ORIGINAL ARTICLE

Water safety: age-specific changes in knowledge and attitudes following a school-based intervention

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Objectives: To explore whether an intervention during mandatory schooling can lead to age-specific changes in water safety knowledge and attitudes.

Methods: Age-specific questionnaires were distributed to 202 kindergarten and grade one pupils, 220 elementary school pupils and 337 pupils attending the first three high school grades in Greater Athens. The information was used to design an educational package that was subsequently presented to pupils of the same grades and similar socio-demographic profiles attending different schools in the same area. One month later, a post-exposure evaluation was conducted using the initial questionnaires, in which 115, 205 and 321 pupils from the respective grade categories provided their responses. In order to compare the performance of pupils exposed to the educational intervention with that of pupils who participated only in the initial assessment, mean differences in scores measuring overall knowledge and attitudes were estimated within each of the three grade groups adjusting for age, gender, sibship size, maternal education and swimming knowledge.

Results: Among kindergarten and grade one pupils, those who received the intervention scored significantly higher for knowledge (17.40%, 95% CI 6.41% to 28.39%) and attitudes (23.64%, 95% CI 4.48% to 42.79%). Among elementary school pupils the gains in knowledge were less evident (14.58%, 95% CI −3.05% to 32.21%)) and almost null in attitudes (5.64%, 95% CI −11.47% to 22.77%). Further advancement of age showed no improvement in knowledge (−0.15%, 95% CI −5.30% to 4.99%) and a minimal, insignificant increase in attitudes (6.32%, 95% CI −1.87% to 14.52%) among exposed high school pupils.

Conclusion: The school-based intervention resulted in considerable positive changes in knowledge and attitudes among very young pupils. Elementary schooling seems to provide meagre opportunities to simply improve knowledge. Alternative/complementary approaches should be sought in any attempt to modify behavior.

Unintentional drowning is an important cause of injury mortality among children in Greece—it has the highest case fatality and is the second leading cause of unintentional injury mortality.[1 2] Compared with the original 15 member states of the European Union (EU), Greece has the highest childhood drowning mortality rate; the majority of the new member states of the enlarged EU seem to have even worse records.[1 2] During the five-year period 1997–2001, 27 Greek children aged 5–14 years drowned in Greece—the respective mortality rate is estimated at five children per million person-years. The country has a 13 676 km long coastline and mild Mediterranean climatic conditions. During the summer period the vast majority of the adult population is busy working in various aspects of the tourist industry, while the school-age population has a long (three months) vacation and daily opportunities to enjoy the seemingly-friendly open water environment. Consequently, most childhood drowning in Greece occurs during the summer period in the sea, as opposed to in swimming pools (which are, as a rule, the usual site of childhood drowning in other countries).

Effective childhood drowning prevention strategies mainly rely on passive measures, such as swimming pool fencing, whereas intensive awareness raising via mass media campaigns or targeted educational efforts seem to be among the few means available, especially for the prevention of childhood drowning in the open water environment. The impact of educational interventions in injury safety, however, is rather difficult to assess.[3–6]

Given the dismal national statistics, the Center for Research and Prevention of Injuries (CEREPRI) in Greece was keen to join a campaign undertaken in 2002 by several EU member states aimed at promoting both water safety and the prevention and control of drowning among children. In particular, CEREPRI assumed the responsibility of coordinating a mass media campaign and several educational and awareness-raising events in cooperation with local authorities across Greece. In this context, it was considered necessary to first customize the common EU messages for the national campaign and tailor them to the main causes of childhood drowning in the Greek physical environment and socio-cultural milieu. To this end, a preliminary water safety educational intervention in schools was performed in order to (1) assess baseline water safety knowledge and attitudes among children and (2) evaluate its impact and eventually use this information to channel activities and resources in the subsequent national campaign.

MATERIALS AND METHODS

Taking into account age-specific cognitive differences, knowledge and attitudes were assessed among three grade categories of pupils: kindergarten and grade one (aged 5 to less than 7 years, hereafter: kindergarten), elementary school (aged 7 to less than 12 years), and first three grades of the secondary education (aged 12–15 years, hereafter: high school) pupils.

