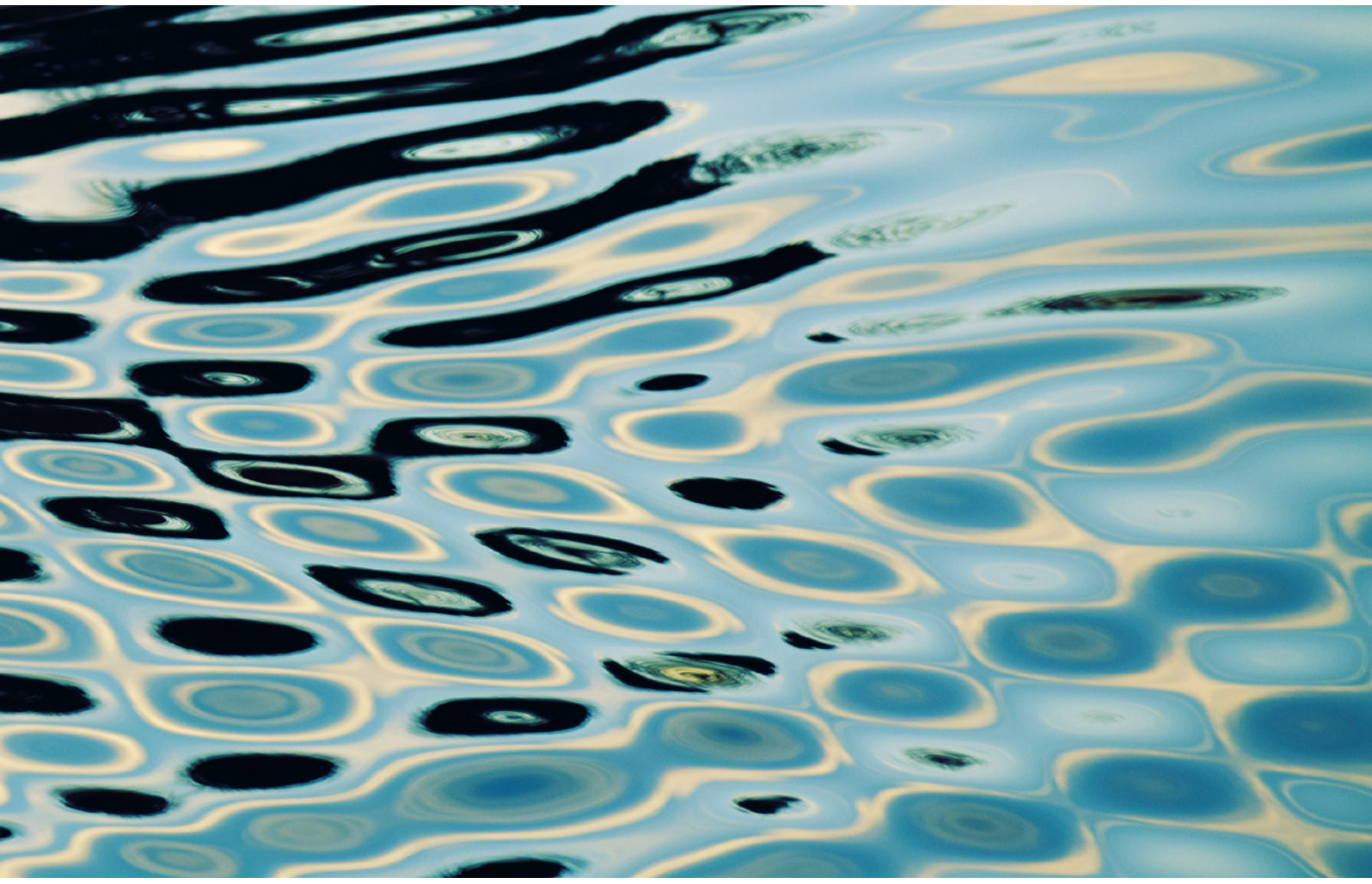
World Health Organization

WHO Guideline on the prevention of drowning through provision of day-care, and basic swimming and water safety skills



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Abbreviations and glossary

DALY: Disability-adjusted life year

EtD: Evidence to Decision (framework)

GDG: Guideline Development Group

GRADE: Grading of Recommendations, Assessment, Development and Evaluations (framework)

GRC: Guideline Review Committee

ICTRP: International Clinical Trials Registry Platform

LMIC: Low- and middle-income countries

PICO: Population Intervention Comparison Outcome

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-analyses

RCT: Randomized controlled trials

ROBINS-I: Risk Of Bias In Non-randomized Studies of Interventions

SEARO: Regional Office for South-East Asia

SDGs: Sustainable Development Goals

UNICEF: United Nations International Children's Emergency Fund agency (also known as United Nations Children's Fund)

UNFPA: United Nations Fund for Population Activities agency (also known as United Nations Population Fund)

WHA: World Health Assembly

WHO: World Health Organization

Glossary

Anchal: A community crèche (i.e. day-care) programme in Bangladesh

Créche: A simple nursery or pre-school programme for young children

Formal day-care: Structured arrangements ensured by trained and capable individual(s) or organization(s) (other than a child's guardians) to ensure supervision of a child is assured and attention given to a child's needs during the day

Pre-school programmes: An educational programme that combines learning and play designed for children prior to starting primary school

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4 Executive summary

Drowning is responsible for an estimated 236 000 deaths a year, half of which occur among people under the age of 30 years. This is likely an underestimation of the true injury burden as in many of the settings where drownings occur, surveillance systems are underdeveloped. And even where robust surveillance systems do exist, cause of death categorizations mean drowning deaths from natural disasters (i.e., floods) or transport-related deaths that occur on water are not recorded as drownings.

Globally, the highest drowning rates occur among children aged 1–4 years, followed by children aged 5–9 years. Drowning is one of the 10 leading causes of death for people aged 1–24 years in every region of the world. In many countries in the Western Pacific and South-East Asia regions, drowning is the leading cause of death for children aged 1–4 years, and in a considerable number of countries it is the leading cause of death among children aged 1–14 years. Well over 90% of drowning mortality occurs in low- and middle-income countries.

As a result of this burden, WHO has undertaken a guideline development process to address two critical research questions in the field of drowning prevention.

Research question 1 – Basic swim skills and water safety training: In low- and middle-income countries that suffer a significant burden of drowning-related morbidity and mortality, does the provision of basic swim skills and water safety training to children aged 6 years or older reduce drowning-related morbidity and mortality?

Research question 2 – Provision of day-care: In low- and middle-income countries, does the provision of programmes that provide capable child care under adult supervision (i.e. day-care) to children under the age of 6 years reduce drowning-related morbidity and mortality?

This guideline presents recommendations and related considerations on the appropriateness of **basic swim skills and water safety training** and the **provision of day-care** to prevent drowning among children in low- and middle-income countries. This objective is consistent with WHA64.27 on child injury prevention, SDG target 3.2 on ending preventable deaths of children under 5 years of age, and the strategic priority of WHO's 13th General Programme of Work, which is to see 1 billion more people enjoying better health and well-being by 2030.

The guideline also serves as a basis for two of three interventions addressed in a simultaneously produced implementation guidance document that focuses on lifesaving and rescue, provision of day-care, and basic swim skills and water safety training. The implementation guidance document draws on this guideline when describing in greater detail implementation of basic swim skills and water safety training and day-care provision. It does not draw on this guideline for information on implementing lifesaving and rescue skills programmes, as these are not within scope for this guideline.

The primary target audience for this guideline are low- and middle-income government agencies, developmental partners, civil society organizations, nongovernmental organizations, and stakeholders and staff involved in establishing or regulating basic swim skills and water safety training or day-care programmes. Those who will ultimately benefit from this guideline are children of any age receiving basic swim skills and water safety training, and children aged up to and including 5 years who can be enrolled in day-care, as well as the broader communities and societies within which these children live.

The Guideline Development Group (GDG) adopted the full scope of GRADE methodology as outlined in the WHO Handbook on guideline development. To familiarize GDG panelists with the GRADE approach, two online training sessions were held on its core concepts, preparatory materials for which were shared in advance.

GDG members contributed significantly to formulating and finalizing the Patient Intervention Comparison and Outcomes (PICO) questions. This included a consensus prioritization of outcomes that was achieved independently of the systematic review process. After consideration of multiple relevant outcomes, the only one deemed "critical" by the GDG was drowning-related mortality. Once the systematic reviews were completed, their core findings were distributed to GDG members and opportunities for input and feedback were provided.

Due to COVID-19-related travel restrictions, the face-to-face component of the GDG's work was held online over two meetings in May 2020. All members of the GDG attended, apart from one member who missed both meetings and one member who missed the second. The PanelVoice component of the GRADEpro software was used to facilitate input on the Evidence to Decision (EtD) framework ahead of the meeting. At the completion of deliberations, the GDG members voted in favour of both interventions (basic swim skills and water safety training and the provision of day-care).

Voting results: For the basic swim skills and water safety training intervention, the votes of the GDG's 13 voting members was 12 votes in favour of the intervention, and 1 against. For the provision of day-care intervention, the votes of the GDG's 12 voting members[1] was 12 votes in favour of the intervention and none against.

Basic swim skills and water safety training

WHO recommends basic swim skills and water safety training programmes for children aged 6 years or older in high-, low- and middle-income countries.

Strong recommendation; Moderate certainty in evidence.

Remarks

This strong recommendation was justified by the GDG based on the moderate certainty in the evidence reported in the systematic review in relation to the critical outcome of drowning-related mortality. It was also justified by the overall balance between the desirable and undesirable effects of swim skills and water safety training as reflected in most of the EtD framework criteria. Organizations that are implementing programmes must ensure the safety of participants and instructors through using appropriate risk-management practices during intervention implementation (i.e. practices that seem reasonably justified and feasible given known undesirable effects), and through adhering to relevant regulatory frameworks. Here, the word "relevant" is used because regulatory frameworks may exist in some, but not all, settings, mandating regulatory requirements for a diverse range of activities such as trainer certification, licensing of swimming sites, and microbiological testing of swimming venues etc. While the objectives of the guideline were directed primarily at low- and middle-income countries, the GDG also endorsed the applicability of this guideline for high-income settings, from which much of the supporting evidence was drawn.

1 One member of the GDC was unable to vote on the day-care intervention (which took place on the second day of the meeting) due to illness.

Provision of day-care

WHO recommends day-care for children under 6 years of age as a drowning prevention strategy in countries with a high burden of drowning.

Strong recommendation; Moderate certainty in evidence.

Remarks

This strong recommendation was justified by the GDG based on the moderate certainty in the evidence reported in the systematic review in relation to the critical outcome of drowning-related mortality. It was also justified by the overall balance between the desirable and undesirable effects of day-care provision for children under the age of 6 years as reflected in most of the EtD framework criteria. Day-care programmes must be established and regulated to assure the safety and well-being of children as well as the equitable treatment of the day-care staff.

Guideline

5

Introduction

5a. Background

Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid. Drowning outcomes are classified as fatal or nonfatal. This definition of drowning, adopted by the 2002 World Congress on Drowning, has been widely used and updated in recent years to include clarification around nonfatal terminology. WHO's *Global report on drowning: preventing a leading killer*, published in 2014, highlighted that 372 000 people drown worldwide each year, and pointed out that drowning is among the 10 leading causes of death for children and young people in every region of the world. The report set out the evidence showing a range of effective drowning prevention interventions and made recommendations for concrete measures to be taken by national and local governments.

5b. Rationale

Following publication of the *Global report on drowning* in 2014 there has been increased recognition of the impact of drowning on communities around the world. This in turn has led to WHO providing further guidance on implementation of drowning prevention programmes and undertaking the production of this guideline.

5c. Scope

This guideline addresses two interventions to prevent drowning: the provision of day-care for pre-school children under 6 years of age (which ensures continuous supervision by a capable adult who is mindful of drowning risks and how to provide for the needs of children, thereby reducing likelihood of drowning); and the provision of basic swim skills and water safety training to children aged 6 years or older.

Swim skills training programmes as public health interventions are better suited to children aged 6 years and older rather than younger children for a variety of reasons: such programmes can be efficiently incorporated at scale within school systems; they require fewer instructors; and they are associated with faster rates of skill acquisition. The evidence review considered evidence for swim skills training programmes for all child age groups, since it was anticipated that the evidence base would be small and we did not wish to disregard or exclude evidence; and because harms (or benefits) of such programmes for children aged 6 years or younger were deemed worthy of consideration

even if the guideline would ultimately concern only children aged 6 years and older.

Although the initial focus of the GDG was on low- and middle-income countries (where well over 90% of drowning mortality occurs), consideration of the evidence led the GDG to conclude that the findings justified making this guideline relevant to high-income countries' populations for the following reasons:

1. Much of the evidence base showing desirable effects on drowning prevention (and other desirable effects) came from studies carried out in high-income countries.
2. While 90% of drowning mortality occurs in low- and middle-income countries, studies consistently show higher drowning rates among vulnerable populations such as ethnic minorities in high-income countries, and so there is a rationale for public health authorities in high-income countries to also consider drowning prevention interventions –and both swim skills provision and day-care interventions would be relevant.
3. Much of the regulatory frameworks to minimize the potential risks from both interventions are already well established in high-income countries and therefore the risk of undesirable effects from either intervention is less in these settings.

5d. Objective

The objective of this guideline is to provide recommendations and any additional considerations regarding the appropriateness of providing day-care and basic swim skills and water safety training to prevent drowning among children in low- and middle-income countries. The guideline will also serve as a basis for two of three concurrently developed implementation guidance documents which will be framed as derivative products, since these will be focused on providing more detailed guidance for implementing these interventions.

5e. Target audience

The primary target audience is government personnel involved in either establishing day-care and basic swim skills and water safety training programmes, or approving the implementation of these by relevant stakeholders. A multisectoral approach is thus essential to the planning and implementation of these programmes. For clarity, the term "government personnel" is a broad term, and it is important to note that the ministries involved in these of programmes will differ from country to country. In some countries this may include mainstream ministerial sectors such as those of education and health, while other countries may see the involvement of ministries such as social affairs, community development etc.

The variability from country to country in terms of ministries involved in programme provision means that the phrasing and framing of this guideline is designed to be accessible and clear to a wide range of potential stakeholders.

There are several secondary audiences whose knowledge and support of this guideline will help with implementation. These audiences include local or national programme implementers (including those that are philanthropic in nature or who offer programmes that are based on payment of fees); funders; parents' groups; school authorities; and community leaders. Nongovernmental organizations (NGOs) whose focus is on supporting child safety and well-being, or development in low- and middle-income countries, will also be an important audience. International development partners including UNICEF and UNFPA are also a secondary audience for this guideline. These agencies work with governments on behalf of women and children and have special roles in low- and middle-income countries to support governments to implement programmes. UNICEF and UNFPA's work with women is of particular relevance, since there is always a potential for discriminatory and blaming attitudes towards women in the event of a child drowning, and as women are typically the primary care-givers.

6 Systematic reviews

The systematic reviews were conducted by Emmy De Buck, Anne-Catherine Vanhove, Dorien O and Koen Veys, researchers of the Centre for Evidence-Based Practice of the Belgian Red Cross (www.cebap.org). The protocol for both reviews was registered with Prospero ([CRD42020167437] and [CRD42020162002]). A summary of the methods used, the studies identified and the risk of bias of the studies is provided below. A summary of the evidence can be found under the Summary of Evidence sections for each respective question (Sections 8b, 9b, and 9c).

Databases searched included Clinicaltrials.gov, Cochrane Library, Embase, ERIC, MEDLINE (PubMed interface), Web of Science, and WHO's International Clinical Trials Registry Platform (ICTRP). Grey literature sources were also searched for relevant evidence (a complete list is included in published PROSPERO protocol registration documents). Reference lists of included studies and any relevant systematic reviews were also checked. No language or date limits were applied. Selection criteria for both PICO questions are provided in Sections 6a and 6b.

The process of study inclusion, data extraction and risk of bias assessment was performed by two reviewers in parallel. All references were entered in reference manager software Endnote X9, and duplicate references were removed. Eligible studies were selected in two rounds, based on title, abstract screening, and full-text screening. Disagreements between the two reviewers at the level of study selection was resolved by consensus or by consulting a third reviewer. Reasons for exclusion were documented in an Excel template.

Characteristics of included studies were extracted in a piloted data extraction form. These characteristics included: author/s, year of publication; study design, study location, study duration, study date; setting (rural, urban, informal-urban); number of participants; mean age or age range of participants; sex of participants; inclusion and exclusion criteria; intervention description (components of the programme – single vs multi component, day-care dose, duration and frequency); description of caregivers or providers of the intervention (age, gender, education, training); outcomes measured, measurement method, timing of measurement; conflicts of interest; source of study funding.

Treatment effects were calculated in Review Manager 5. Dichotomous outcomes were expressed as a risk ratio, together with the 95% confidence interval (CI). Drowning mortality or drowning incidence was expressed as an absolute number per 100 000 individuals per year (mortality rate or incidence rate), and effect measures were reported as rate ratios with 95% CI. Rate ratios were calculated according to the Cochrane handbook, chapter 6.7.1. The rate ratio and standard errors were imported into Review Manager, and the Generic Inverse Variance method was used to calculate CIs. Continuous outcomes were expressed as mean differences, with 95% CI. No meta-analyses were conducted because of too much heterogeneity. A summary of the evidence and the overall confidence in effect estimates for each outcome is presented in a "Summary of findings" table. Since meta-analysis was not possible, the results are summarized narratively.

The risk of bias assessment was done with the Cochrane Risk of Bias tool for randomized controlled trials (RCTs), and the ROBINS-I tool for other study designs. Disagreements were resolved by discussion or by consulting a third author. All judgements of risk of bias are justified in the risk of bias tables, and a source of information for each judgement is provided. The GRADE approach was used to assess the overall certainty of evidence as well as specific categories of certainty (very low, low, moderate and high). Justification for all decisions to downgrade is provided as footnotes.

Studies that were excluded from the reviews because they did not fulfil the selection criteria but were still relevant for the "evidence to recommendation" step as a source of expert opinion were narratively listed and provided to the GDG in addition to the systematic reviews. Annex 1 (swim skills) and Annex 2 (day-care) provide summaries of the evidence profiles for each PICO question and the EtD tables finalized by the Guideline Development Group.

6a. Basic swim and water safety skills[2] training

PICO question and criteria

Do educational programmes that provide basic swimming and/or water safety training (either as a discrete intervention or as part of a multicomponent programme) (I) to children of any age (P) compared to no such programmes or other drowning prevention approaches (C) reduce drowning-related mortality or morbidity and/or increase water safety knowledge, skills or behaviour (O)?

