooling with as cool water as possible.	72	68,5	0,93	0,74
6c A cardiac problem is excluded.	24	98,9	0,00	0,00
6d This may be prevented by wearing a hat.	80	47,8	0,01	0,00
7 A student has severe chest pain on the right side and dyspnea after a violent collision with a fellow student.				
7a The injured student should be laid on the injured side.	8	15,2	0,55	0,36
7b It is probably a serial fracture of the ribs.	52	58,7	0,71	0,55
8 Pain management after accidents in sports				
8a In case of stomach ache a positioning with elevated legs to relax the abdominal wall may be helpful.	72	56,5	0,24	0,16
9 Which statements concerning positioning of injured people are right?				
9a The position which is most comfortable for the person is the best if there are no medical reasons against it.	56	76,1	0,08	0,05
9d In case of stomach ache after a collision the student should be laid on the back with elevated legs.	72	81,5	0,44	0,30
9e An unconscious student should be laid in recovery position.	88	92,4	0,77	0,49
10 During a volleyball match a student has blocked a shot and has now an aching hand.				
10b Cold pack application or other external cooling with water may reduce pain and swelling of the hand.	96	89,1	0,51	0,30
10d If the student is not symptom-free after a break, the hand should be held still and an examination by a physician to exclude a fracture should be organised.	56	94,6	0,00	0,00
11 A student has fallen at a run and cannot put weight on his foot now.				
11a If there is no external bleeding, one can reduce pain and swelling by external cooling.	96	92,4	0,85	0,53
11c An open fracture should be covered with a sterile wound dressing.	84	82,6	1,00	0,87
11d Even if the student is symptom-free after a break, an examination by a physician is mandatory before a continuation of the activity.	56	54,3	1,00	0,89

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