Abbreviations: EU, European Union; CEREPRI, Center for Research and Prevention of Injuries

Accordingly, three age-specific questionnaires were developed in collaboration with pediatricians, lifeguards and pedagogues to assess knowledge and attitudes with regard to water safety and drowning prevention. The questionnaires were anonymous and comprised socio-demographic variables (age, gender, number of siblings, educational level of parents), self-reported pre-existing swimming knowledge (without floating devices) and multiple choice or open-ended questions regarding water safety knowledge and attitudes (see http://www.injuryprevention.com/supplemental for Appendix). The latter included country-specific items selected by the Greek team, whereas a combination of simple text with pictures was preferred for the questionnaire addressed to the very young pupils, which were developed after reviewing interventions undertaken elsewhere and the materials provided by the coordinators of the EU campaign.

Questionnaires were first tested in small groups of ~15 children per studied grade category, and no major problems were found regarding the pupils' question comprehension. During the first phase of the study (March 2002), health professionals from CEREPRI, in collaboration with school teachers, distributed the revised versions of the questionnaires in a convenience sample of schools and classrooms in the Greater Athens area.

To our knowledge, no previous systematic health education effort among pupils with regard to water safety had taken place. Therefore, the background information acquired in the needs assessment phase of the study helped the customization of age-specific audiovisual educational material to the actual needs of Greek children.

From mid April to mid May 2002, the same health professionals presented the age-adjusted materials to pupils with similar socio-demographic characteristics attending different schools from the ones participating in the first phase of the study but also located in Greater Athens. Specifically, a special day event was scheduled in class in collaboration with the respective schoolteacher, comprising a short audiovisual presentation followed by discussion on the personal experiences of pupils, comments on how relevant events could have been averted, and/or drama plays. Take-home materials such as leaflets, crosswords, stickers and pins with messages for water safety were also distributed.

Each classroom was revisited one month later by the same health professionals in order to submit the initial ''knowledge and attitudes'' assessment questionnaire to previously exposed pupils. The latter pupils comprised the intervention group, whereas those pupils who filled in the needs assessment and were not exposed to any intervention served as the comparison group. None of the pupils objected to completing the questionnaire. Twenty eight pupils who had been absent during the intervention did not participate in the evaluation process and another 24 were absent during the evaluation. Both health and education professionals were again present in class and volunteered to provide clarification as necessary, whereas socio-demographic characteristics of kindergarten pupils were completed ahead of time by the teacher. Upon completion, the questionnaires were delivered by the health visitor to CEREPRI for quality checking and analysis. This process was finalized by early June 2002—that is, before the launch of any other component of the national campaign on 3 July 2002.

The Ethics Committee of the Athens University Medical School as well as the Ministry of Education approved the study protocol and no parental consent or child assent was required due to the nature of the intervention.

Statistical analyses were conducted separately for each of the three grade categories. A score for knowledge and another one for attitudes were derived for each grade category (ie, six scores in total) by adding responses to all respective questions (correct = 1, wrong = 0), dividing the sum by the total number of the respective questions and then multiplying by 100. Subsequently, general linear mixed models were used to estimate differences in mean scores for children who received the intervention compared to non-exposed pupils. This analysis takes into account the clustering of children in classrooms and of classrooms in schools. The results of this analysis were also adjusted for the standard demographic variables: age (one year increments), gender and maternal education (years of education in three categories: 0–9 years, 10–12 years, over 12 years), which is considered the best single indicator of socioeconomic status in this country, as well as sibship size (one child or more), because it may affect the level of knowledge of children within families. Results were also adjusted for reported pre-existing knowledge of swimming (yes/no), as swimming knowledge may influence overall water safety knowledge and attitudes. Finally, the observed differential effect of the intervention across the studied grade categories was examined using the Wald test for heterogeneity.[7]

Table 1 Distribution and basic characteristics of the 1400 pupils by socio-demographic variables and knowledge of swimming by grade category and exposure to water safety messages status