- Population: 0–17 years, high-, low- and middle-income countries
- Intervention: educational programme that delivers basic swimming and/or water safety
- Comparator: no intervention; a variant of the studied intervention or a different educational programme that delivers basic swimming and/or water safety; or another drowning prevention intervention
- Outcome:
  - **Primary**: drowning-related mortality or morbidity, number of nonfatal and fatal drownings
  - **Secondary**: water safety knowledge, water safety (e.g., swimming ability, water recovery), water safety behaviour, programme safety, cost-effectiveness
- Study type: RCT including non- and quasi-RCTs, case-control studies, (prospective/retrospective) cohort studies, and controlled before-after studies; all languages

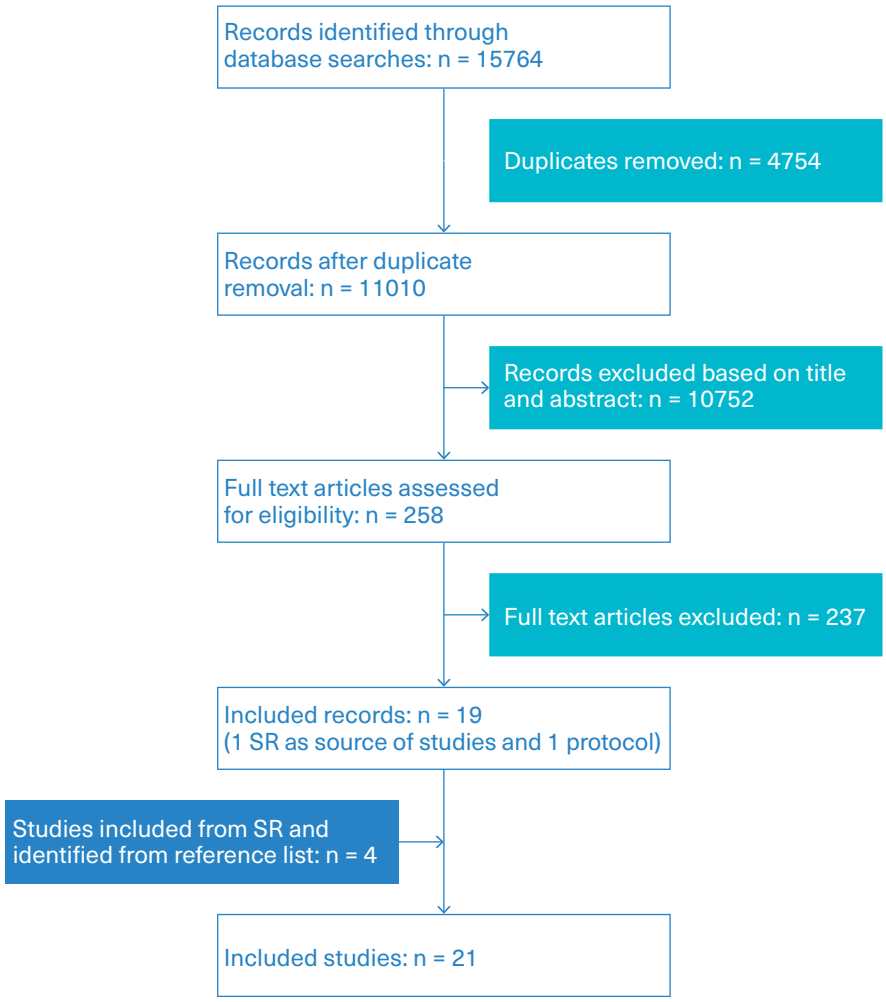
Two distinct categories of interventions were explored: in-water and out-of-water educational interventions.

Results

All databases were searched until December 17, 2019. Figure 1 outlines the PRISMA table for the included studies from the basic swim skills and water safety training systematic review (SR).

2 Basic water safety skills include, *inter alia,* safe behaviour around water hazards to minimize the risk of inadvertently entering water; ensuring vulnerable individuals (e.g. those too young to swim or who do not know how to swim) are supervised or otherwise prevented from inadvertently entering water; responding safely and effectively to someone who is drowning; wearing lifejackets on boats; not consuming alcohol prior to swimming; and knowing how to float and breathe if one is unable to swim and inadvertently enters water.

Figure 1: PRISMA table for the systematic review on the provision of basic swim skills and water safety training for the reduction of drowning-related mortality and morbidity



The systematic review on basic swim skills and water safety training programmes identified 21 included studies. A summary of the studies' characteristics is presented in Table 1.

Table 1: Summary of characteristics from identified studies for the systematic review on the provision of basic swim skills and water safety training for the reduction of drowning-related mortality and morbidity

Study characteristics	No. of studies
Study design	
Randomized controlled trial	4
Non-randomized controlled trial	10
Retrospective cohort study	4
Case-control study	3
Study setting	
High-income country	13
Low- and middle-income country	8
Interventions examined	
In-water basic swim skills training (total)	8
Comparing training to no training	3
Comparing weekly training to no training	1
Comparing shallow water training to deep water	1
Evaluating use of motility stories	1
Evaluating use of buoyancy aids	2
Comparing out-of-water safety training to no training	4
Comparing combined in-water and out-of-water training to no training	4
Comparing 12 weeks of training (combined programme) to 8 weeks of training	1
Comparing out-of-water training as part of broader educational programme to no training	4
Comparing out-of-water training as part of broader educational programme with a handbook to a programme without a handbook	1
Reported outcomes	
Drowning-related mortality	3
Water safety knowledge	7
Water safety skills	7
Water safety behaviour	10
Cost-effectiveness	1
Drowning morbidity	0
Programme safety	0

6b. Provision of day-care

PICO question and criteria

Do programmes that provide formal day-care (**I**) to children under the age of 6 years (**P**) (either as a discrete intervention or as part of a multicomponent programme) compared to no such programmes (**C**) reduce drowning-related morbidity and mortality in low- and middle-income countries (**O**)?

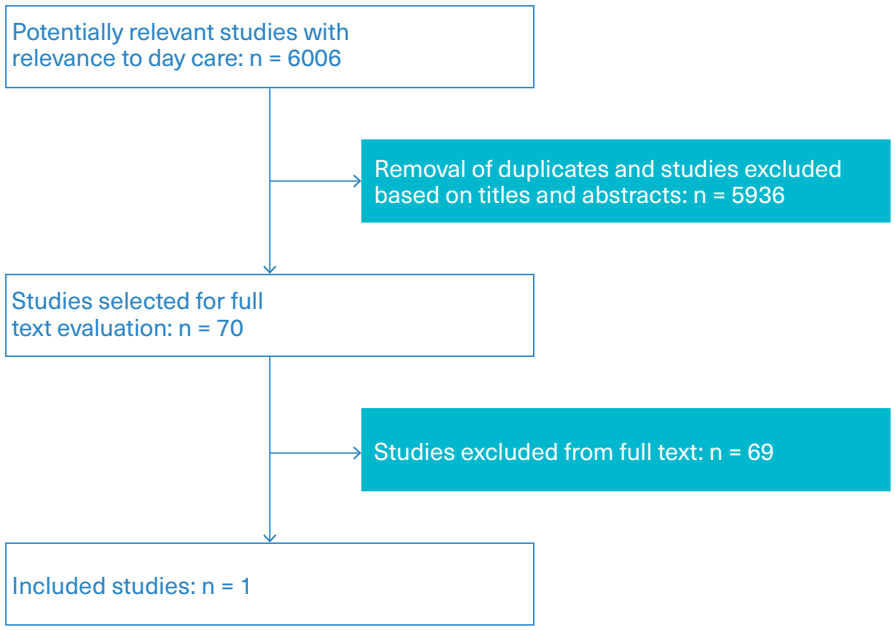
- Population: 0–5 years, low- and middle-income countries
- Intervention: formal out-of-home day-care programmes
- Comparator: not implementing such programmes; home-based care; or other drowning prevention interventions
- Outcome:
  - **Primary:** drowning-related mortality or morbidity, number of nonfatal and fatal drownings
  - **Secondary:** unsafe water exposure, unintentional injury incidence, programme safety, cost-effectiveness
- Study type: RCT, including non- and quasi-RCTs, case-control studies, (prospective/retrospective) cohort studies, and controlled before-after studies; all languages

In addition to this systematic review on day-care that focused on drowning outcomes, an overview of existing systematic reviews on day-care was developed for high-, low- and middle-income countries by searching the same databases and with a broader focus on non-drowning related outcomes such child development (cognitive, physical and behavioural); mortality/morbidity (not related to drowning); nutrition; employment of parents. The decision to examine this literature on the harms and benefits of day-care interventions that are unrelated to drowning prevention was agreed upon by the GDG as important to completion of the GRADE EtD framework.

Results

All databases were searched until November 23, 2019. Figure 2 outlines the PRISMA table for the studies from the provision of day-care systematic review.

Figure 2: PRISMA diagram for the systematic review on the provision of day-care for the reduction of drowning-related mortality and morbidity



The systematic review on day-care programmes yielded one retrospective cohort study, conducted in rural Bangladesh. One of the intervention components of this study was a crèche programme providing supervision but also education and nutrition. The study measured mortality, risk of drowning, risk of injuries, and cost-effectiveness. The systematic review has been published in The Cochrane Library (De Buck et al., 2021).

Following the Guideline Development Group meeting, and as part of its publication process, the systematic review was updated and a second very recent study was identified and also described in the published review. This latter study however did not change the conclusions of the current guideline.

The overview of existing systematic reviews on the effect of day-care programmes resulted in 19 systematic reviews, of which two included low- and middle-income country studies and the 17 described high-income country studies. These reviews reported social and cognitive development outcomes, health outcomes (asthma, diabetes, infectious disease, obesity, nutritional status, stress), healthy behaviour, and economic outcomes (household income, maternal employment). Quantitative data (including meta-analyses) were extracted if reported, and otherwise narrative evidence conclusions were formulated. Study limitations were reported by the systematic review authors.

7 Going from evidence to recommendations

The GDG employed the GRADE EtD framework as a means of considering multiple additional factors that would inform the formulation of recommendations. The EtD framework is a systematic, structured and transparent approach to decision-making. The framework employs explicit criteria for generating guideline recommendations considering research evidence, certainty of evidence, and where required, expert opinion and topical knowledge from the perspective of the target audience. The criteria elicit judgments about the balance between the observed evidence of desirable and undesirable outcomes; overall certainty of evidence; relative values of target stakeholders for desirable and undesirable outcomes; resource use (cost) where applicable; concerns about potential for inequities in health; and acceptability and feasibility considerations.

The GDG considered the body of evidence in totality for each recommendation for all critical and important outcomes. Given the nature of the swim skills and day-care topics, studies differed widely in design, intervention and reported outcomes. The GDG was also provided with information related to the wider benefits of day-care provision that relate to a broad range of social and developmental determinants. The GDG considered as favourable or desirable the impacts of day-care provision beyond what would be deemed to be expected for drowning prevention.

Unfavourable or undesirable outcomes were given considerable attention. They included the potential dangers involved in providing in-water swim skills training in rural low- and middle-income country settings where drowning could result from a poorly developed and regulated programme and inadequate training of teaching and supervisory staff. Similarly, risks of adverse effects (for children or caregivers) in sub-optimal day-care settings were considered.

The GDG also considered values and preferences of those affected by the guidelines (in this case parents and caregivers); the resource implications of the recommendations; the impact on health equity; and the acceptability and feasibility of the recommendations. Consideration of these factors was based on the experience and insight of GDG members, as well as both empiric and qualitative judgements derived from the evidence base used for the systematic review. All GDG decisions were attempted to be reached via consensus, however, in the case of dissenting opinions, final decisions were made using voting criteria pre-approved by the WHO Guideline Review Committee

(GRC). The voting criteria pre-approved by the GRC were: a simple majority for weak/conditional recommendations, and more than 70% for strong recommendations).

As per the GRADE approach, recommendations were classified as either strong or weak and as being in favour or against the intervention.

8

Basic swim skills and water safety training

8a. Recommendation

WHO recommends basic swim skills and water training programmes for children aged 6 years or older in high-, low- and middle-income countries.

Strong recommendation; Moderate certainty in evidence.

8b. Summary of evidence

The summary of evidence for the various types of basic swim skills and water safety training that were covered in the systematic review are presented below. Additional evidence that was not used for this guideline is summarized in Annex 5.

Basic swim skills training

A basic swim skills educational programme may reduce drowning-related mortality in 1-4-year-olds compared to no basic swim skills educational programme, but the effect on drowning-related mortality in 5–14-year-old children is uncertain (very low to low-certainty evidence; Brenner et al., 2009; Yang et al., 2007).

A basic swimming skill educational programme may have little to no effect on certain swim skills and it may increase other skills, but the evidence is very uncertain (very low-certainty evidence; Erbaugh, 1986).

Water safety training (out-of-water)

The evidence suggests that water safety training reduces drowning-related mortality (low-certainty evidence; Liu et al., 2019).

A water safety educational programme may increase water safety knowledge but may have little to no effect in certain age groups (very low-certainty to moderate certainty evidence; Barcala-Furelos et al., 2019; Shen et al., 2016; Terzidis et al., 2007). Water safety training may make little to no difference on certain water safety behaviours while improving others and effects differ between age groups, but the effects can be very uncertain (low-certainty to very low-certainty evidence; Shen et al., 2016; Terzidis et al., 2007).

Combined water safety training (out-of-water) and basic swim skills training (in-water)

A large observational study of an educational programme combining water safety training and basic swim skill training found a large effect size in terms of reduction of risk of death from drowning compared to no training (moderate-certainty evidence; Rahman et al., 2012). Effects on the crude mortality per age group are uncertain.

Educational programmes combining water safety training and basic swim skill training may improve certain skills but have little to no effect on others, compared to no training, and the effects differ among programmes of different duration, but evidence from some of the studies is uncertain (very-low certainty to low-certainty evidence; Asher et al., 1995).

Educational programmes combining water safety and basic swim skills training resulted in little to no difference in deck behaviour, rescue behaviours and (un)safe water entries, but some of the evidence is very uncertain (very low-certainty to low-certainty evidence; Asher et al., 1995; Mecrow et al., 2015a; Mecrow et al., 2015b).

The cost-effectiveness of the SwimSafe programme in Bangladesh, an educational programme combining water safety training and basic swim skill training, is US$ 3009 per death averted and US$ 85 per disability-adjusted life year (DALY) averted (moderate-certainty evidence; Rahman et al., 2012).

Water safety training (out-of-water) as part of a broader educational programme

As mentioned above, the studies investigating water safety training (out-of-water) as part of a broader educational programme will be published in a separate systematic review by the evidence synthesis team.

8c. Rationale and remarks

Drowning is an important and under-addressed cause of mortality with a predisposition to affect children and those in low- and middle-income countries. In high-income countries, basic swim skills and water safety training programmes have been widely adopted to introduce drowning prevention skills, knowledge and behaviours to children with the goal of reducing the threat of fatal and nonfatal drownings. Even in high-income countries, however, there is still significant inequality in adoption and uptake (e.g., by race, ethnicity and socioeconomic status).

The evidence supports early implementation of training programmes for children and suggests improved mortality and morbidity outcomes with both basic swim skills and water safety training programmes. Of note, there was a suggestion in the

studies analysed that the earlier a school-aged child participates in the training intervention, the greater the benefit they may receive (especially in terms of appropriate water safety behaviours and knowledge). This is possibly explained by providing them with proper education on the topic before they form their own opinions on how to act and stay safe in and around water, which will likely be influenced by other factors later in life.

A few studies identified in the systematic review discussed potential harms associated with training programmes, including: increased risk tolerance due to perceived skills and safety; parental perception that children needed less supervision if they have received training; general hazards associated with children participating in activities around an aquatic environment (drowning or injury during training); and potential for communicable disease spread. The GDG felt that the concerns identified in a few observational studies of increased risk tolerance were common to many other public health interventions, and that by recommending training that offers both swim skills as well as knowledge of and modelling of water safe behaviours, the undesirable effect would be small.

In sum, the GDG concluded that the systematic review had shown that the intervention demonstrated a significant reduction in the critical outcome of drowning-related mortality based on evidence deemed to be of moderate certainty. While the systematic review had also uncovered outcomes (typically with lower ratings of certainty) that inform knowledge and other important swim-specific outcomes these were agreed upon as interesting but less directly relevant to our critical outcome of drowning-related mortality. The critical outcome of drowning-related mortality was informed by a large non-randomized study that demonstrated a large effect size on this outcome and was therefore deemed to be of moderate certainty for that outcome.

Following consideration of all other criteria within the EtD, the majority of the GDG considered that for all other criteria the desirable effects greatly outweigh the undesirable effects, but also that all other considerations (including cost-effectiveness, feasibility, acceptability and equity) aligned in support of a strong favourable recommendation. The EtD table in Annex 1 presents the entirety of this rationale. It also shows that the GDG accepted that evidence for harms was not nearly as robust, was more scarce, and did not dissuade the GDG from finding in favour of the strong recommendation provided here. The GRADE tables for basic swim skills and water safety are presented in Annex 3.

The relative success of training programmes in high-income countries is in part due to the regulatory frameworks that have developed from close government, public health and stakeholder involvement. The GDG discussed at length that any

recommendation of swim skills and water safety training programme implementation must include the requirement that appropriate steps be taken by organizations implementing these programmes to create a safe environment for those involved. Risk management approaches and regulations should include strategies to ensure safety of participants and instructors, prevention of communicable disease and infection transmission, and acceptable, safe content and instructional techniques. Specific strategies for developing and implementing programmes that impart knowledge and skills as they relate to swim skills and water safety are beyond the focus of this guideline but will be addressed in a derivative implementation guidance document from WHO.

The GDG recognized that the level of resources required to initiate training programmes varies depending on location, local knowledge and existing infrastructure. The Bangladesh SwimSafe project, however, demonstrated that effective and safe implementation of swim skills and water safety training could be carried out at a relatively low cost per child. The GDG encourages other programmes implementing these measures to gather the necessary data and publish findings in peer-reviewed literature to further augment understanding of effectiveness and cost-effectiveness of this intervention.

The GDG recognized that much of the evidence for this recommendation comes from observational and retrospective data. This data set cannot establish a definite causal relationship between swim skills and/or water safety training and drowning reduction, as other confounding factors may play a role. For example, swim skills training of children may also heighten caregivers' awareness of the risks of unsupervised water activities and this leads to observed decreases in drowning rates. An additional limitation of these recommendations is that weight is placed on indirect evidence where swimming skill performance and knowledge about safe behaviours is believed to be a surrogate for individuals' ability to protect themselves from drowning.

9

Provision of day-care

9a. Recommendation

WHO recommends day-care for children under 6 years of age as a drowning prevention strategy in countries with a high burden of drowning.

Strong recommendation; Moderate certainty in evidence.

9b. Summary of evidence from the systematic review

It was shown that formal day-care resulted in a statistically significant decrease of the risk of death from drowning, the risk of death from injuries, and the risk of overall deaths (adjusted for gender, location and birth cohort), compared to not being enrolled in a crèche programme. A statistically significant decreased risk of death from other causes than injuries could not be demonstrated (moderate-certainty evidence; Rahman et al., 2012).

Formal day-care programmes resulted in a statistically significant decrease of the overall mortality rate for children aged 1–4 years, but this effect could not be demonstrated for the other age categories nor for the drowning mortality rate (no adjustments for covariates) (very low-certainty; Rahman et al., 2012).

The cost-effectiveness of the Anchal crèche programme in Bangladesh equals US$ 27 606 per death averted and US$ 812 per DALY averted (moderate certainty; Rahman et al., 2012).

9c. Overview of reviews investigating provision of day-care for non-drowning outcomes

To capture more indirect evidence concerning other outcomes and from high-income countries, the systematic review team conducted a review of existing systematic reviews (setting: high-, low- and middle-income countries; outcome: all other outcomes).

Desirable effects were found for child cognitive ability, academic achievement, mental health, and behavioural outcomes. Inconsistent effects were noted for nutrition, obesity, and healthy behaviour. Undesirable effects were related to infectious diseases, asthma and the development of psychological stress. A summary of the identified studies and their results are presented in Table 2.

Table 2: Summary of results identified in review of systematic reviews investigating provision of day-care with non-drowning outcomes

Desirable effects	
Comparing centre-based care in low- and middle-income countries to none	Increase in child cognitive ability (Brown et al., 2014)
	Increase in adequate social interaction and cognitive development (Leroy et al., 2012)
Comparing centre-based care in high-income countries to none	No statistically significant result demonstrated for cognitive ability or psychosocial development (Van Urk et al., 2014)
Comparing pre-school programmes in high-income countries to none	Increase in intelligence and academic achievement; reduction in borderline mental retardation; need for special education; retention in grade; not graduating from high school; and delinquent behaviour (Gorey, 2001)
	Increase in IQ at 36 months and 5 years of age; reduction in need for special education; retention in grade; five or more arrests; and involvement in drug dealing (Zoritch et al., 2000)
	Beneficial effect on crime; beneficial or no effect on social competence; mixed effects on externalizing behaviours and no effect on self-esteem, self-concept and internalizing behaviours (D'Onise et al., 2010)
Comparing day-care in high-income countries after 3 years of age to none	Decrease risk of Type 1 diabetes (Kaila et al., 2001)
Inconsistent results	
Assessing association between day-care and nutritional status	Results were mixed positive, negative, and inability to demonstrate an association (Da Silva et al., 2010; Leroy et al., 2012; Costa et al., 2019)
Assessing association between day-care and healthy behaviour	Day-care may reduce screen viewing (unclear if significant); for physical activity and sleep studies there was a mixed positive or no difference found (Costa et al., 2019)
Assessing association between day-care and obesity	Results were mixed positive, negative or inability to demonstrate an association (Alberdi et al., 2016; Black et al., 2017; Swyden et al., 2017; D'Onise et al., 2010)

9d. Rationale and remarks

The EtD table for day-care is provided in Annex 2 and the GRADE table for day-care is presented in Annex 4.

Drowning is a major killer of children aged under 6 years, especially in low- and middle-income countries. Lack of capable supervision of children is one of the main risk-factors for child drowning. Institutional supervision of children through formalized day-care arrangements within communities can reduce deaths from drowning. It is important to note that the rationale for formalized day-care arrangements as a drowning prevention intervention is that it should in principle ensure constant adult supervision of beneficiary children. This is particularly relevant for cultural settings where both parents are obliged to work and social or cultural factors make it difficult or impossible for another competent adult (e.g. a grandparent or adult neighbour) to supervise pre-school children. In settings where other modalities exist to ensure constant adult supervision of pre-school children, the provision of formalized day-care arrangements may not be strictly necessary as a drowning prevention intervention, although the additional desirable effects of formalized day-care arrangements should not be overlooked.

The upper limit of this recommendation aligns with the education goal of SDG 4.2 – "by 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education". By aligning with this target, the guidelines help support the call for pre-primary education programmes and policies.

Evidence on acceptability and impact on health equity is limited. However, evidence favours the intervention (that a formal day-care programme should be used for prevention of drowning in children in low- and middle-income countries) and desirable effects outweigh undesirable effects. It is important, however, for more information to be gathered on the types of day-care programmes that are most effective. There has been an increasing amount of information generated during the past decade on how to design, implement, and evaluate child-care programmes. There is a need to increase government funding to implement quality programmes, generate political will, and move successful programmes to scale.

Issues related to equity, and in particular the gender implications of day-care programmes, deserve some further discussion here. The panel observed that quality day-care programmes improve family income by enabling women to enter the workforce while their children receive basic health, nutrition, and social and cognitive development within a nurturing and protective environment. Day-care programmes were also noted to produce

savings by improving the efficiency of educational systems through reductions in dropout, having to repeat years, and remedial programmes (Gorey, 2001). Childcare programmes were also noted to offer the possibility of increased labour force participation by women while freeing girl siblings to learn and earn as well (Angeles et al., 2014; Rosero, 2012). The studies supporting these were identified during the search for non-drowning outcomes.

As examples noted by the panel, Thailand and Viet Nam have operated national day-care/pre-school programmes for many years. Early childhood drowning rates have decreased during this time. It should be noted that while some reports have suggested it is not feasible to implement day-care using rural villagers as attendants, this contrasts with Bangladesh-based studies which suggest that village-based day-care is feasible.

The GDG panelists discussed at some length the issues of acceptability and sustainability of day-care programmes in low- and middle-income country settings. Major themes emerging from the combined experience of GDG members were that: in many low- and middle-income countries parents who can afford to will send their children to day-care, particularly if they see a learning benefit; parents are generally eager to improve educational opportunities of their children; pre-school systems in many low- and middle-income countries settings are part of an informal system of care and may be provided by friends, neighbours, extended family members, local NGOs or be government supported; day-care arrangements for children tend to allow parents greater occupational opportunities and are often something parents are willing to pay for on a sliding scale or in-kind basis if the day-care arrangement is seen by the parents as being of high quality.

There is some evidence (e.g., Mexico) that a substantial government subsidy can reduce parental co-payments to a level that is acceptable. Based on this, it appears there is some evidence that if government subsidies are substantial, day-care interventions are acceptable. Child-care programmes have a greater benefit to children from high-risk home environments.

Children, particularly girls, who are enrolled in child-care programmes also have a greater likelihood of enrolling in primary school on time, which in turn improves their progress and performance once there. This relieves child-care pressure on older siblings, particularly girls, enabling them to stay in school. Child-care programmes also support working women by providing safe environments for children and increasing family income. Child-care programmes with support to parents can promote positive parenting and thus reduce the potential for violence, abuse and neglect.

Early childhood programmes cut across different sectors. In Thailand and Viet Nam for example, many pre-school programmes are implemented by the Ministry of Education. Day-care programmes (where focused on the 0–3 years age group), are often under the direction of the Ministry of Health. All programmes should be of high developmental quality and address issues of child protection and safety. Ideally, programmes should also be linked to health and nutritional services in order to provide a comprehensive set of child development services. Private or NGO-run programmes must meet any government-established educational, safety and health standards. Examples of these may include, inter alia, standards around handwashing and toileting, educational domains to be addressed in structured activities and training, and ratio of caregivers to children.

Implementation should also consider within-country inequities. In most low- and middle-income countries education quality provided by the public/government educational sector varies remarkably between urban and rural areas. The GDG felt that an important positive aspect of implementation of day-care programmes in rural areas of low- and middle-income countries was the opportunity to reduce this inequity and positively impact the overall early childhood development context for children in traditionally disadvantaged areas.

10 Research gaps

As a result of the guideline development process, the panel recognized that many unknowns still exist and that further data are still needed in many areas to better optimize drowning prevention interventions in low- and middle-income countries.

For both the provision of day-care and basic swim skills and water safety training programmes, greater use of data and peer-reviewed publications is needed. Any region or organization undertaking the important initiatives outlined in this document are strongly encouraged to collect and publish data as they move through the process. Outcomes that could be examined include: drowning-related mortality or morbidity; improvement in children's swim or water safety skills; programme cost-effectiveness; and safety-related events.

Additionally, research is needed to explore the effectiveness of implementation arrangements in different sectors within a country (e.g., urban versus rural, public versus private arrangements).

Regarding basic swim skills and water safety programmes, it would be beneficial to obtain data relating to:

- best implementation practices for new training programmes in high-, low- and middle-income countries;
- cost-benefit analysis of new (or upscaling existing) training programmes in high-, low- and middle-income countries;
- before-and-after studies assessing mortality and morbidity due to drowning trends in countries that implement training programmes, as well as studies of potential adverse events of such programmes;
- acceptability and feasibility studies examining the incorporation of swim skills and water safety training programmes into other interventions (e.g., day-care, school etc.);
- optimal strategies to teach swim skills and water safety in various socioeconomic and cultural settings, such as: length of courses; style of instruction; activities within each lesson; and location of lesson.

As national governments and other stakeholders develop new programmes for children, they should incorporate research and evaluation elements throughout the process that can be used to improve future projects. For regions that have programmes already in place, an evaluative structure should be implemented to assess ongoing feasibility and the potential to address some of the research gaps previously discussed. Sharing of data through open-access and academic literature is critical for successful global implementation.

11 Dissemination, implementation and evaluation

To provide global normative guidance, WHO will use its convening power and dissemination networks to promote awareness and understanding of this guideline, using standard channels such as international conferences, the WHO website and associated platforms, news releases, and technical support provided in response to queries raised by Member States or other stakeholders.

At the more practical intervention implementation level it is important to note that WHO and partners involved in addressing drowning in high-burden settings have been collaborating closely with each other and with national and subnational levels of government. Both interventions considered in this guideline are implemented within, by, and for communities and their involvement in all stages of implementation is critical. This includes community involvement in conducting background epidemiological surveys on drowning risk; use of methods such as social autopsy to collectively identify risk factors for drowning deaths; discussion of traditional responses to drowning victims; attitudes towards organized child care and supervision; and attitudes towards provision of basic swim skills and water safety training.

Sociocultural factors may hinder implementation of either of these interventions and it is therefore imperative that implementation is preceded by efforts to ensure that programmes are both feasible to implement and acceptable for the target population. WHO recommends that a comprehensive situation assessment should be carried out to determine the likelihood of constructive, sustainable, equitable and effective community involvement with either intervention prior to implementation. This comprehensive situation assessment would necessarily be undertaken in conjunction with local partners and it is not possible to define with precision what it would entail in every case as this would vary between settings.

While there will therefore be differences across settings, a comprehensive situation assessment would almost certainly include key informant interviews with representatives of constituencies who would be impacted by the interventions, or necessary for them to be implemented: e.g. local government partners, parent groups, community leaders, and some NGO's working in sectors relevant to either intervention. As above, social autopsy methods have proved very useful in engaging community members in discussions around risk factors for drowning and these methods have shown great effectiveness in

sensitizing communities to the need for drowning prevention programmes and their underlying logic. Community surveys that ascertain the incidence and risk factors for drowning would be another method by which a comprehensive situation assessment could be undertaken, as these could provide the more detailed etiologic information necessary for informing the most appropriate age groups and risk factors to target with interventions.

As above, the research priorities that are included in this guideline should be considered strongly by all partners, since implementation of either of these interventions is an opportunity to add to peer-reviewed knowledge in these areas.

12 Management of the guideline development process

This guideline was managed following the standard WHO procedures inherent in guideline development. Planning discussions and documentation were developed in collaboration with the Guideline Review Committee Secretariat. In line with these, an experienced GRADE methodologist was engaged. A Guideline Development Group, WHO Steering Group, and External Review Group were established, with broad technical expertise, geographical representation, and gender balance. Declarations of Interest and confidentiality agreements were secured from all members of the GDG as per standard WHO practice, and biographies of these individuals were made publicly available on the WHO website before GDG members were formally appointed. Appropriate candidates for the evidence review work were approached and interviewed, and the selection made with the Belgian Centre for Evidence-Based Medicine. PICO questions were developed with the evidence review team, WHO and the methodologist; refined and further refined following feedback from the GDG and the WHO Steering Group. A planning document was submitted to the Guideline Review Committee and then revised prior to final acceptance.

WHO and the methodologist then worked closely with the evidence review team to finalize the evidence review process. Due to the COVID-19 pandemic, GDG briefings were conducted remotely and PanelVoice was used to house the evidence review data, allow panelists to pre-vote on the EtD framework questions, and to draw attention to any new evidence panelists wished to share. The GDG panel meeting was held remotely over two successive days and the conclusions of the entire process were then synthesized into this guideline. This guideline was shared with and further refined by members of the GDG, WHO Steering Group and External Review Group before being submitted to the GRC.

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Annexes

Annex 1:
Basic swim skills and water safety
Evidence to Decision table

Question

Should swim skills training vs. no swim skills training be used for drowning prevention?	
Population:	0–17 years, high-, low- and middle-income countries
Intervention:	Swim skills training
Comparison:	No swim skills training
Main outcomes:	Drowning prevention
Setting:	Countries with substantial morbidity/mortality from drowning

Assessment

Problem Is the problem a priority?		
Judgement	**Research evidence**	**Additional considerations**
No Probably no Probably yes **Yes** Varies Don't know	Key facts (from WHO): Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid; outcomes are classified as death, morbidity and no morbidity. - **Drowning is the third leading cause of unintentional injury death worldwide, accounting for 7% of all injury-related deaths.** - **There are an estimated 236 000 annual drowning deaths worldwide.** - **Global estimates may significantly underestimate the actual public health problem related to drowning.** - **Children, males and individuals with high levels of exposure to water are most at risk of drowning.** Scope of the problem In 2019, an estimated 236 000 people died from drowning, making drowning a major public health problem worldwide. In 2019, injuries accounted for just under 8% of total global mortality. Drowning is the third leading cause of unintentional injury death, accounting for 7% of all injury-related deaths. Countries in all regions and at all income levels share the world's drowning burden, but some regions account for a larger share than others: - Low- and middle-income countries account for over 90% of unintentional drowning deaths. - Over half of the world's drowning occurs in WHO's Western Pacific Region and South-East Asia Region. - Drowning death rates are highest in the WHO African Region and are 15–20 times higher than those in Germany or the United Kingdom, respectively. Despite limited data, several studies reveal information on the economic cost of drowning. In the United States of America (USA), 45% of drowning deaths are among the most economically active segment of the population. Coastal drowning in the USA alone accounts for US$ 273 million each year in direct and indirect costs. In Australia and Canada, the total annual cost of drowning injury is US$ 85.5 million and US$ 173 million respectively.	

	There is a wide range of uncertainty around the estimate of global drowning deaths. Official data categorization methods for drowning exclude intentional drowning deaths (suicide or homicide) and drowning deaths caused by flood disasters and water transport incidents. Data from high-income countries suggest these categorization methods result in significant underrepresentation of the full drowning toll by up to 50% in some high-income countries. Nonfatal drowning statistics in many countries are not readily available or are unreliable.	

Summary of discussion

The GDG felt that drowning is a priority issue in many population groups, especially those who are exposed to water for daily activity. Of note, inhabitants of low- and middle-income countries are particularly at risk, with over 90% of unintentional drownings occurring in these countries. The financial impact of drowning is significant, as a few studies have demonstrated. The GDG acknowledged that there is likely a significant underreporting of drowning deaths that hinders public understanding of the magnitude of the public health problem. Although there was discussion about how a basic swim skill and water safety programme would be undertaken and managed in various low- and middle-income countries, when compared to high-income countries, there was a unanimous consensus that the drowning burden is a significant priority.

Desirable effects
How substantial are the desirable anticipated effects?

Judgement	Research evidence	Additional considerations
Trivial Small **Moderate** Large Varies Don't know	Desirable effects **Systematic review** (setting: high-, low- and middle-income countries; outcomes: drowning, water safety knowledge/skills/behaviour): Basic swim skills training vs no training - A basic swim skills educational programme **may reduce drowning-related mortality in 1–4-year-olds** compared to no basic swim skills educational programme (low-certainty evidence; Brenner et al., 2009; Yang et al., 2007). It may have **little to no effect on drowning-related mortality in 5–14-year-old children**, but the **evidence is very uncertain** (very low-certainty evidence; Yang et al., 2007). - A basic swimming skills educational programme **may have little to no effect** on "diving" swimming performance at 4 months of training compared to no training and it may increase the "diving" swimming performance at 8 months and "front locomotion", "back locomotion", "kicking", "jump entry" and "ring pick-up" at both 4 and 8 months, but the **evidence is very uncertain** (very low-certainty evidence; Erbaugh, 1986).	Desirable effects **Expert opinion/additional information** (based on studies identified through the systematic review, but not fulfilling the selection criteria for study type, population or outcome, or based on data that were not extracted in the systematic review): Basic swim skills training - One narrative review claims that swimming lessons can help children **relax, achieve confidence, learn to care** for themselves, as well as control and relate to water (Bruneman, 1976). - In a non-randomized study in Spain, the effects of three different flotation devices during swimming lessons were evaluated. The authors claimed that the **perceived competence** of 4-year-old children **was higher** after following a swimming lesson programme using the Kiflot swimming device, compared to children following a similar programme, but with either flotation belts or cuffs instead of Kiflot (Bautista et al., 2018).

Water safety training (out-of-water) vs no water safety training

- The evidence **suggests** that water safety training **reduces drowning-related mortality** (low-certainty evidence; Liu et al., 2019).
- The outcome knowledge was reported in three studies comparing water safety training to no training. According to results from one RCT, a water safety educational programme **probably increases safety knowledge** (moderate-certainty evidence; Shen et al., 2016). One observational study also showed that water safety training **may increase knowledge about prevention in the swimming pool and/or about prevention on the beach** compared to no training, but **this evidence is very uncertain** (very low-certainty evidence; Barcala-Furelos et al., 2019). Finally, one observational study showed that water safety training **may make little to no difference among high school students** compared to no training (low-certainty evidence; Terzidis et al., 2007). The same study showed that water safety training **may result in an increase in knowledge in kindergarten students** but **may have little to no effect on knowledge in elementary school** students, but this **evidence is all very uncertain** (very low-certainty evidence; Terzidis et al., 2007).
- The outcome water safety behaviour was reported in two studies. Results from one RCT showed that water safety training may result in **little to no difference in perceived vulnerability** (low-certainty evidence; Shen et al., 2016), but **probably improved the simulated behaviour** (moderate-certainty evidence; Shen et al., 2016). Results from an observational study indicate that a water safety programme **may improve water safety attitudes in kindergarten students** and **may have little to no effect in water safety attitudes in elementary school students**, but the **evidence is very uncertain** (very low-certainty evidence; Terzidis et al., 2007). A water safety programme **may result in little to no difference in water safety attitudes in high school students** (low-certainty evidence; Terzidis et al., 2007).

Combined water safety training (out-of-water) and basic swim skills training (in-water) vs no training

- An educational programme combining water safety training and basic swim skill training **probably reduces risk of death from drowning** compared to no training (moderate-certainty evidence; Rahman et al., 2012). The evidence is **very uncertain** about the effect of a combined programme on the **crude mortality rates** per age group (4–12 years old), but it **may have little to no effect** (very low-certainty evidence; Rahman et al., 2012).
- One RCT reported water safety skills compared an educational programme combining water safety training and basic swim skill training to no training. **Swimming ability may improve** after both an 8-week programme and a 12-week programme compared to no programme, **but the evidence is very uncertain** (very low-certainty evidence; Asher et al., 1995). **Water recovery may improve** after both an 8-week programme and a 12-week programme compared to no programme (low-certainty evidence). An **8-week training programme**
- In an observational retrospective cohort study among 4-year-old children in Portugal, swimming instructions given in shallow water were associated with better aquatic skills compared to instructions given in deep water if children had limited previous swimming experience; scores for 14 out of 17 skills were higher in cases where children had only 6 months of previous practice (this information is also included in the systematic review). However, where more swimming experience was present, mastery of most **aquatic skills was comparable** in children with instructions given either in shallow water or deep water; scores for 5 out of 17 skills were higher in cases where children had 12 months of practice and scores for 0 out of 17 skills were higher in cases where children had 18 months of practice, for shallow compared to deep water (Costa et al., 2012).
- A Canadian qualitative study compared a parent group that received regular, detailed feedback about their 2–5-year-old children's swim skills and improvements during 10 weekly swimming lessons, with one that did not. Importantly, when the parent-targeted component was included, parents **more accurately judged their child's actual swim abilities** (Morrongiello et al., 2013). However, there was also an undesirable effect (see "Undesireable effects" section that follows).