	Kindergarten pupils		Elementary school pupils		High school pupils	
	Exposure to messages		Exposure to messages		Exposure to messages	
Variable	No	Yes	No	Yes	No	Yes
Age, mean years (SD)	5.63 (0.69)	5.50 (0.69)	9.41 (1.05)	9.47 (1.60)	13.46 (0.93)	13.37 (1.04)
Gender, n (%)						
Male	91 (45.0)	63 (54.8)	102 (46.4)	100 (48.8)	169 (50.1)	156 (48.6)
Female	111 (55.0)	52 (45.2)	118 (53.6)	105 (51.2)	168 (49.9)	165 (51.4)
Sibship size, n (%)						
1	55 (27.2)	36 (31.3)	32 (14.5)	35 (17.1)	36 (10.7)	43 (13.4)
2	105 (52.0)	59 (51.3)	124 (56.4)	105 (51.2)	190 (56.4)	186 (57.9)
3+	42 (20.8)	20 (17.4)	64 (29.1)	65 (31.7)	111 (32.9)	92 (28.7)
Maternal education in years, n (%)						
<10	21 (10.4)	3 (2.6)	22 (10.0)	16 (7.8)	75 (22.3)	45 (14.0)
10–12	91 (45.1)	73 (63.5)	63 (28.6)	53 (25.9)	151 (44.8)	130 (40.5)
13+	90 (44.5)	39 (33.9)	135 (61.4)	136 (66.3)	111 (32.9)	146 (45.5)
Knowledge of swimming, n (%)						
No	182 (90.1)	106 (92.2)	86 (39.1)	75 (36.6)	65 (19.3)	50 (15.6)
Yes	20 (9.9)	9 (7.8)	134 (60.9)	130 (63.4)	272 (80.7)	271 (84.4)
Total	202 (100.0)	115 (100.0)	220 (100.0)	205 (100.0)	337 (100.0)	321 (100.0)

Table 2 Mean (SD) values of knowledge and attitudes scores by exposure status and grade category as well as multiple linear regression derived estimates of the per cent of difference in mean scores due to exposure to messages

		Without exposure		After exposure				
Variable	Grade category	Mean score (%)	SD (%)	Mean score (%)	SD (%)	Adjusted* difference (%)	95% CI (%)	p Value
Knowledge	Kindergarten	65.68	20.68	84.20	17.64	17.40	6.41 (28.39)	0.005
	Elementary school	61.93	20.26	75.79	20.64	14.58	−3.05 (32.21)	0.08
	High school	70.59	16.85	70.82	18.79	−0.15	−5.30 (4.99)	0.92
						p<0.001		
Attitudes	Kindergarten	58.66	36.13	77.39	32.61	23.64	4.48 (42.79)	0.02
	Elementary school	42.82	20.05	48.58	20.28	5.64	−11.47 (22.77)	0.41
	High school	31.04	26.22	37.20	25.41	6.32	−1.87 (14.52)	0.09
						p=0.01†		

*Adjusted for age, gender, sibship size, maternal education and knowledge of swimming.
†Derived from the Wald test for heterogeneity of the underlying coefficients indicating the significance of the differential effect of the intervention by grade category.

RESULTS

The collaboration of pupils with health and educational professionals in the school environment yielded a dataset with minimal missing data (2.3%). All subsequent analysis is based on information provided by 202 kindergarten and grade one, 220 elementary school and 337 high school pupils during the initial assessment and by 115 kindergarten and grade one, 205 elementary school and 321 high school pupils during the post-exposure evaluation.

Table 1 shows mean ages and standard deviations as well as distributions of kindergarten, elementary and high school pupils by gender, sibship size, maternal education, reported knowledge of swimming and exposure to messages (intervention) status. Children not exposed to water safety messages and those who received the educational intervention were of similar socio-demographic profiles, apart from maternal education, among the high school pupils. Youngsters previously exposed to the customized educational messages were born to mothers of higher educational level than those in the comparison group, but this variable was controlled for in the subsequent analysis.