Educational water safety training

- Educational water safety trainings are often part of a broader injury prevention programme. An RCT in China studied the effect of a school-family-individual multi-level education intervention with an educational water safety component and found that at follow-up, the **mean knowledge and attitude scores of accidental injuries (including injuries related to traffic, falls, burns, and asphyxia) were significantly higher** in the intervention group, compared to their controls (Cao et al., 2015).
- An RCT in Brazil that studied the effect of the "Pense Bem" programme for high-school students (an educational injury prevention programme based on the English Think First programme) **improved students' knowledge of traumatic brain and spinal cord injuries**. However, an effect of the intervention on **most attitudes toward injury prevention** could **not** be **demonstrated** (Falavigna et al., 2012).
- Another study in the USA also implemented an educational injury prevention programme and the results of this non-RCT also showed **increased children's knowledge of injury and use of safety habits** (Azeredo et al., 2003).
- Another non-RCT in the United Kingdom studied the effect of the Injury Minimization Programme for Schools, which also included a visit to the hospital as an educational component of the programme, and found that children in the intervention group **improved their injury prevention knowledge, attitudes and behaviours** (e.g. first aid knowledge and basic life support techniques) (Frederick et al., 2000).

- compared to no training may result in **little to no difference in "jump and swim" skills**, but a **12-week programme may increase "jump and swim"** skills compared to no training (low-certainty evidence; Asher et al., 1995).
- Three studies, one RCT and two observational studies, reported three different types of water safety behaviour outcomes. The evidence from the RCT suggest that both an 8-week and a 12-week educational programme combining water safety and basic swim skills training resulted in **little to no difference in deck behaviour** (low-certainty evidence; Asher et al., 1995). One observational study reported on rescue behaviour comparing children who followed an educational programme combining water safety training and basic swim skill training to either children who did not swim or children who were natural swimmers. **Compared to non-swimmers**, an educational programme combining water safety and swim skills **training may increase the number of rescues ever performed** but it **may have little to no effect compared to natural swimmers**; the **evidence is very uncertain** for both results (very low-certainty evidence; Mecrow et al., 2015a). An educational programme combining water safety and basic swim training compared to natural swimmers **may have little to no effect on rescues performed in the last year or month** for 6–14-year-olds overall, **or on rescue rates per age group** both in the last month and the last year; the **evidence is very uncertain** (very low-certainty evidence; Mecrow et al., 2015a). It **may also have no effect on entries into the water to rescue (considered an unsafe rescue method) or on land-based (reach and throw) rescues (considered a safe rescue method)**, but again **the evidence is very uncertain** (very low-certainty evidence; Mecrow et al., 2015a). The other observational study showed undesirable effects (see "Uundesirable effects" section that follows).

Water safety training (out-of-water) as part of a broader educational programme vs no training

- Three studies reported knowledge outcomes comparing educational injury prevention programmes containing a water safety component to no training. The first study reported that these programmes **may increase knowledge of good swimming habits and knowledge of water safety rules**, but the evidence is very uncertain (very low-certainty evidence; Azeredo et al., 2003). Another study reported that such an educational injury prevention programme **may result in little to no difference in water safety knowledge** (low-certainty evidence; Frederick et al., 2000). The final study reports water safety knowledge separately for three grades: grade 1, grade 2 and grade 3. For each of these grades **the evidence suggests that an injury prevention programme with a water safety component increases water safety knowledge** (low-certainty evidence; Greene et al., 2002).
- Three studies (one RCT and two observational studies) reported water-safety behaviour outcomes for this comparison. An educational injury programme with a water safety component **may improve diving safety attitudes, but the evidence is very uncertain** (very low-certainty evidence; Azeredo et al., 2003).
- In the USA, a non-RCT was set up to study the effects of the Think First programme, adapted for 6–8-year-olds, and showed **significantly increased knowledge of injury prevention** at the treatment schools in comparison to the control schools (Greene et al., 2002).
- In an uncontrolled study in Australia, the Water Safety in the Bush programme was implemented (an educational water safety training programme delivered to remote communities, including many Aboriginal communities). This study reported that training programmes with a larger number of contact hours **increased skills in water safety, swimming ability, life-saving and water confidence** (Beattie et al., 2008).
- One qualitative study in the USA evaluated the effects of a 3-year drowning prevention campaign, including general water safety educational materials targeting 1–14-year-olds and found through telephone surveys with their parents that it increased life vest use (Bennett et al., 1999).
- A master thesis by van Driel (2017) evaluated the Dutch educational intervention "Water safe", delivered in primary schools to 10–12-year-olds. The programme is designed to enhance the knowledge and address attitudes and perceived skills a child has regarding water safe behaviour. **Scores of the intervention group were higher than scores of the control group on social influences** at post-measurement: **children who participated in the programme thought more positively about the perceived social pressure to engage or not to engage in water safe behaviour**. Several other factors did not show any desirable effects (see "Uundesirable effects" section that follows).

	- Another observational study reported that an educational injury prevention programme **may result in an increase in being able to identify the risk "toddler fall in water" and being able to decide to stop playing near water** compared to no programme (low-certainty evidence; Frederick et al., 2000). However, this study also reported undesirable effects (see "Uundesirable effects" section that follows). According to results from an RCT, an injury prevention programme **probably results in an increase in the number of children who completely or partially agree with "will check the depth of the swimming pool"** compared to no programme **immediately after the programme**, but probably results in **little to no difference at 5 months follow-up** (moderate-certainty evidence; Falavigna et al., 2012).	

Summary of discussion

The GDG felt that there was sufficient evidence to support with consensus that the effect size of intervention was moderate in nature when discussing desirable effects. They felt that this was demonstrated clearly in the systematic review results. There were several comments regarding how the effect size may differ according to children's ages. Evidence in the systematic review results showed most benefit for younger children, with an unclear effect on basic swim skills and water safety training for older children into their teenage years. There was also a concern noted about recommending this training for children at too young an age due to overlap with other public health priorities during the pre-school years. When combining all ages together however, the GDG still supported that there was a moderate size desirable effect but noted that this may change slightly depending on specific age categories.

Undesirable effects
How substantial are the undesirable anticipated effects?

Judgement	Research evidence	Additional considerations
Large Moderate **Small** Trivial Varies Don't know	**Undesirable effects** **Systematic review** (setting: high-, low- and middle-income countries; outcomes: drowning, water safety knowledge/skills/behaviour): Water safety training (out-of-water) as part of a broader educational programme vs no training One study reported both desirable (see section above) as well as undesirable water safety behaviour outcomes when comparing an injury programme with a water safety component to no training. Surprisingly, such an educational programme **may decrease being able to identify the risk "playing with a ball near water", being able to identify general water danger and being able to decide not to go near water** compared to no training (low-certainty evidence, Frederick et al., 2000).	**Undesirable effects** **Expert opinion/additional information** (based on studies identified through the systematic review, but not fulfilling the selection criteria for study type, population or outcome, or based on data that were not extracted in the systematic review): Basic swim skills training - In most instances, swimming lessons inevitably imply the use of swimming pools. In a WHO guideline document, the authors warn of the **hazards associated with activities in and around the swimming pool**. The hazards from drowning and injury (e.g. diving into the upslope of a pool bottom or into the shallow portion of the pool – the most common cause of spinal injuries in pools) are the most obvious hazards, but also less visible hazards relating to swimming pools and similar recreational water environments exist, including those posed by microbes and chemicals. The risk of illness or infection is primarily associated with faecal contamination of the water and water quality

Combined water safety training (out-of-water) and basic swim skills training (in-water) vs no training

An observational study looked at water entries and compared children who participated in an educational programme combining water safety and basic swim training to natural swimmers. An educational programme compared to natural swimmers **may result in little to no difference on zero entries in the water, one entry in the water and two entries in the water** (low-certainty evidence; Mecrow et al., 2015b). Similarly, it **may have little to no effect on three or more entries, but for this outcome the evidence is very uncertain** (very low-certainty evidence; Mecrow et al., 2015b). An educational programme compared to natural swimmers **may have little to no effect on entries to play or swim in the water or on recreational water entries without adult supervision, but the evidence is very uncertain** (very low-certainty evidence; Mecrow et al., 2015b).

Different types of swimming or water safety instruction

In addition to the body of evidence mentioned above ("programme vs no programme" comparisons), several studies compared different types of swimming or water safety instruction (different settings, materials etc.). The findings of these studies **were not split** into desirable and undesirable effects, and are listed below:

Different content of basic swim skills training: use of motor stories

A swim skills programme using aquatic motor stories may have little to no effect on aquatic motor competence compared to an approach without such stories, but the evidence is very uncertain (very low-certainty evidence; Moreno-Murcia et al., 2016).

Different schedules of basic swim skills training: daily vs weekly

Ten daily swimming lessons may have little to no effect on the front crawl swimming skill rate of improvement compared to 10 weekly swimming lessons, but the evidence is very uncertain (very low-certainty evidence; Bradley et al., 1996).

Different didactic materials: use of buoyancy aids

Swimming instruction with multiple buoyancy and propulsion aids may have little to no effect on water safety skills (leg action, front crawl arm action and swim-leg action) or water safety behaviour (aquatic readiness) compared with swimming instruction with kickboard only (mainly self-support), but the evidence is very uncertain (very low-certainty evidence; Parker et al., 1999).

Another study compared three buoyancy aids: a kiflot, cuffs and a flotation belt. Which device is used may have little to no effect on the swimming ability, but the evidence is very uncertain (very low-certainty evidence; Bautista et al., 2018).

management can be ensured by appropriate treatments, including filtration and the proper application of chlorine or other disinfectants. However, exposure to chlorination by-products or other chemical hazards, either through direct ingestion of the water, inhalation of volatile or aerosolized solutes and dermal contact or absorption through the skin, should also be minimized. Additionally, air quality should be optimal, e.g. through appropriate ventilation in the case of indoor swimming pools (WHO, 2006).

- One uncontrolled before-and-after study in Turkey showed an **increased incidence of ear infections** in children who attended swimming courses for one month (Akoglu et al., 2006).
- In a recommendation document by the Committee on Injury and Poison Prevention from 2000, the authors warn that when children are in water there is a **risk for hypothermia**, **water intoxication and the spread of communicable diseases** that can be prevented by following the existing medical guidelines. They also warn that participation in aquatic programmes for children should not give their parents a false sense of security about their child's safety in and around water (Committee on Sports Medicine and Fitness and Committee on Injury and Poison Prevention 2000).
- In a narrative review, the authors argue it is possible that increased swimming ability, through swimming lessons, could **potentially increase drowning rates through increased exposure to water and risky situations** (Brenner et al., 2003). The authors of a study showing increased teenage car crash rates upon the implementation of school-based teenage driver education programme also expressed similar concerns related to early swimming lessons; they stated that it is not known whether proficiency in swimming reduces drowning to an extent that would offset the increased exposure from exercising that skill (Robertson et al., 1983).
- The general belief is that formal swimming lessons for children lead to reduced childhood drowning rates, however, one case-control study in the USA suggested that this might not be the case in older children, since **no statistically significant association between formal swimming lessons and drowning risk** was found in children aged 5–19 years old (Brenner et al., 2009).
- A Canadian qualitative study compared a parent group who received regular, detailed feedback about their 2–5-year-old children's swim skills and improvements during 10 weekly swimming lessons, with one that did not. These **parents judged that their child needed less supervision** (false sense of safety) near water, compared to parents who did not have regular feedback (Morrongiello et al., 2013). A parent-targeted component of swimming lessons should therefore be careful not to stimulate a false sense of security in their child's ability.
- One study conducted focus group discussions with Vietnamese teenagers and their parents and identified **the strong influence of peer pressure on teenagers to swim**, despite poor swim skills, to be accepted by the dominant culture of their "American" peers (Quan et al., 2006).

	Different settings: shallow vs deep water The evidence suggests that swimming skills training in shallow water compared to training in deep water results in little to no difference in the following aquatic motor skills: water orientation and adjustment at vertical position; breath control – immersion of the face and eye opening; autonomous in deep pool (leg and arms displacement) (low-certainty evidence; Costa et al., 2012). Evidence from the same study suggests that shallow water training may increase other aquatic motor skills: water entry, horizontal buoyancy, body position at ventral gliding, body position at dorsal gliding, body position at longitudinal rotation in gliding, body position at front and back somersaults, leg kick with breath control at ventral body position with flutter boards, leg kick with breath control at ventral body position without any flutter device, leg kick with breath control at dorsal body position with flutter boards, leg kick with breath control at dorsal body position without any flutter device, feet-first entry, head-first entry, vertical buoyancy at deep water and deep-water immersion (low-certainty evidence; Costa et al., 2012). Combined water safety training (out-of-water) and basic swim skills training (in-water): number of weeks of training One RCT compared educational programmes with both water safety and basic swim skills training of differing lengths. A 12-week training programme compared to an 8-week training programme may have little to no effect on swimming ability but the effect is very uncertain (very low-certainty evidence; Asher et al., 1995). The evidence suggests that a 12-week programme results in little to no difference in water recovery at the end of the programme but may result in an increase in water recovery at 12-week follow-up compared to an 8-week programme (low-certainty evidence; Asher et al., 1995). A 12-weeks programme may improve "jump and swim" skill both at the end of training and at 12 weeks follow-up compared to an 8-week programme (low-certainty evidence; Asher et al., 1995). A 12-week training programme may, however, result in little to no difference in deck behaviour compared to an 8-week programme both at the end of training and at 12-weeks follow-up (low-certainty evidence; Asher 1995). Water safety training (out-of-water) as part of a broader educational programme: programme vs handbook An educational intervention programme containing a water safety component compared to handbook education only probably results in little to no difference in drowning prevention knowledge and attitude (moderate-certainty evidence; Cao et al., 2015).	Educational water safety training A master thesis by van Driel (2017) evaluated the Dutch educational intervention "Water safe" delivered in primary school to 10–12-year-olds. The measured desirable effect on social influences is described in the previous section. The **knowledge component of the questionnaire was not deemed reliable enough** to be included in the analysis. Self-efficacy was lower post-measurement than pre-measurement for both the control and intervention group, but **no differences between the groups was identified in the post-measurement for self-efficacy.** According to the authors the decrease in self-efficacy is therefore not due to the intervention and they hypothesize that filling out the first questionnaire could trigger children to reflect on their own abilities more. **Feelings and beliefs (attitude) did not differ between control and intervention group** at the post-intervention measurement nor did it change over time in either group. Participants were neither very positive nor very negative about the usefulness of the programme (2.70 on a five-point scale) and rated effort needed as 1.90 (on a five-point scale). **A higher score on the perceived usefulness of the programme correlated with a higher score in feelings and beliefs.** The authors state that future research should investigate if perceived usefulness (of learning water safety behaviour) influences feelings and beliefs.

Summary of discussion

The GDG recognized that there were potential undesirable effects identified in the literature review associated with the implementation of swim skills and water safety training. However, the data from the systematic review did not demonstrate worsening swim skills or water safety behaviour from any of the interventions. Additionally, the arguments identified from other expert documents were felt by the GDG to reflect the same undesirable effects frequently cited with many public health interventions – that by providing training, you increase the potential for harm because people will take greater risks, or provide less supervision, etc. They felt that the likelihood of this was small, and not well supported by the evidence overall.

One concern raised was that if swim skills and water safety training is implemented in settings without appropriate programme regulation or safety supervision, then children may be at a greater risk for drowning or other injury/disease by participating. After discussion however, it was felt that the notion of "undesirable" effects in delivering swim skills training is managed by policy and programmatic frameworks designed to reduce risk during instruction and commonly include issues such as student:teacher ratios, venue management (i.e. supervision), basic rescue, water quality, and teaching qualifications. The GDG said that programme implementation advice would be an important addition to any recommendation made by WHO.

Overall, they felt the undesirable effect size was small.

Certainty of evidence
What is the overall certainty of the evidence of effects?

Judgement	Research evidence	Additional considerations
Very low Low **Moderate** High No included studies	Please see evidence profiles and the systematic review results in the preceding "Desirable effects" and "Undesirable effects" sections. The critical outcome of drowning mortality was deemed to be of moderate certainty due to a large effect size.	Please see summaries of the additional information results in the preceding "Desirable effects" and "Undesirable effects" sections.

Summary of discussion

The GDG recognized that the research and data identified was significantly heterogeneous. They also acknowledged the difficulty of conducting high-quality research in this area. The Rahman (2012) study – which is the primary study for the critical outcome of reducing drowning-related mortality in children – was rated as moderate certainty of evidence by the systematic review team. The remaining outcomes are all secondary and appear to have lower certainty of evidence described. Despite this, based on the Rahman study and the GDG's experience in high-income countries, training children in swim skills and water safety will reduce mortality and morbidity due to drowning. As a result, the majority supported a moderate certainty of evidence for the primary outcome.

Values Is there important uncertainty about, or variability in, how much people value the main outcomes?		
Judgement	**Research evidence**	**Additional considerations**
Important uncertainty or variability Possibly important uncertainty or variability **Probably no important uncertainty or variability** No important uncertainty or variability		

Summary of discussion

The GDG referenced evidence from Tanzania (Pando, 2018; IPSOS 2010) that suggested swimming skills were considered a priority by community members when discussing possible drowning prevention initiatives. The main factor the GDG discussed as potentially creating variability of whether children or parents would value children learning swim skills was whether there was a financial cost associated. Where a cost was associated, families (depending on their socioeconomic status) may have to choose between other necessities and this training. The GDG felt that overall, in various regions, there would be minimal variability that learning basic swim skills and water safety would be valued as important skill if it were provided for free. As a result, the consensus agreed that there was probably no important uncertainty or variability as a value in this context, but there may be increased variability if there was a financial barrier to participate.

Balance of effects
Does the balance between desirable and undesirable effects favour the intervention or the comparison?

Judgement	Research evidence	Additional considerations
Favours the comparison Probably favours the comparison Does not favour either the intervention or the comparison **Probably favours the intervention** Favours the intervention Varies Don't know		

Summary of discussion

The majority of the GDG agreed that the balance of effects favoured the intervention. A detailed discussion of the desirable and undesirable effects is noted above under the respective sections. Highlights of this discussion are that the GDG felt there was definite evidence that basic swim skills and water safety training reduced drowning-related mortality in children, and there was agreement that there was no evidence to suggest children were harmed during swim training. They selected "probably favours" over "favours" as they recognized that evidence in the undesirable effects category was not as robust as in the desirable effects category (and therefore may not have captured potential effects), and that there was the risk of publication bias in this field (i.e. not publishing harms).

Resources required
How large are the resource requirements (costs)?

Judgement	Research evidence	Additional considerations
Large costs Moderate costs Negligible costs and savings Moderate savings Large savings **Varies** Don't know	**Systematic review** (setting: high-, low- and middle-income countries; outcomes: drowning, water safety knowledge/skills/behaviour): - Costs for the one-time SwimSafe programme in Bangladesh (part of the PRECISE programme) averaged US$ 13.46 per child, with 77% dedicated to providing swimming lessons (Rahman et al., 2012). - The Injury Minimization Programme for Schools in the the United Kingdom was free to schools, but the programme cost approximately £10 per child (Frederick et al., 2000).	**Expert opinion/additional information** (based on studies identified through the systematic review, but not fulfilling the selection criteria study type, population, or outcome, or based on data that were not extracted in the systematic review): Basic swim skills training - One qualitative study among guardians of children in primary school in a rural setting in Thailand measured their perceptions related to drowning risk and highlighted that, to facilitate swimming skills training for school children, the guardians reported that the **infrastructure in rural areas needs to be improved** (Loasee et al., 2014). - Another qualitative study in Viet Nam used semi-structured in-depth interviews about drowning reduction interventions with key stakeholders engaged in drowning prevention in Viet Nam. One of the key stakeholders reported that, **in cases where government funding was not available, some schools partnered with private companies for the installation of a portable pool**, costing 100 million Vietnamese Dong per pool. In practice, the private companies paid for the installation of the pool and the schools provided the location. Additionally, the private company also charged fees for swimming lessons (Jagnoor et al., 2019). - In a qualitative study in the Republic of Korea, experts were asked to determine major concerns regarding survival swim programmes, using the Delphi method protocol. They identified **lack of educational facilities and limited space and time** among the most critical issues regarding the survival swim programme (Lee et al., 2019).

Summary of discussion

The GDG noted the limited data in this area, and that experiences in high-income countries are not likely to directly equate to low- and middle-income countries. The Rahman Bangladesh study did support that a per-child cost it is a relatively affordable intervention in the long-term. However, they used local and natural resources (ponds). Some members of the GDG noted that cost can vary on what infrastructure (both natural and manmade) exists in communities already that can be used as an instructional site. They noted other variables that would affect this: type of training facilities used, ratio of trainers to students, length of course, labour costs and type of training materials needed. As a result, the majority of the GDG supported a varies judgment for this category. They also recommended that any region implementing these recommendations should undertake research to monitor costs and cost-effectiveness, thereby generating more data to help planning in other regions in the future.

Certainty of evidence of required resources What is the certainty of the evidence of resource requirements (costs)?		
Judgement	**Research evidence**	**Additional considerations**
Very low Low Moderate High		
No included studies		

Cost effectiveness
Does the cost-effectiveness of the intervention favour the intervention or the comparison?

Judgement	Research evidence	Additional considerations
Favours the comparison Probably favours the comparison Does not favour either the intervention or the comparison Probably favours the intervention **Favours the intervention** Varies No included studies	**Systematic review** (setting: high-, low- and middle-income countries; outcomes: drowning, water safety knowledge/skills/behaviour): - The cost-effectiveness of the SwimSafe programme in Bangladesh, an educational programme combining water safety training and basic swim skill training, is US$ 3009 per death averted and US$ 85 per death averted (moderate-certainty evidence; Rahman et al., 2012).	

Summary of discussion

The majority of the GDG felt that the cost-effectiveness favoured the intervention. They cited the SwimSafe programme in Bangladesh, and the cost per child that it required to operate. Although concern was expressed that this was only one study, the GDG felt that the critical outcome of drowning-related mortality for children was so important that it was reasonable to conclude that the intervention was favoured with the information provided.

Equity
What would be the impact on health equity?

Judgement	Research evidence	Additional considerations
Reduced Probably reduced Probably no impact Probably increased **Increased** Varies Don't know		**Expert opinion/additional information** (based on studies identified through the systematic review, but not fulfilling the selection criteria study type, population or outcome, or based on data that were not extracted in the systematic review): - One narrative review critically evaluated the Canadian Red Cross' Swim Programme and suggested that the White/European Canadian approach to basic swim skills and water safety was better than those of other ethnic communities, and underlined that previous studies identified notable **differences in aquatic risk perception among various populations and cultures** due to diverse beliefs and attitudes towards drowning or other activities in and around water: White males consistently perceive less risk than White females and male and female counterparts from other ethnic backgrounds. The authors suggest that the historical predominance of swimming in North America as a middle- to upper-class sport and recreational activity that is predominantly practiced by White people or those of European descent might possibly and partially explain these differences. Finally, they argue that future programmes (and programme instructors) should consider the differences in cultural and ethnic backgrounds (Rich et al., 2014). - In another narrative review, the authors highlighted that **swimming participation is higher in urbanized counties of the USA with higher median incomes and a greater percentage of White residents** and a lower percentage of African-American residents. They argue that swimming appears to be a **socially exclusive activity**. Additionally, the authors link the mechanism of social exclusivity to the observed higher drowning rates in pools among Black males and females aged 5 to 19 years, compared to their White counterparts (Hastings et al., 2006). - In a qualitative study it was reported that overall, White children in the sample reported a lower level of agreement with the statement, "I am afraid of drowning/being injured while swimming" compared to African-American, Hispanic/Latino, and other children of colour (Irwin et al., 2011).

Summary of discussion

The GDG felt that this intervention would increase health equity. Several reasons for this were discussed. First, there is already a significant discrepancy between high-, low- and middle-income countries in risk of death due to drowning for children. It is hoped that this recommendation will support interventions that will help reduce this gap and make water safety a more widely accepted and adopted goal. Two reviews in the additional considerations also support that swimming is more popular in urbanized regions with higher incomes. By increasing awareness of the need for this intervention in low- and middle-income countries, once again, the aim is to make it a more universal skillset. It is important for any implementation strategy to consider local cultural practices and to work with local people to create a system that will be inclusive and based equity factors like gender, and not only benefit those of a particular socioeconomic status.

Acceptability Is the intervention acceptable to key stakeholders?		
Judgement	**Research evidence**	**Additional considerations**
No Probably no **Probably yes** Yes Varies Don't know		**Expert opinion/additional information** (based on studies identified through the systematic review, but not fulfilling the selection criteria study type, population or outcome): - The acceptance of swimming or educational water safety lessons could **be hampered by the beliefs that parents have towards the causal reasons for drowning**. A qualitative study carried out over 13 months in Matlab, Bangladesh, held open-ended interviews with families who had lost a child or experienced a near-death due to drowning, and families with at least one child under 5 years living near a body of water. Causal explanations for childhood drowning given by the children's parents are primarily associated with "evil spirits" believed to entice young children to water or bewitch mothers so that they forget about the child. Another primary interpretation relates to a water goddess known to prey on small children. In some instances, when a young child is discovered in water, parents refrain from rescuing the child due to a belief that if a parent touches a drowning child, the child will die (Blum et al., 2009). - Another qualitative study conducted focus group discussions with Vietnamese teenagers and their parents and described that they both **believed that drownings occurred because it was fate**. The belief that drowning incidents are not preventable might interfere with the acceptance of future educational water safety trainings or swimming lessons in this population. This study also revealed that Vietnamese teenagers reported that the use of lifejackets would make them appear weak and therefore, embarrassment could be another factor that could hamper the acceptance of swimming lessons. Finally, this study also highlighted that parents perceived **high costs as the major barrier** to send their children to swimming lessons (Quan et al., 2006). - The Australian study that implemented the Water Safety in the Bush programme assumes that the parents are the most relevant ones to target for water safety messages. However, the authors note that, in an Aboriginal context, this **responsibility may be extended to other family members**, such as older siblings (Beattie et al., 2008). Therefore, to avoid cultural inappropriateness, effective training programmes need to be adaptable to respond to specific cultural differences.

Summary of discussion

The GDG felt that there is no strong evidence to support or refute that swim skills and water safety training would be accepted. However, expert opinion leads them to believe that there is an acceptance that swimming is a critical skill for children, and that there is a desire for children to participate in learning it. The biggest threat to acceptance is believed to be related to cultural context and sensitivities, as well as socioeconomic challenges to inclusion. Evidence from Zanzibar shows that training programmes can be adapted to be inclusive for key stakeholders: providing sex-segregated training, training of local female instructors, community education on drowning risk (through community theatre) and culturally appropriate swimwear for girls has increased girl's participation in survival swimming training from 4% in 2014 to 56% in 2018. The GDG felt that similar experiences would be found in other regions. Overall, the GDG believed that there would probably be acceptance of basic swim skills and water safety training programmes, but it was caveated that local culture will guide implementation strategies.

Feasibility
Is the intervention feasible to implement?

Judgement	Research evidence	Additional considerations
No Probably no Probably yes **Yes** Varies Don't know		**Expert opinion/additional information** (based on studies identified through the systematic review, but not fulfilling the selection criteria study type, population or outcome, or based on data that were not extracted in the systematic review): - A recommendation document by the Committee on Injury and Poison Prevention from 2000 mentions that **generally, children are not developmentally ready for swimming lessons until after their 4th birthday** (Committee on Sports Medicine and Fitness and Committee on Injury and Poison Prevention 2000). - A position statement from the Canadian Paediatric Society in 2003 about swimming and water safety reaches the same conclusion, stating that children under the age of 4 years do not have the developmental ability to master water survival skills and swim independently (Nguyen et al., 2003). - In one qualitative study from the Republic of Korea, experts were asked to identify major concerns regarding survival swim programmes, using the Delphi method protocol. They identified **lack of government support** to be among one of the most critical issues regarding the survival swim programme (Lee et al., 2019). - A qualitative study in Viet Nam used semi-structured, in-depth interviews about a drowning reduction intervention with key stakeholders engaged in drowning prevention in Viet Nam. Key stakeholders reported that the feasibility to implement drowning prevention activities largely depends on the **availability of consistent government funding,** and in many cases there is no guaranteed funding allocation from the central government. However, in cases of limited financial resources, it was feasible for some provinces in urban areas to continue implementing swimming programmes through financial support from their own communities (Jagnoor et al., 2019).

		- Researchers from the Water Safety in the Bush programme in Australia reported that it was a challenge to **recruit and retain the adequately skilled instructors** needed for programme sustainability (Beattie et al., 2008).

Summary of discussion

The GDG believed that the intervention has been demonstrated to be feasible, especially when weighed against the reduction of fatal drownings in children, and used the Bangladesh study (Rahman et al., 2012) as an example. The GDG discussed how countries such as Thailand and Viet Nam have adopted similar models to continue offering swim skills and water safety training, and noted that feasibility varies depending on context and resource availability, especially if there is government support and community willingness to adopt and keep the programme running at its own cost. They also noted that feasibility can change over time, as upfront costs can be larger than those needed to manage the programme in the long-term.

Summary of judgements

	Judgement						
Problem	No	Probably no	Probably yes	**Yes**		Varies	Don't know
Desirable effects	Trivial	Small	**Moderate**	Large		Varies	Don't know
Undesirable effects	Large	Moderate	**Small**	Trivial		Varies	Don't know
Certainty of evidence	Very low	Low	**Moderate**	High			No included studies
Values	Important uncertainty or variability	Possibly important uncertainty or variability	**Probably no important uncertainty or variability**	No important uncertainty or variability			
Balance of effects	Favours the comparison	Probably favours the comparison	Does not favour either the intervention or the comparison	**Probably favours the intervention**	Favours the intervention	Varies	Don't know
Resources required	Large costs	Moderate costs	Negligible costs and savings	Moderate savings	Large savings	**Varies**	Don't know
Certainty of evidence of required resources	Very low	Low	Moderate	High			**No included studies**
Cost-effectiveness	Favours the comparison	Probably favours the comparison	Does not favour either the intervention or the comparison	Probably favours the intervention	**Favours the intervention**	Varies	No included studies
Equity	Reduced	Probably reduced	Probably no impact	Probably increased	**Increased**	Varies	Don't know
Acceptability	No	Probably no	**Probably yes**	Yes		Varies	Don't know
Feasibility	No	Probably no	Probably yes	**Yes**		Varies	Don't know

Type of recommendation

Strong recommendation against the intervention	Conditional recommendation against the intervention	Conditional recommendation for either the intervention or the comparison	Conditional recommendation for the intervention	**Strong recommendation for the intervention**

Summary of discussion

The GDG discussed at length whether there should be a “conditional” or “strong” recommendation for the intervention. Proponents for “conditional” cited a relatively small body of supporting evidence. However, the GDG ultimately decided that the outcome (reduction of mortality and morbidity associated with drownings in children) was strongly supported by the systematic review, additional documents, and expert opinion discussed throughout the meeting. The majority of the GDG agreed with this, with the caveat that an implementation document be developed with recommendations to help regions planning to move forward with the intervention. Important considerations in this implementation document should include risk management approaches, regulations, and strategies to ensure safety of participants and instructors, prevention of communicable disease and infection transmission, and acceptable, safe content and instructional techniques.

Additionally, the GDG noted that although the initial focus was on low- and middle-income countries, it was felt that the evidence (which largely came from high-income countries) was relevant enough to make a strong recommendation applicable to high-income countries as well.

The GDG also supported further evidence-gathering in this area. Studies on type/design of swim skills programme and their cost-effectiveness, impact on health equity, acceptability and feasibility were recommended. In addition, before-and-after studies assessing mortality and morbidity due to drowning trends in countries, and before-and-after studies of potential adverse events (such as participant or instructor injury, communicable or infectious disease spread and behaviours/attitudes of children following participation in a programme from regions that implement training programmes) would be an asset.

Finally, in terms of implementation, the GDG recommended a “start small and scale-up” approach for regions considering this intervention; this would allow for assessment and refinement of each implementation step, and to optimize results in the long-term.

Annex 2:
Day-care Evidence to Decision table

Question

Should formal day-care programmes vs. no day-care programmes be used for prevention of drowning in children in low- and middle-income countries?	
Population:	0–5 years, low- and middle-income countries
Intervention:	Formal out-of-home day-care programmes
Comparison:	No day-care programmes
Main outcomes:	Risk of death from drowning; Risk of death from injuries; Risk of death from other causes than injuries; Risk of overall deaths; Overall mortality rate at 1 year of age; Overall mortality rate at 2 years of age; Overall mortality rate at 3 years of age; Overall mortality rate at 4 years of age; Overall mortality rate at 5 years of age; Drowning mortality rate at 1 year of age; Drowning mortality rate at 2 years of age; Drowning mortality rate at 3 years of age; Drowning mortality rate at 4 years of age; Drowning mortality rate at 5 years of age; Cost-effectiveness (cost (US$)/death averted); Cost-effectiveness (cost (US$)/DALY averted)

Assessment

Problem Is the problem a priority?		
Judgement	**Research evidence**	**Additional considerations**
No Probably no Probably yes **Yes** Varies Don't know	Key facts (from WHO): Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid; outcomes are classified as death, morbidity and no morbidity. - **Drowning is the third leading cause of unintentional injury death worldwide, accounting for 7% of all injury-related deaths.** - **There are an estimated 320 000 annual drowning deaths worldwide.** - **Global estimates may significantly underestimate the actual public health problem related to drowning.** - **Children, males and individuals with high levels of exposure to water are most at risk of drowning.** Scope of the problem In 2019, an estimated 236 000 people died from drowning, making drowning a major public health problem worldwide. In 2019, injuries accounted for just under 8% of total global mortality. Drowning is the third leading cause of unintentional injury death, accounting for 7% of all injury-related deaths. Countries in all regions and at all income levels share the world's drowning burden, but some regions account for a larger share than others: - Low- and middle-income countries account for over 90% of unintentional drowning deaths. - Over half of the world's drowning occurs in WHO's Western Pacific Region and South-East Asia Region. - Drowning death rates are highest in the WHO African Region and are 15–20 times higher than those in Germany or the United Kingdom, respectively. Despite limited data, several studies reveal information on the economic cost of drowning. In the United States of America (USA), 45% of drowning deaths are among the most economically active segment of the population. Coastal drowning in the USA alone accounts for US$ 273 million each year in direct and indirect costs. In Australia and Canada, the total annual cost of drowning injury is US$ 85.5 million and US$ 173 million respectively.	

	There is a wide range of uncertainty around the estimate of global drowning deaths. Official data categorization methods for drowning exclude intentional drowning deaths (suicide or homicide) and drowning deaths caused by flood disasters and water transport incidents. Data from high-income countries suggest these categorization methods result in significant underrepresentation of the full drowning toll by up to 50% in some high-income countries. Nonfatal drowning statistics in many countries are not readily available or are unreliable.	

Summary of discussion

The GDG felt that drowning is a priority problem in many population groups, especially those exposed to water for daily activity. The GDG acknowledged that there is likely a significant underreporting of drowning deaths that hinders public understanding of the magnitude of drowning as a public health problem. The GDG also felt that drowning constitutes a serious burden, particularly in low- and middle-income countries where over 90% of drownings occur. Within these settings, at risk populations of pre-school aged children who may not have continual adult supervision were agreed to be at particular risk for drowning.

The PICO question is limited to whether formal day-care programmes in low- and middle-income countries reduce drowning vs. no programmes. Since day-care programmes would logically only prevent drowning among children under the age of 6 years, the drowning statistics to frame the problem statement should be for those age groups. That said, in low- and middle-income countries, the priority depends on more than the numbers of children affected, which is substantial, but without precise numbers. Priority depends on the availability of resources, as well as the ability of governments to mount a national-level programme. Small, local-level programmes are unable to provide significant early childhood drowning reductions, and the only way to scale to the national level is through government adoption and ownership. For those low- and middle-income countries where this is possible, it is a priority. Examples include Thailand and Vietnam, both of which have national day-care/pre-school programmes. Some evidence exists in both countries that programmes implemented at national level have decreased early childhood drowning. For low- and middle-income countries where the government has not become formally involved, drowning, or any other child injury issue, can be seen as competition for resources by other programmes the government gives priority to, with undesirable political consequences. The evidence presented would support drowning as a priority if a government in a low- or middle-income country agrees it is and devotes the necessary political will and resources to its prevention. Where that is not the case, the priority is to get low- and middle-income countries governments to make it a priority.

Desirable effects
How substantial are the desirable anticipated effects?