In table 2, mean (standard deviation) of scores for knowledge and attitudes both without and after exposure to water safety messages are presented, as well as differences in mean scores adjusted for age, gender, sibship size, maternal education and knowledge of swimming, taking into account the clustering of children in classrooms and of classrooms in schools. The intervention was in general associated with noticeable age-specific differentials in both knowledge and attitudes.

In particular, among kindergarten pupils sizeable adjusted positive differences in mean scores were evident for both knowledge and attitudes (17.40% (95% CI 6.41% to 28.39%) and 23.64% (95% CI 4.48% to 42.79%), respectively).

Among elementary school pupils, the adjusted difference in knowledge mean scores were proportionally smaller and not statistically significant in comparison to those noted among the very young children (14.58% (95% CI −3.05% to 32.21%)). The variance component results have been examined from mixed effect models. The random effects were found to be 26.8 for schools and 74.0 for classes in the schools. These figures are relatively small compared to the total variance (419.0) and statistically non-significant. If this result is taken to suggest that it is pertinent to calculate the degrees of freedom based on the number of the children and not on the number of schools then the estimated differences remain practically the same but the precision is improved (14.58% (95% CI 2.10% to 22.06%), $p = 0.02$). With regard to the attitudes score, however, the positive difference was minimal and not statistically significant (5.64% (95% CI −11.47% to 22.77%)).

Lastly, among high school pupils, there was almost no difference in the knowledge scale of the intervention compared to the control group (−0.15%, CI −5.30% to 4.99%); with regard to the attitude score, a slight positive difference was noted in the intervention group (6.32%, CI −1.87% to 14.52%). Examining as above, the variances of the random effects (0.07 for schools, 7.45 for classes in the schools) relative to total variance (635.56) are negligible, suggesting that it is appropriate to calculate the degrees of freedom based on the number of children and not on the number of schools. Therefore, pooling the degrees of freedom seems to be pertinent, in which case the adjusted differences remain practically the same but the statistical precision is improved (6.32% (95% CI 1.26% to 11.38%), $p = 0.01$).

Overall, the effect of the intervention was significantly different across grade category ($p<0.001$ for knowledge and $p = 0.01$ for attitudes).

DISCUSSION

Exposure of pupils attending mandatory education to customized messages mainly related to safety in the open water environment was only associated with sizeable and statistically significant positive changes in knowledge and attitudes among the very young. Marked differential effects were noted with the advancement of age, namely an attenuated positive change in knowledge among 7–12-year-old children and null afterwards, whereas there was little change in attitudes from the age of 7 onwards. On the basis of these findings, it was considered necessary to use alternative methods and adjust the allocation of resources for the subsequent national campaign, mainly to mass media-promoted events.

Passive injury prevention measures are preferable due to their apparently higher efficiency compared with active measures, including educational efforts. Despite their high theoretical effectiveness however, their implementation at population level can be hindered under real-life conditions.[8] For example, even though pool fencing has been shown to be an effective safety measure, Greece has not passed respective legislation mainly because of strong resistance from those in the tourist industry; neither did intensive efforts to convince policy makers during a campaign in 2002 yield any positive results. Gaps and barriers have also been identified between the theoretical effectiveness and the implementation/adoption of passive prevention measures for other types of injury at the population level.[9] This realisation necessitated concurrent undertaking of active measures which should converge towards the main objective, taking into account national or local time and cause coordinates. Indeed, the profile of childhood drowning in Greece and changes in social life during summer has focused the campaign mainly on safety in the sea and related activities.

To our knowledge, this is the first attempt to address drowning prevention among children that has mainly focused on open water environments. Our findings are in agreement

with current knowledge on safety interventions and practices in several health promotion domains of the EU, such as mental health, also calling for head start programs and showing a high potential for change among the youngest children, which thereafter decreases with age. This may be due to the fact that older children are less receptive to educational messages about safety than younger children.[10] Therefore, alternative methods should be sought in any effort to improve the uptake of information, affect attitudes and eventually contribute to behavior modification, among which those relying on positive peer pressure and active participation have challenging components.[11–14]