Judgement	Research evidence	Additional considerations
Trivial Small Moderate **Large** Varies Don't know	Desirable effects **Systematic review** (setting: low- and middle-income countries; outcome: drowning/injuries): - It was shown that formal day-care resulted in a statistically significant **decrease of the risk of death** from drowning, the risk of death from injuries, and the risk of overall deaths (adjusted for gender, location, and birth cohort), compared to not being enrolled in a crèche programme. A statistically significant decreased risk of death from causes other than injuries could not be demonstrated (Rahman et al., 2012). Evidence is of moderate certainty. - In terms of **crude mortality rates** it was shown that a formal day-care programme resulted in a statistically significant decrease of the overall mortality rate at 4 years, but this effect **could not be demonstrated** for other age categories nor for the drowning mortality rate (no adjustments for covariates) (Rahman 2012). Evidence is of very low certainty.	Desirable effects Review of existing systematic reviews (setting: high-, low- and middle-income countries; outcome: all other outcomes): - Centre-based care in low- and middle-income countries: It was shown that centre-based care compared to no centre-based care resulted in a statistically significant **increased child cognitive ability** as measured on different scales (Brown et al., 2014). Another review found increased adequate social interaction and cognitive development, but no meta-analysis was done (Leroy et al., 2012). - Centre-based care in high-income countries: A statistically significant **difference in child cognitive ability and psychosocial development could not be demonstrated** (van Urk et al., 2014). - Pre-school programmes in high-income countries: It was shown that specific pre-school programmes compared to no such programmes resulted in statistically significant **increased intelligence, academic achievement**, and a statistically significant **decreased identification of borderline mental impairment, need for special education, retention in grade, not graduating from high school, delinquent behaviour** (Gorey, 2001). It was shown that day-care (including specific pre-school programmes) compared to no day-care resulted in a statistically significant **increase of IQ** at 36 months and at age 5 years, and a statistically significant **decreased** need for **special education, retention in grade, five or more arrests and being arrested for drug dealing** (Zoritch et al., 2000). It was shown that day-care (including specific pre-school programmes) compared to no day-care resulted in a **beneficial effect on reducing crime**, a **beneficial effect or no effect on social competence**, **mixed effects on externalizing behaviours** and **no effect on self esteem, self concept and internalizing behaviours** (D'Onise et al., 2010). - It was shown that exposure to day-care after the age of 3 years compared to no exposure resulted in a statistically significant **decreased risk of type 1 diabetes** (Kaila et al., 2001). - Evidence concerning **nutrition/nutritional status** is **inconsistent**. Several individual studies found a positive association between centre-based day-care and nutrition, while other studies found a negative association, mixed effects or could not demonstrate any association (Da Silva et al., 2010; Leroy et al., 2012; Costa, 2019).

- Evidence concerning "**healthy behaviour**" is **inconsistent**. It was shown that day-care compared to home-based child care resulted in a decrease of screen viewing, although no statistics were provided (Vanderloo, 2014). For physical activity, sedentary behaviour, and sleep, individual studies showed either a positive association or could not demonstrate a difference (Costa, 2019).
- Evidence concerning **obesity** is **inconsistent**. Several individual studies found a negative association between centre-based day-care and obesity, while other studies found a positive association, mixed effects or could not demonstrate any association (Alberdi et al., 2016; Black et al., 2017; Swyden et al., 2017; D'Onise et al., 2010).

Expert opinion/additional information (based on studies identified through the systematic review, but not fulfilling the selection criteria for study type, population or outcome):

- A child-care based programme called "Operacion Rescate Infantil" (Child Rescue Programme, or ORI) implemented in Ecuador – a country with high levels of poverty and inequality – promoted the integral development of children in low-income households in rural and semi-urban areas. It included an educational component as well as a nutritional component, and was delivered by trained community mothers or "madres communitarias". This programme **increased household income and maternal employment**, as measured in a cohort study (Rosero, 2012).
- An impact report (cohort study) of Mexico's "Programa de estancias infantiles para apoyar a madres trabajadoras" (Childcare programme to support working mothers, or PEI) which specifically targeted low-income mothers with a lack of access to child care showed **increased maternal employment** upon implementation. However. it had **no significant impacts on household income** (Angeles et al., 2014).
- Another cohort study of children in low-income communities in Kenya, Uganda and Tanzania/Zanzibar who received child care programmes with a strong educational component showed a **positive effect on cognitive development** (Mwaura, 2008). A similar effect on cognitive development was found in the Ecuadorian ORI study (Rosero, 2012).
- Other experimental studies compared the effects on children in day-care versus home-care settings and found **no statistically significant differences between these settings for language, or gross and fine motor development.** One study was among impoverished young children enrolled in a child-care programme delivered by a "Madre Cuidadora" (a mother-carer from the local community) in a "Wawa Wasi" centre – part of Peru's national "Wawa Wasi" programme. The programme included a safety and educational component as well as three meals a day (Cueto et al., 2009). Also, no statistically significant differences between these settings were found **for dietary diversity and child development** in the Mexican PEI study (Angeles et al., 2014).

		- It was reported in a retrospective cohort study, reviewing medical records from patients admitted for drowning or near-drowning, that most child drowning incidents in Cape Town, South Africa (a low-to-middle-income country) happened in the absence of supervision (Joanknecht et al., 2015). - A case-control study identified **lack of child supervision** as a **risk factor for nonfatal drowning** among children in rural areas of Guangdong Province, China (a low-to-middle-income country), where drowning mortality is ranked second highest globally (Ma et al., 2010). Two other case-control studies, one in young children in rural Bangladesh (a low-to-middle-income country) where every 30 minutes a child drowns, and another study in young children in rural China, similarly identified **lack of child supervision** as a **risk factor for fatal drowning** (Yang et al., 2007; Khatlani et al., 2017). Studies reporting injury rates in day-care versus home-care settings produce opposing conclusions (see also "Undesirable effects"): - **Injury rate was found to be lower** in day-care settings compared to home-care settings when analysing very young children (under the age of 2 years) in a case-control study in the USA (Davis et al., 2013). Similarly, the injury rate was lower in day-care settings compared to home-care settings in a coastal town in Norway (another high-income country) in very young children under the age of 2 years (Kopjar et al., 1996).

Summary of discussion

The GDG felt that there was sufficient evidence to support (with consensus) that the effect size of intervention was large in nature when discussing desirable effects. The systematic review results showed clearly with evidence of moderate certainty that drowning deaths were significantly reduced through formal day-care. In addition, evidence from the review of existing systematic reviews showed there was a wide spectrum of other, very significant desirable effects associated with day-care.

Undesirable effects
How substantial are the undesirable anticipated effects?

Judgement	Research evidence	Additional considerations
Large Moderate **Small** Trivial Varies Don't know	Undesirable effects **Systematic review** (setting: low- and middle-income countries; outcome: drowning/injuries): - No undesirable effects described.	Undesirable effects Review of existing systematic reviews (setting: high-, low- and middle-income countries; outcome: all other outcomes): - A systematic review of day-care programmes versus no such programmes in low- and middle-income countries found **increased aggressive behaviour** (no meta-analysis done) (Leroy et al., 2012). - It was shown that day-care compared to no day-care resulted in a statistically significant **increased risk of early recurrent wheezing and asthma risk** before the age of 6 years, but not after the age of 6 years (Ochoa Sangrador et al., 2018). There was no difference in illness including asthma diagnosis and hospitalizations between pre-school programme intervention and control groups (D'Onise et al., 2010). - **Infectious disease**: It was shown that day-care compared to no day-care resulted in a **statistically significant increase** of cytomegalovirus infection (Zheng et al., 2019). Attendance at day-care centres was a risk factor for intestinal parasites and respiratory infections (Pedraza 2014), upper respiratory tract infection, acute otitis media, otitis media with fluid draining, lower respiratory tract infections and gastroenteritis (Ochoa Sangrador et al., 2007), although it is unsure if these associations were significant (Pedraza et al., 2014; Ochoa Sangrador et al., 2007). - It was shown that exposure to day-care compared to a home setting resulted in a statistically **significant positive correlation with stress levels** (Vermeer et al., 2006). Expert opinion/additional information (based on studies identified through the systematic review, but not fulfilling the selection criteria for study type, population or outcome): - Surprisingly, the Ecuadorian ORI study found **a negative effect** of the child-care programme **on children's height** (Rosero, 2012). - One cross-sectional study analysed the association between the number and type of child-care arrangements young children's health problems in the USA, and estimated that an increase in centre-based or non-relative child-care arrangements had a strong association with **increased risk of health problems** (e.g. ear infections, gastrointestinal illness, asthma diagnosis and unintentional injuries), compared to child care given by relatives (Chen, 2013).

		Studies reporting injury rates in day-care versus home-care settings have opposing conclusions (see also "Desirable effects"): - Five case-control studies reported that children in day-care in high-income countries had **more injuries** compared to home-care settings. Four of these studies were based on data on children in day-care in the USA (Gunn et al., 1991; Kotch et al., 1997; Schwebel et al., 2007; Davis et al., 2013) and one study was based on data on children in Swedish day-care centres (Sellström et al., 1994). - Two similar USA studies reported **no differences in injury risk** between day-care versus home-care settings (Rivara et al., 1989; Kotch et al., 1993).

Certainty of evidence
What is the overall certainty of the evidence of effects?

Judgement	Research evidence	Additional considerations
Very low Low **Moderate** High No included studies	Please see evidence profiles and the systematic review results in the preceding "Desirable effects" and "Undesirable effects" sections. The critical outcome of drowning mortality was deemed to be of moderate certainty due to a large effect size.	Please see summaries of the additional information results in the preceding "Desirable effects" and "Undesirable effects" sections.

Summary of discussion

The GDG recognized the heterogeneity of the research and data reviewed. It was also evident that there were difficulties in conducting high-quality research in the area and that very few studies had included the critical outcome of interest. The Rahman (2012) study – which is the primary study for the critical outcome of reducing drowning-related mortality in children – was rated as moderate certainty of evidence by the systematic review team. All remaining outcomes (both desirable and undesirable effects) were of secondary importance and in general had lower certainty of evidence described. Because of the Rahman (2012) study's relevance to the critical outcome under consideration, and the GDG's deliberations, the majority of the GDG supported a moderate certainty of evidence for the primary outcome.

Values
Is there important uncertainty about or variability in how much people value the main outcomes?

Judgement	Research evidence	Additional considerations
Important uncertainty or variability		
Possibly important uncertainty or variability		
Probably no important uncertainty or variability		
No important uncertainty or variability		

Summary of discussion

The GDG noted that a number of factors drove the values attributed to day-care as an intervention to prevent drowning. These included whether significant financial costs were associated, programme quality, and social and cultural understanding of the value of the early childhood period. Perspectives also mattered, with working mothers tending to value day-care programmes highly because of the provision of a safe place for children while they are working, whereas government personnel in sectors such as education would value these programmes for their impacts on outcomes such as dropout rates and preparedness for school. The GDG felt that across various regions there would be minimal variability in these values, and that generally day-care programmes would be highly valued (as long as any financial barriers to participation were in keeping with available resources at the household level). Accordingly, the majority of the GDG agreed there was probably no important uncertainty or variability in sthe value that would typically be attributed to day-care as an intervention to prevent drowning.

Balance of effects Does the balance between desirable and undesirable effects favour the intervention or the comparison?		
Judgement	**Research evidence**	**Additional considerations**
Favours the comparison Probably favours the comparison Does not favour either the intervention or the comparison **Probably favours the intervention** Favours the intervention Varies Don't know		

Summary of discussion

The majority of the GDG agreed that the balance of effects favoured the intervention. A detailed discussion of the desirable and undesirable effects is noted above under the respective sections. Highlights of this discussion are that the GDG felt there was definite evidence that day-care reduced drowning-related mortality in children, and there was agreement that evidence was inconsistent for some undesirable outcomes, and that overall the undesirable effect size was small. The GDG selected "probably favours" over "favours" as the GDG recognized that evidence in the undesirable effects category was not as robust as in the desirable effects category (and therefore may not have captured potential effects), and that there was the risk of publication bias in this field (i.e. not publishing harms).

Resources required
How large are the resource requirements (costs)?

Judgement	Research evidence	Additional considerations
Large costs Moderate costs Negligible costs and savings **Moderate savings** Large savings Varies Don't know	The cost of the Anchal crèche programme (part of PRECISE programme) in Bangladesh equals US$ 60.50 per child in the first year, and US$ 50.70 per child per year for following years (Rahman et al., 2012).	Expert opinion/additional information (based on studies identified through the systematic review, but not fulfilling the selection criteria study type, population or outcome): The Mexican PEI study analysed the costs of providing day-care and concluded that the income received through government subsidies and parent's fees is enough to cover the costs per child; nevertheless it was underlined that any variation in operational costs could put the sustainability of day-care settings at risk (Angeles et al., 2014).

Summary of discussion

The GDG noted the limited data in this area, and that resource requirements and savings would not equate directly between high-income and low- and middle-income countries. The Rahman Bangladesh study (2012) provided evidence that the per-child cost is relatively affordable over the long-term. Further, savings can be quite high when programmes have a positive impact on children's progress and performance in primary school and help lay the foundation for long-term positive health and emotional well-being. Of course, savings are substantial if the death of a child is averted. Some members of the GDG noted the potential sensitivity of these costs to variations in operational costs arising from local contexts. The majority of the GDG supported a moderate savings judgment for this category. They also recommended that programme implementation should incorporate monitoring of costs and cost-effectiveness in order to buttress the evidence base around these aspects in the future.

Certainty of evidence of required resources
What is the certainty of the evidence of resource requirements (costs)?

Judgement	Research evidence	Additional considerations
Very low		
Low		
Moderate		
High		
No included studies		

Summary of discussion

Resource requirements will vary between high-, low- and middle-income countries. The best evidence regarding resource requirements came from the Rahman (2012) study and was deemed of moderate certainty. The majority of the GDG felt certainty of evidence of required resources should be accorded a moderate rating.

Cost-effectiveness
Does the cost-effectiveness of the intervention favour the intervention or the comparison?

Judgement	Research evidence	Additional considerations
Favours the comparison Probably favours the comparison Does not favour either the intervention or the comparison Probably favours the intervention **Favours the intervention** Varies No included studies	The cost-effectiveness of the Anchal crèche programme (part of PRECISE programme) in Bangladesh equals US$ 27 606 per death averted and US$ 812 per DALY averted (Rahman et al., 2012). Evidence is of moderate certainty.	

Summary of discussion

The majority of the GDG felt that consideration of cost-effectiveness favoured the intervention. They cited the findings from the Rahman (2012) crèche programme which provided evidence of moderate certainty demonstrating day-care to be “very cost effective” when considered according to WHO-CHOICE criteria. Although concern was expressed that the evidence base did not extend beyond the Rahman (2012) study, the majority of the GDG felt that the critical outcome of drowning-related mortality for children was so important that it was reasonable to conclude that the intervention was favoured on a cost-effectiveness basis.

Equity
What would be the impact on health equity?

Judgement	Research evidence	Additional considerations
Reduced		
Probably reduced		
Probably no impact		
Probably increased		
Increased		
Varies		
Don't know		

Summary of discussion

The GDG felt that day-care programmes can increase health equity. The rationale for this included: likelihood of such programmes to enroll children regardless of country income level, religion, and sex; the likelihood that such programmes would be established as a matter of priority in higher drowning risk communities, which typically are more disadvantaged; that such programmes typically have a greater benefit to children from high-risk home environments; that such programmes relieve older siblings (particularly sisters) of child-care pressure, enabling them to stay in school, and support working women by increasing family income through providing safe environments for children they are at work. Child-care programmes that support parents were also noted to be capable of promoting positive parenting and thus reduce potential for violence, abuse and neglect.

Acceptability
Is the intervention acceptable to key stakeholders?

Judgement	Research evidence	Additional considerations
No		
Probably no		
Probably yes		
Yes		
Varies		
Don't know		

Summary of discussion

The GDG felt that day-care interventions were acceptable to key stakeholders. Findings from Bangladesh as well as Mexico indicate that communities embrace and support day-care and understand the importance of supervision, as well as the benefits for early childhood development. GDG members also noted that recognition of the links with reduction in drowning deaths as well as other desirable effects including schooling and literacy benefits were important drivers of acceptance in communities. Experience with government funding (as in Mexico) had also been shown to be associated with reduction of parental co-payments to levels that were acceptable.

Feasibility
Is the intervention feasible to implement?

Judgement	Research evidence	Additional considerations
No		
Probably no		
Probably yes		
Yes		
Varies		
Don't know		

Summary of discussion

The majority of the GDG felt that day-care interventions were feasible in low- and middle-income countries and are commonplace in high-income countries. Demand for such programmes has grown as women become a greater part of the workforce in low- and middle-income countries. The GDG noted that a great amount of information has been generated during the past decade on how to design, implement, and evaluate child-care programmes. There is a need to increase government funding to implement quality programmes, generate pollical will, and move successful programmes to scale. The GDG noted feasibility varies depending on context and resource availability, especially if there is government support and community willingness to adopt and keep the programme running at its own cost. They also noted that feasibility can change over time, as upfront costs can be larger than those needed to manage the programme in the long-term.

Summary of judgements

	Judgement						
Problem	No	Probably no	Probably yes	**Yes**		Varies	Don't know
Desirable effects	Trivial	Small	Moderate	**Large**		Varies	Don't know
Undesirable effects	Large	Moderate	**Small**	Trivial		Varies	Don't know
Certainty of evidence	Very low	Low	**Moderate**	High			No included studies
Values	Important uncertainty or variability	Possibly important uncertainty or variability	**Probably no important uncertainty or variability**	No important uncertainty or variability			
Balance of effects	Favours the comparison	Probably favours the comparison	Does not favour either the intervention or the comparison	**Probably favours the intervention**	Favours the intervention	Varies	Don't know
Resources required	Large costs	Moderate costs	Negligible costs and savings	**Moderate savings**	Large savings	Varies	Don't know
Certainty of evidence of required resources	Very low	Low	**Moderate**	High			No included studies
Cost-effectiveness	Favours the comparison	Probably favours the comparison	Does not favour either the intervention or the comparison	Probably favours the intervention	**Favours the intervention**	Varies	No included studies
Equity	Reduced	Probably reduced	Probably no impact	Probably increased	**Increased**	Varies	Don't know
Acceptability	No	Probably no	Probably yes	**Yes**		Varies	Don't know
Feasibility	No	Probably no	Probably yes	**Yes**		Varies	Don't know

Type of recommendation

Strong recommendation against the intervention	Conditional recommendation against the intervention	Conditional recommendation for either the intervention or the comparison	Conditional recommendation for the intervention	**Strong recommendation for the intervention**

Summary of discussion

Although there is a need for further evidence on its feasibility, acceptability and impact on health equity, the majority of the GDG felt there is sufficient and strong enough evidence with no undesirable effects to conclude that a formal day-care programme should be used to prevent drowning among children in low- and middle-income countries. It is important however for more information to be gathered on the types of day-care programmes that are most effective.

The GDG noted that operational considerations needed to be developed, aimed at minimizing the risk of spread of infectious disease. Also, the GDG observed that effective and safe day-care programmes for young children should include a number of components to assure quality, including a developmentally appropriate curriculum focusing on cognitive, social and emotional learning; adequate involvement of children in their learning; parental involvement; caregiver training and supervision; and an environment that meets standards for safety and space. Links to health care and nutrition services are needed. Hours and consistency of operation also need to be considered to ensure centres are open during high-risk periods for drownings.

Drowning is a major killer of children under the age of 6 years, especially in low- and middle-income countries. Lack of proper supervision of children is one of the main risk-factors for child drowning. Institutional supervision of children through formal day-care can reduce deaths from drowning.

Day-care programming should be monitored and evaluated in low- and middle-income settings in order to develop further the evidence base to guide decisions around this intervention.

Annex 3:
Basic swim skills and water safety GRADE Tables

Author(s): Anne-Catherine Vanhove, Koen Veys, Dorien O, Emmy De Buck

Question: An educational programme for basic swimming skills compared to no educational programme for basic swimming skills for drowning prevention in children

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme for basic swimming skills	No educational programme for basic swimming skills	Relative (95% CI)	Absolute (95% CI)	
Drowning-related mortality: 0–4-year-old children (Brenner et al., 2009, Yang 2007)											
2 [1,2]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	We chose to extract only adjusted effect estimates if available. These aOR could not be combined in a meta-analysis due to difference in direction of reported result. Both studies show results in favour of swim skill training. Formal swimming lessons vs not (Brenner et al., 2009): 61 cases and 134 controls: aOR: 0.12 (0.01 to 0.97) No proper swimming lessons vs proper swimming lessons (Yang 2007): 64 cases and 128 controls: aOR: 1.8 (1.1 to 5.5)				●●○○ Low
Drowning-related mortality: 5–14-year-old children (Yang 2007)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	very serious [c,d,e]	none	69 cases	138 controls	**P > 0.05** (0.00 to 0.00)	-	●○○○ Very low
							-	0.0%		**-- per 1.000** (from -- to --)	
Swimming performance in the category "Locomotion: front" at 4 months (Erbaugh, 1986)											
1 [3]	observational studies	very serious [f,g]	not serious	not serious	serious [c]	none	30	64	-	**MD 3.6 higher** (2.27 higher to 4.93 higher) [h]	●○○○ Very low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme for basic swimming skills	No educational programme for basic swimming skills	Relative (95% CI)	Absolute (95% CI)	
Swimming performance in the category "Locomotion: front" at 8 months (Erbaugh, 1986)											
1 [3]	observational studies	very serious [f,g]	not serious	not serious	serious [c]	none	30	64	-	**MD 3.9 higher** (2.44 higher to 5.36 higher) [h]	●○○○ Very Low
Swimming performance in the category "Locomotion: back" at 4 months (Erbaugh, 1986)											
1 [3]	observational studies	very serious [f,g]	not serious	not serious	serious [c]	none	30	64	-	**MD 2.3 higher** (0.86 higher to 3.74 higher) [h]	●○○○ Very Low
Swimming performance in the category "Locomotion: back" at 8 months (Erbaugh, 1986)											
1 [3]	observational studies	very serious [f,g]	not serious	not serious	serious [c]	none	30	64	-	**MD 3.4 higher** (1.69 higher to 5.11 higher) [h]	●○○○ Very Low
Swimming performance in the category "Kicking" at 4 months (Erbaugh, 1986)											
1 [3]	observational studies	very serious [f,g]	not serious	not serious	serious [c]	none	30	64	-	**MD 3 higher** (1.5 higher to 4.5 higher) [h]	●○○○ Very Low
Swimming performance in the category "Kicking" at 8 months (Erbaugh, 1986)											
1 [3]	observational studies	very serious [f,g]	not serious	not serious	serious [c]	none	30	64	-	**MD 3.6 higher** (2.14 higher to 5.06 higher) [h]	●○○○ Very Low
Swimming performance in the category "Entry: jump" at 4 months (Erbaugh, 1986)											
1 [3]	observational studies	very serious [f,g]	not serious	not serious	serious [c]	none	30	64	-	**MD 3.1 higher** (0.94 higher to 5.26 higher) [h]	●○○○ Very Low
Swimming performance in the category "Entry: jump" at 8 months (Erbaugh, 1986)											
1 [3]	observational studies	very serious [f,g]	not serious	not serious	serious [c]	none	30	64	-	**MD 3.6 higher** (1.54 higher to 5.66 higher) [h]	●○○○ Very Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme for basic swimming skills	No educational programme for basic swimming skills	Relative (95% CI)	Absolute (95% CI)	
Swimming performance in the category "Diving" at 4 months (Erbaugh, 1986)											
1 [3]	observational studies	very serious [f,g]	not serious	not serious	serious [c,i]	none	30	64	-	**MD 0.3 higher** (0.05 lower to 0.65 higher) [h]	●○○○ Very Low
Swimming performance in the category "Diving" at 8 months (Erbaugh, 1986)											
1 [3]	observational studies	very serious [f,g]	not serious	not serious	serious [c]	none	30	64	-	**0.4 higher** (0.01 higher to 0.79 higher) [h]	●○○○ Very Low
Swimming performance in the category "Ring pick-up" at 4 months (Erbaugh, 1986)											
1 [3]	observational studies	very serious [f,g]	not serious	not serious	serious [c]	none	30	64	-	**MD 0.9 higher** (0.28 higher to 1.52 higher) [h]	●○○○ Very Low
Swimming performance in the category "Ring pick-up" at 8 months (Erbaugh, 1986)											
1 [3]	observational studies	very serious [f,g]	not serious	not serious	serious [c]	none	30	64	-	**MD 1.1 higher** (0.5 higher to 1.7 higher) [h]	●○○○ Very Low

CI: Confidence interval; **MD:** Mean difference **aOR**

Explanations

a. Moderate bias due to confounding (ROBINS-I).
b. Moderate bias in classification of participants into study (potential recall bias) (ROBINS-I).
c. Limited sample size.
d. Lack of data.
e. We downgraded by -2 for imprecision as the sample size is limited and the lack of data prohibited us from assessing whether the 95% CI contained both appreciable harm as well as appreciable benefit (set at aOR > 1.25 and aOR < 0.75 respectively).
f. Serious bias due to confounding (ROBINS-I).
g. Moderate bias in measurement of outcomes (ROBINS-I).
h. Range of possible scores was not reported in the study.
i. Large variability of results.

References

1. Yang L, Nong QQ, Li CL, Feng QM, Lo SK. Risk factors for childhood drowning in rural regions of a developing country: a case-control study. Inj Prev. 2007;13(3):178–182.
2. Brenner RA, Taneja GS, Haynie DL, Trumble AC, Qian C, Klinger RM, Klebanoff MA. Association between swimming lessons and drowning in childhood: A case-control study. Arch Pediatr Adolesc Med. 2009;163(3):203–210.
3. Erbaugh SJ. Effects of aquatic training on swimming skill development of preschool children. Percept Motor Skills 1986;62(2):439–446.

Author(s): Anne-Catherine Vanhove, Koen Veys, Dorien O, Emmy De Buck

Question: An educational programme for basic swimming skills with motility stories compared to a traditional educational programme for basic swimming skills for drowning prevention in children

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme for basic swimming skills with motility stories	A traditional educational programme for basic swimming skills	Relative (95% CI)	Absolute (95% CI)	
Aquatic motor competence (Scale from: 1 to 4)											
1 [1]	observational studies	very serious [a,b]	not serious	not serious	serious [c]	none	8	8	-	**MD 0.07 higher** (0.26 lower to 0.4 higher)	●○○○ Very Low

CI: Confidence interval; MD: Mean difference

Explanations

a. Serious bias due to confounding (ROBINS-I).
b. Moderate bias in measurement of outcomes (ROBINS-I).
c. Limited sample size.

References

1. Moreno-Murcia J, Hernandez EH, Polo R, Lopez E, Carbonell B, Meseguer S. The effect of stories on real and perceived aquatic competence in preschoolers. International Journal of Medicine and Sciences of Physical Activity and Sports; 2016.

Author(s): Anne-Catherine Vanhove, Koen Veys, Dorien O, Emmy De Buck

Question: A daily educational programme for basic swimming skills compared to a weekly educational programme for basic swimming skills for drowning prevention in children

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	A daily educational programme for basic swimming skills	A weekly educational programme for basic swimming skills	Relative (95% CI)	Absolute (95% CI)	
Front crawl swimming skill rate of improvement											
1 [1]	observational studies	very serious [a,b,c]	not serious	not serious	very serious [d,e,f]	none	17	16	-	**P > 0.05 0** (0 to 0) [g]	●○○○ Very Low

CI: Confidence interval

Explanations

a. Serious risk of bias due to confounding.
b. Serious risk of bias in measurement of the outcomes.
c. Moderate risk of bias due to missing data.
d. Limited sample size.
e. Lack of data.
f. We downgraded by -2 for imprecision as the sample size is limited and the lack of data prohibited us from assessing whether the 95%CI contained both appreciable harm as well as appreciable benefit.
g. No-effect estimate or 95% CI reported for the outcome.

References

1. Bradley SM, Parker HE, Blanksby BA. Learning front-crawl swimming by daily or weekly lesson schedules. Pediatric Exercise Science. 1996;8(1):27–36.

Author(s): Emmy De Buck, Anne-Catherine Vanhove, Dorien O and Koen Veys.

Question: An educational programme for basic swimming skills with buoyancy aides compared to an educational programme for basic swimming skills without buoyancy aides for drowning prevention in children

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme for basic swimming skills with buoyancy aids	An educational programme for basic swimming skills without buoyancy aids	Relative (95% CI)	Absolute (95% CI)	
Water safety skills: leg action (Parker et al., 1999) (Scale from: 0 to 14)											
1 [1]	observational studies	serious [a,b,c]	not serious	not serious	very serious [d,e,f]	none	10	8	-	**MD 1.59 higher** (0 to 0) [g]	⨁◯◯◯ Very Low
Water safety skills: front crawl arm action (Parker et al., 1999) (Scale from: 0 to 14)											
1 [1]	observational studies	serious [a,b,c]	not serious	not serious	very serious [d,e,f]	none	10	8	-	**MD 1.51 higher** (0 to 0) [g]	⨁◯◯◯ Very Low
Water safety skills: swim-leg action (Parker et al., 1999) (Scale from: 0 to 14)											
1 [1]	observational studies	serious [a,b,c]	not serious	not serious	very serious [d,e,f]	none	10	8	-	**MD 1.5 higher** (0 to 0)	⨁◯◯◯ Very Low
Water safety behaviour: aquatic readiness (i.e. voluntary entry with no fear of the water) (Parker et al., 1999)											
1 [1]	observational studies	serious [a,b,c]	not serious	not serious	very serious [e,h,i]	none	8/9 (88.9%)	5/5 (100.0%)	**RR 0.93** (0.65 to 1.32)	**-- per 1.000** (from -- to --)	⨁◯◯◯ Very Low
Water safety skills: aquatic competency (Bautista et al., 2018)											
1 [2]	observational studies	very serious [c,j]	not serious	not serious	very serious [d,e,f]	none	This study compared the use of 3 buoyancy aids with each other: kiflot vs cuffs vs flotation belt (n=6 for each). p=0.078 in the chi square analysis over the 3 intervention groups				⨁◯◯◯ Very Low

CI: Confidence interval; **MD:** Mean difference; **RR:** Risk ratio

Explanations

a. Moderate risk of bias due to confounding (ROBINS-I).
b. Moderate risk of bias due to missing data (ROBINS-I).
c. Moderate risk of bias in measurement of the outcome (ROBINS-I).
d. Lack of data.
e. Limited sample size.
f. We downgraded by -2 for imprecision as the sample size is limited and the lack of data prohibited us from assessing whether the 95%CI contained both appreciable harm and appreciable benefit.
g. 95% CI could not be calculated as SD values were not reported, p > 0.05.
h. Large variability of results.
i. We downgraded by -2 for imprecision as the sample size is limited and the large variability of results results from a 95% CI that contains both appreciable harm and appreciable benefit (set at RR < 0.75 and RR > 1.25 respectively).
j. Serious risk of bias due to confounding (ROBINS-I).

References

1. Parker HE, Blanksby BA, Quek KL. Learning to swim using buoyancy aides. Pediatric Exercise Science; 1999.
2. Bautista EQ, Piqueras JAS, Gonzalez MPL, Jordan OC. Influence of different aquatic materials on the perceived competence in the aquatic environment by students in the second cycle of early childhood education. Sport Tk-Euro-American Journal of Sports Sciences. 2018;7(2):73–79.

Author(s): Anne-Catherine Vanhove, Koen Veys, Dorien O, Emmy De Buck

Question: An educational programme for basic swimming skills in shallow water compared to an educational programme for basic swimming skills in deep water for drowning prevention in children

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme for basic swimming skills in shallow water	An educational programme for basic swimming skills in deep water	Relative (95% CI)	Absolute (95% CI)	
Aquatic motor skill 1: water entry (Scale from: 1 to 3)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 0.37 higher** (0 to 0) [d]	●●○○ Low
Aquatic motor skill 2: water orientation and adjustment at vertical position (Scale from: 1 to 3)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 0.25 higher** (0.05 lower to 0.55 higher)	●●○○ Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme for basic swimming skills in shallow water	An educational programme for basic swimming skills in deep water	Relative (95% CI)	Absolute (95% CI)	
Aquatic motor skill 3: breath control - immersion of the face and eye opening (Scale from: 1 to 5)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 0.32 higher** (0.31 lower to 0.95 higher)	●●○○ Low
Aquatic motor skill 4: horizontal buoyancy (Scale from: 1 to 4)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 1.75 higher** (1.13 higher to 2.37 higher)	●●○○ Low
Aquatic motor skill 5: body position at ventral gliding (Scale from: 1 to 4)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 2 higher** (1.41 higher to 2.59 higher)	●●○○ Low
Aquatic motor skill 6: body position at dorsal gliding (Scale from: 1 to 4)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 1.88 higher** (0 to 0) [e]	●●○○ Low
Aquatic motor skill 7: body position at longitudinal rotation in gliding (Scale from: 1 to 3)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 0.88 higher** (0.58 higher to 1.18 higher)	●●○○ Low
Aquatic motor skill 8: body position at front and back somersaults (Scale from: 1 to 4)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 0.88 higher** (0.26 higher to 1.5 higher)	●●○○ Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme for basic swimming skills in shallow water	An educational programme for basic swimming skills in deep water	Relative (95% CI)	Absolute (95% CI)	
Aquatic motor skill 9: leg kick with breath control at ventral body position with flutter boards (Scale from: 1 to 4)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 1.44 higher** (0.94 higher to 1.94 higher)	●●○○ Low
Aquatic motor skill 10: leg kick with breath control at ventral body position without any flutter device (Scale from: 1 to 4)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 1.32 higher** (0.86 higher to 1.78 higher)	●●○○ Low
Aquatic motor skill 11: leg kick with breath control at dorsal body position with flutter boards (Scale from: 1 to 4)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 1.13 higher** (0.75 higher to 1.51 higher)	●●○○ Low
Aquatic motor skill 12: leg kick with breath control at dorsal body position without any flutter device (Scale from: 1 to 4)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 1.19 higher** (0.79 higher to 1.59 higher)	●●○○ Low
Aquatic motor skill 13: feet-first entry (Scale from: 1 to 3)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 0.56 higher** (0.14 higher to 0.98 higher)	●●○○ Low
Aquatic motor skill 14: head-first entry (Scale from: 1 to 3)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 0.75 higher** (0.29 higher to 1.21 higher)	●●○○ Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme for basic swimming skills in shallow water	An educational programme for basic swimming skills in deep water	Relative (95% CI)	Absolute (95% CI)	
Aquatic motor skill 15: autonomous in deep pool (legs and arms displacement) (Scale from: 1 to 3)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c,f]	none	16	16	-	**MD 0.44 higher** (0.09 lower to 0.97 higher)	●●○○ Low
Aquatic motor skill 16: vertical buoyancy at deep water (Scale from: 1 to 6)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 1.62 higher** (0.76 higher to 2.48 higher)	●●○○ Low
Aquatic motor skill 17: deep-water immersion (Scale from: 1 to 4)											
1 [1]	observational studies	serious [a,b]	not serious	not serious	serious [c]	none	16	16	-	**MD 1.37 higher** (0.69 higher to 2.05 higher)	●●○○ Low

CI: Confidence interval; **MD:** Mean difference

Explanations

a. Moderate risk of bias due to confounding (ROBINS-I).
b. Moderate risk of bias in measurement of the outcome (ROBINS-I).
c. Limited sample size.
d. p=0.005 according to paper. 95% CI and p-value not estimable using RevMan because SD of intervention group is 0.
e. p=0.000 according to paper. 95% CI and p-value not estimable using RevMan because SD of control group is 0.
f. Large variability of results.

References

1. Costa AM, Marinho DA, Rocha H, Silva AJ, Barbosa TM, Ferreira SS, Martins M. Deep and shallow water effects on developing preschoolers' aquatic skills. Journal of Human Kinetics. 2012;32:211–219.