The effectiveness of intervention programs and educational campaigns regarding childhood injury prevention in general, or water safety and drowning prevention in particular, varies depending on the design, intensity and objectives.[3 4 5] Major concerns, however, relate to whether the observed gains would actually translate into behavioral changes that would have a long-term impact on water safety.[15–17] Indeed, it remains questionable whether even intensive efforts that involve active participation could result in concrete gains, as was the case with the partially successful school training effort targeting pedestrian injury prevention undertaken by Rivara *et al*.[18]

Our results need to be appreciated in the knowledge that this study was based on scarce resources and relied largely on voluntary work. Nevertheless, the conclusions drawn regarding both the process and the main results as to the potential effectiveness of an educational intervention in cognitively different age groups can be used by interested stakeholders in other countries with similar socio-demographic and geographical conditions. Moreover, the convenient methodology encourages practitioners to integrate a minimum set of evaluation components when initiating injury prevention interventions—an important issue in view of the EU-wide injury prevention campaigns envisioned in the forthcoming European Commission and Parliament Communications.[19]

Among the limitations of the study are the short duration of intervention and the fact that the evaluation was undertaken in a period quite proximal (within one month) to that of the respective exposure, which implies that the intervention might actually have an even less long-lasting effect. Moreover, as the children who participated in the assessment of background knowledge and attitudes were not the same individuals as those involved in the intervention and the post-exposure evaluation, there might be concerns about whether the overall results accurately reflect a before and after exposure experiment confined to the same individuals. However, as there were no major differences regarding socio-demographic characteristics and these variables were also controlled for in the analysis, it seems most likely that the design used in this study had no major impact in the estimated effect of the intervention (although the latter may still be biased by factors we were not able to consider). Furthermore, some additional bias cannot be excluded, as self-reported information allows scope for exaggerating positive behaviors.[4 11 20] This bias, however, is likely to be balanced between before and after exposure evaluation. The low proportion of absenteeism, as well as the fact that it was not selective on either the intervention or evaluation day at the individual level, suggests that no major bias is likely to have been introduced. Lastly, it was difficult to evaluate the differential impact of this educational intervention on the behavioral modification of pupils who participated in the study as the mass media components of the campaign, including daily radio and television advertisements, commenced immediately after the post-exposure evaluation. Although chance may have played a role, however, it is noticeable that during the respective summer period no childhood drowning was noted in the country.

Key points

- A modest, school-based intervention addressing water safety knowledge and attitudes produced positive changes among very young pupils, in line with current practices in several health promotion domains in the EU. To what extent this translates into long-lasting behavioral modification needs further exploration.
- For children age 7 years and above, using educational interventions to promote water safety faces the same obstacles as any other type of health education message. Alternative/complementary approaches should be sought when addressing this population group, especially when designing large-scale campaigns to change behavior.
- Whenever applicable, passive prevention methods should be used as they are more effective than educational efforts. However, if time-, country- and age-specific coordinates of childhood drowning call for it, carefully designed interventions with customized messages should be used.
- This is especially important where passive prevention measures are unrealistic—for example, in countries with favorable climates and greater access to open water.
- The potential contribution of the school system towards effective delivery of modest interventions to improve water safety knowledge and attitudes among the youngest pupils should not be underestimated.
- Convenient methodological designs may encourage practitioners to use a minimum set of evaluation components for injury prevention; this is important in view of the EU-wide injury prevention campaigns envisioned in the forthcoming European Commission and Parliament Communications.

In conclusion, exposure to customized and age-specific water safety messages through school-centered activities may facilitate the uptake of information and affect the attitudes of younger children. However, this educational process appears to have only a limited effect in inducing positive changes in attitudes, and even less of knowledge, from the age of 7 years onwards.

IMPLICATIONS FOR PREVENTION

Given the lack of passive prevention measures for childhood drowning, school-based educational interventions aimed at behavioral modification cannot be excluded, especially in less well-resourced countries with climatic and lifestyle conditions that maximize children's contact with water environments. The convenient study design and analysis used in the current study may help bridge the gap between theory and practice by reducing evaluation barriers faced by practitioners in the field. Moreover, it can help identify population segments that are more apt to uptake safety education messages over and beyond the age-specific patterns identified in the present investigation.

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