Author(s): Anne-Catherine Vanhove, Koen Veys, Dorien O, Emmy De Buck

Question: An educational programme for water safety skills (without in-water training) compared to no educational programme for water safety skills (without in-water training) for drowning prevention in children

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme for water safety skills (without in-water training)	No educational programme for water safety skills (without in-water training)	Relative (95% CI)	Absolute (95% CI)	
Drowning-related mortality (Liu et al., 2019)											
1 [1]	observational studies	serious [a,b,c]	not serious	not serious	serious [d]	none	79 cases -	79 controls 0.0%	**aOR 0.23** (0.07 to 0.74) [e]	- **-- per 1.000** (from -- to --)	●●○○ Low
Safety knowledge (%) (Shen et al., 2016)											
1 [2]	randomized trials	serious [f]	not serious	not serious	not serious	none	137	143	-	**partial η^2 0.03 higher** (0.002 higher to 0.08 higher) [g]	●●●○ Moderate
Knowledge about prevention of drowning on the beach (%) (after training) (Barcala-Furelos et al., 2019)											
1 [3]	observational studies	very serious [h]	not serious	not serious	serious [d]	none	14	12	-	**MD 53.28 higher** (36.05 higher to 70.51 higher)	●○○○ Very Low
Knowledge about prevention of drowning on the beach (%) (follow up: 1 months) (Barcala-Furelos et al., 2019)											
1 [3]	observational studies	very serious [h]	not serious	not serious	serious [d]	none	14	12	-	**MD 49.71 higher** (37.39 higher to 62.03 higher)	●○○○ Very Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme for water safety skills (without in-water training)	No educational programme for water safety skills (without in-water training)	Relative (95% CI)	Absolute (95% CI)	
Knowledge about prevention in the swimming pool (%) (after training) (Barcala-Furelos et al., 2019)											
1 [3]	observational studies	very serious [h]	not serious	not serious	serious [d]	none	14	12	-	**MD 56.67 higher** (38.8 higher to 74.54 higher)	●○○○ Very Low
Knowledge about prevention in the swimming pool (%) (follow up: 1 month) (Barcala-Furelos et al., 2019)											
1 [3]	observational studies	very serious [h]	not serious	not serious	serious [d]	none	14	12	-	**MD 33.1 higher** (17.57 higher to 48.63 higher)	●○○○ Very Low
Knowledge about prevention on the beach and in the swimming pool (combined) (%) (after training) (Barcala-Furelos et al., 2019)											
1 [3]	observational studies	very serious [h]	not serious	not serious	serious [d]	none	14	12	-	**MD 54.97 higher** (41.85 higher to 68.09 higher)	●○○○ Very Low
Knowledge about prevention on the beach and in the swimming pool (combined) (%) (follow up: 1 months) (Barcala-Furelos et al., 2019)											
1 [3]	observational studies	very serious [h]	not serious	not serious	serious [d]	none	14	12	-	**MD 41.4 higher** (29.9 higher to 52.9 higher)	●○○○ Very Low
Water safety knowledge in kindergarten students (%) (Terzidis et al., 2007)											
1 [4]	observational studies	very serious [a,i]	not serious	not serious	serious [d]	none	115	202	-	**adjusted MD 17.4 higher** (6.41 higher to 28.39 higher)	●○○○ Very Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme for water safety skills (without in-water training)	No educational programme for water safety skills (without in-water training)	Relative (95% CI)	Absolute (95% CI)	
Water safety knowledge in elementary school students (%) (Terzidis et al., 2007)											
1 [4]	observational studies	very serious [a,i]	not serious	not serious	serious [j]	none	205	220	-	**adjusted MD 14.58 higher** (3.05 higher to 32.21 higher)	●○○○ Very Low
Water safety knowledge in high school students (%) (Terzidis et al., 2007)											
1 [4]	observational studies	very serious [a,i]	not serious	not serious	not serious	none	321	337	-	**adjusted MD 0.15 lower** (5.3 lower to 4.99 higher)	●●○○ Low
Perceived vulnerability (Shen et al., 2016) (Scale from: 0 to 5)											
1 [2]	randomized trials	serious [k]	not serious	not serious	serious [l]	none	137	143	-	**partial η^2 0.001 higher** (0 to 0.02 higher)	●●○○ Low
Simulated behaviour (Shen et al., 2016) (Scale from: 0 to 1)											
1 [2]	randomized trials	serious [m]	not serious	not serious	not serious	none	135	141	-	**partial η^2 0.03 higher** (0.003 higher to 0.09 higher)	●●●○ Moderate
Water safety attitudes in kindergarten students (%) (Terzidis et al., 2007)											
1 [4]	observational studies	very serious [a,i]	not serious	not serious	serious [d]	none	115	202	-	**adjusted MD 23.64 higher** (4.48 higher to 42.79 higher)	●○○○ Very Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme for water safety skills (without in-water training)	No educational programme for water safety skills (without in-water training)	Relative (95% CI)	Absolute (95% CI)	
Water safety attitudes in elementary school students (%) (Terzidis et al., 2007)											
1 [4]	observational studies	very serious [a,i]	not serious	not serious	serious [j]	none	205	220	-	**adjusted MD 5.64 higher** (11.47 lower to 22.77 higher)	●○○○ Very Low
Water safety attitudes in high school students (%) (Terzidis et al., 2007)											
1 [4]	observational studies	very serious [a,i]	not serious	not serious	not serious	none	321	337	-	**adjusted MD 6.32 higher** (1.87 lower to 14.52 higher)	●●○○ Low

CI: Confidence interval; **MD:** Mean difference

Explanations

a. Moderate risk of bias due to confounding (ROBINS-I).
b. Moderate risk of bias in classification of interventions (potential recall bias) (ROBINS-I).
c. Moderate risk of bias due to missing data (ROBINS-I).
d. Limited sample size.
e. The authors only reported a 90% CI. This CI therefore represents the 90% CI and not the 95% CI.
f. Lack of blinding of participants and the outcome assessors (participants): yes, but this unlikely to affect the outcome. Other limitations present. (Cochrane risk-of-bias tool)
g. Partial η^2: measure of effect size representing the proportion of the total variability in each outcome attributable to the intervention. A small effect size is considered to be 0.01, a medium effect size 0.06, and a large effect size 0.14.
h. Serious risk of bias due to confounding (ROBINS-I).
i. Serious risk of bias in measurement of outcomes (ROBINS-I).
j. Large variability of results.
k. Lack of blinding of participants and the outcome assessors (participants): yes. Other limitations present (Cochrane risk-of-bias tool) .
l. Large variability of results: confidence interval includes small effect size of partial η^2.
m. Lack of blinding of participants: yes. Other limitations present (Cochrane risk-of-bias tool).

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Question: An educational programme combining water safety training (out-of-water) and basic swim skills training (in-water) compared to no educational programme for drowning prevention in children

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme combining water safety training (out-of-water) and basic swim skills training (in-water)	No educational programme	Relative (95% CI)	Absolute (95% CI)	
Risk of death from drowning (Rahman et al., 2012)											
1 [1]	observational studies	serious [a]	not serious	not serious	not serious [b]	none	1/57834 (0.0%)	77/102636 (0.1%)	**adjusted RR 0.072** (0.017 to 0.307)	**0 fewer per 1.000** (from 0 fewer to 0 fewer)	●●●○ Moderate
Drowning mortality rate at 4 years of age (per 100 000 person-years) (Rahman et al., 2012)											
1 [1]	observational studies	very serious [c]	not serious	not serious	serious [d,e]	none	0/0 [f]	0/0 [f]	**Rate ratio 0.55** (0.03 to 9.17)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Drowning mortality rate at 5 years of age (per 100 000 person-years) (Rahman et al., 2012)											
1 [1]	observational studies	very serious [c]	not serious	not serious	serious [d,e]	none	0/0 [f]	0/0 [f]	**Rate ratio 0.24** (0.01 to 3.99)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Drowning mortality rate at 6 years of age (per 100 000 person-years) (Rahman et al., 2012)											
1 [1]	observational studies	very serious [c]	not serious	not serious	serious [d,e]	none	0/0 [f]	0/0 [f]	**Rate ratio 0.17** (0.01 to 2.83)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme combining water safety training (out-of-water) and basic swim skills training (in-water)	No educational programme	Relative (95% CI)	Absolute (95% CI)	
Drowning mortality rate at 7 years of age (per 100 000 person-years) (Rahman et al., 2012)											
1 [1]	observational studies	very serious [c]	not serious	not serious	serious [d,e]	none	0/0 [f]	0/0 [f]	**Rate ratio 0.17** (0.02 to 1.27)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Drowning mortality rate at 8 years of age (per 100 000 person-years) (Rahman et al., 2012)											
1 [1]	observational studies	very serious [c]	not serious	not serious	serious [d,e]	none	0/0 [f]	0/0 [f]	**Rate ratio 0.12** (0.01 to 2.10)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Drowning mortality rate at 9 years of age (per 100 000 person-years) (Rahman et al., 2012)											
1 [1]	observational studies	very serious [c]	not serious	not serious	serious [d,e]	none	0/0 [f]	0/0 [f]	**Rate ratio 0.20** (0.01 to 3.57)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Drowning mortality rate at 10 years of age (per 100 000 person-years) (Rahman et al., 2012)											
1 [1]	observational studies	very serious [c]	not serious	not serious	serious [d,e]	none	0/0 [f]	0/0 [f]	**Rate ratio 0.72** (0.03 to 16.02)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Drowning mortality rate at 11 years of age (per 100 000 person-years) (Rahman et al., 2012)											
1 [1]	observational studies	very serious [c]	not serious	not serious	serious [d,e]	none	0/0 [f]	0/0 [f]	**Rate ratio 3.79** (0.08 to 190.76)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme combining water safety training (out-of-water) and basic swim skills training (in-water)	No educational programme	Relative (95% CI)	Absolute (95% CI)	
Drowning mortality rate at 12 years of age (per 100 000 person-years) (Rahman et al., 2012)											
1 [1]	observational studies	very serious [c]	not serious	not serious	serious [d,e]	none	0/0 [f]	0/0 [f]	**Rate ratio 6.00** (0.12 to 302.41)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Swimming ability (8 weeks training) (Asher 1995) (Scale from: 0 to 15)											
1 [2]	randomized trials	very serious [g,h,i,j]	not serious	not serious	serious [k]	none	61	48	-	**MD 2.8 higher** (1.43 higher to 4.17 higher)	●○○○ Very Low
Swimming ability (12 weeks training) (Asher et al, 1995) (Scale from: 0 to 15)											
1 [2]	randomized trials	very serious [g,h,i,j]	not serious	not serious	serious [k]	none	61	48	-	**MD 4.97 higher** (3.64 higher to 6.3 higher)	●○○○ Very Low
Water recovery (8 weeks training) (Asher et al., 1995) (Scale from: 1 to 12)											
1 [2]	randomized trials	serious [g,i,j,l]	not serious	not serious	serious [k]	none	61	48	-	**MD 1.45 higher** (0.5 higher to 2.4 higher)	●●○○ Low
Water recovery (12 weeks training) (Asher et al., 1995) (Scale from: 1 to 12)											
1 [2]	randomized trials	serious [g,i,j,l]	not serious	not serious	serious [k]	none	61	48	-	**MD 3 higher** (2.04 higher to 3.96 higher)	●●○○ Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme combining water safety training (out-of-water) and basic swim skills training (in-water)	No educational programme	Relative (95% CI)	Absolute (95% CI)	
Jump and swim (8 weeks training) (Asher et al., 1995) (Scale from: 1 to 12)											
1 [2]	randomized trials	serious [g,i,j,l]	not serious	not serious	serious [k]	none	61	48	-	**MD 0.31 higher** (0.25 lower to 0.87 higher)	●●○○ Low
Jump and swim (12 weeks training) (Asher et al., 1995) (Scale from: 1 to 12)											
1 [2]	randomized trials	serious [g,i,j,l]	not serious	not serious	serious [k]	none	61	48	-	**MD 1.33 higher** (0.66 higher to 2 higher)	●●○○ Low
Deck behaviour (8 weeks) (Asher et al., 1995) (Scale from: 1 to 12)											
1 [2]	randomized trials	serious [g,i,j,l]	not serious	not serious	serious [d,k]	none	61	48	-	**MD 0.33 lower** (1.21 lower to 0.55 higher)	●●○○ Low
Deck behaviour (12 weeks) (Asher et al., 1995) (Scale from: 1 to 12)											
1 [2]	randomized trials	serious [g,i,j,l]	not serious	not serious	serious [k]	none	61	48	-	**MD 0.2 higher** (0.74 lower to 1.14 higher)	●●○○ Low
Rescues ever performed: 6–14 years (SwimSafe vs non-swimmer) (Mecrow et al., 2015a)											
1 [3]	observational studies	very serious [a,m,n]	not serious	not serious	serious [e]	none	95/3890 (2.4%)	2/3943 (0.1%)	**RR 48.15** (11.88 to 195.19)	**-- per 1.000** (from -- to --)	●○○○ Very Low
Rescues ever performed: 6–14 years (SwimSafe vs natural swimmers) (Mecrow et al., 2015a)											
1 [3]	observational studies	very serious [a,m,n]	not serious	not serious	serious [d,e]	none	95/3890 (2.4%)	91/3924 (2.3%)	**RR 1.05** (0.79 to 1.40)	**-- per 1.000** (from -- to --)	●○○○ Very Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme combining water safety training (out-of-water) and basic swim skills training (in-water)	No educational programme	Relative (95% CI)	Absolute (95% CI)	
Rescues performed in previous month: 6–14 years (SwimSafe vs natural swimmers) (Mecrow et al., 2015a)											
1 [3]	observational studies	very serious [a,m,n]	not serious	not serious	serious [d,e]	none	29/3890 (0.7%)	19/3924 (0.5%)	**RR 1.54** (0.86 to 2.74)	**-- per 1.000** (from -- to --)	●○○○ Very Low
Rescues performed in previous year: 6–14 years (SwimSafe vs natural swimmers) (Mecrow et al., 2015a)											
1 [3]	observational studies	very serious [a,m,n]	not serious	not serious	serious [d,e]	none	90/2890 (3.1%)	79/3924 (2.0%)	**RR 1.15** (0.85 to 1.55)	**-- per 1.000** (from -- to --)	●○○○ Very Low
Rescue rates /1000 (previous month): 6–8 years (SwimSafe vs natural swimmers) (Mecrow et al., 2015a)											
1 [3]	observational studies	very serious [a,m,n]	not serious	not serious	very serious [e,o,p]	none	0/1322 (0.0%)	0/0 [q]	**RR 1.07** (0.00 to 0.00) [r]	**-- per 1.000** (from -- to --)	●○○○ Very Low
Rescue rates /1000 (previous month): 9–11 years (SwimSafe vs natural swimmers) (Mecrow et al., 2015a)											
1 [3]	observational studies	very serious [a,m,n]	not serious	not serious	very serious [e,o,p]	none	0/2096 (0.0%)	0/0 [q]	**RR 1.98** (0.00 to 0.00) [r]	**-- per 1.000** (from -- to --)	●○○○ Very Low
Rescue rates /1000 (previous month): 12–14 years (SwimSafe vs natural swimmers) (Mecrow et al., 2015a)											
1 [3]	observational studies	very serious [a,m,n]	not serious	not serious	very serious [e,o,p]	none	0/472 (0.0%)	0/0 [q]	**RR 1.24** (0.00 to 0.00) [r]	**-- per 1.000** (from -- to --)	●○○○ Very Low
Rescue rates /1000 (previous year): 6–8 years (SwimSafe vs natural swimmers) (Mecrow et al., 2015a)											
1 [3]	observational studies	very serious [a,m,n]	not serious	not serious	very serious [e,o,p]	none	0/1322 (0.0%)	0/0 [q]	**RR 1.2** (0.0 to 0.0) [r]	**-- per 1.000** (from -- to --)	●○○○ Very Low
Rescue rates /1000 (previous year): 9–11 years (SwimSafe vs natural swimmers) (Mecrow et al., 2015a)											
1 [3]	observational studies	very serious [a,m,n]	not serious	not serious	very serious [e,o,p]	none	0/2096 (0.0%)	0/0 [q]	**RR 1.27** (0.00 to 0.00) [r]	**-- per 1.000** (from -- to --)	●○○○ Very Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme combining water safety training (out-of-water) and basic swim skills training (in-water)	No educational programme	Relative (95% CI)	Absolute (95% CI)	
Rescue rates /1000 (previous year): 12–14 years (SwimSafe vs natural swimmers) (Mecrow et al., 2015a)											
1 [3]	observational studies	very serious [a,m,n]	not serious	not serious	very serious [e,o,p]	none	0/472 (0.0%)	0/0 [q]	**RR 0.72** (0.00 to 0.00) [r]	**-- per 1.000** (from -- to --)	●○○○ Very Low
Water rescue (SwimSafe vs natural swimmers) (Mecrow et al., 2015a)											
1 [3]	observational studies	very serious [a,m,n]	not serious	not serious	serious [e]	none	78/95 (82.1%) [s]	75/91 (82.4%) [s]	**RR 1.00** (0.87 to 1.14)	**-- per 1.000** (from -- to --)	●○○○ Very Low
Land-based rescue (reach and throw) (SwimSafe vs natural swimmers) (Mecrow et al., 2015a)											
1 [3]	observational studies	very serious [a,m,n]	not serious	not serious	very serious [d,e,t]	none	9/95 (9.5%) [s]	8/91 (8.8%) [s]	**RR 1.08** (0.43 to 2.67)	**-- per 1.000** (from -- to --)	●○○○ Very Low
Three or more entries into the water (SwimSafe vs natural swimmers) (Mecrow et al., 2015b)											
1 [4]	observational studies	very serious [a,m]	not serious	not serious	serious [d]	none	346/3523 (9.8%)	300/3523 (8.5%)	**RR 1.15** (1.00 to 1.34)	**-- per 1.000** (from -- to --)	●○○○ Very Low
Two entries into the water (SwimSafe vs natural swimmers) (Mecrow et al., 2015b)											
1 [4]	observational studies	very serious [a,m]	not serious	not serious	not serious	none	1692/3523 (48.0%)	1773/3523 (50.3%)	**RR 0.95** (0.91 to 1.00)	**-- per 1.000** (from -- to --)	●●○○ Low
One entry into the water (SwimSafe vs natural swimmers) (Mecrow et al., 2015b)											
1 [4]	observational studies	very serious [a,m]	not serious	not serious	not serious	none	356/3523 (10.1%)	384/3523 (10.9%)	**RR 0.93** (0.81 to 1.06)	**-- per 1.000** (from -- to --)	●●○○ Low
No entries into the water (SwimSafe vs natural swimmers) (Mecrow et al., 2015b)											
1 [4]	observational studies	very serious [a,m]	not serious	not serious	not serious	none	1129/3523 (32.0%)	1066/3523 (30.3%)	**RR 1.06** (0.99 to 1.14)	**-- per 1.000** (from -- to --)	●●○○ Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme combining water safety training (out-of-water) and basic swim skills training (in-water)	No educational programme	Relative (95% CI)	Absolute (95% CI)	
Playing or swimming in water (SwimSafe vs natural swimmers) (Mecrow et al., 2015b)											
1 [4]	observational studies	very serious [a,m]	not serious	not serious	serious [d,e]	none	19/3523 (0.5%)	11/3523 (0.3%)	**RR 1.73** (0.82 to 3.62)	**-- per 1.000** (from -- to --)	●○○○ Very Low
Recreational water entries without adult supervision (SwimSafe vs natural swimmers) (Mecrow et al., 2015b)											
1 [4]	observational studies	very serious [a,m]	not serious	not serious	serious [d]	none	30/31 (96.8%)	11/15 (73.3%)	**RR 1.32** (0.97 to 1.80)	**-- per 1.000** (from -- to --)	●○○○ Very Low
Cost-effectiveness (cost ($Int) per death averted) (Rahman et al., 2012)											
1 [1]	observational studies	serious [a]	not serious	not serious	not serious	none	57834	102636	-	**3009 higher** (1813 higher to 19796 higher)	●●●○ Moderate
Cost-effectiveness (cost ($Int) per DALY averted) (Rahman et al., 2012)											
1 [1]	observational studies	serious [a]	not serious	not serious	not serious	none	57834	102636	-	**85 higher** (51 higher to 561 higher)	●●●○ Moderate

CI: Confidence interval; **MD:** Mean difference; **RR:** Risk ratio

Explanations

a. Moderate bias due to confounding (ROBINS-I).
b. While the number of events is low, we decided not to rate down for imprecision due to the very large sample size.
c. Serious bias due to confounding (ROBINS-I).
d. Large variability of results.
e. Low number of events.
f. Number of students not available per age group.
g. Lack of randomization and allocation: unclear. (Cochrane risk-of-bias tool)
h. Lack of blinding of participants: unclear. Lack of blinding of personnel: yes. Lack of outcome assessors: yes. (Cochrane risk-of-bias tool)
i. Incomplete accounting of outcome of events: yes, but reasons were provided and there was no differential drop-out between the comparison groups. (Cochrane risk-of-bias tool)
j. Other limitations present (Cochrane risk-of-bias tool).
k. Limited sample size.
l. Lack of blinding of participants: unclear. Lack of blinding of personnel: yes. Lack of outcome assessors: no. (Cochrane risk-of-bias tool).
m. Serious bias in measurement of outcomes (ROBINS-I).
n. Moderate bias in selection of the reported result (ROBINS-I).
o. Lack of data.
p. We downgraded by -2 for imprecision as the sample size is limited and the lack of data prohibited us from assessing whether the 95% CI contained both appreciable harm as well as appreciable benefit (set at RR < 0.75 or RR > 1.25).
q. Number of students not available per each age group.
r. 95% CI could not be calculated.
s. Data represent number of entries, not number of participants.
t. We downgraded by -2 for imprecision as the number of events is low and the large variability resulted from a 95% CI containing both appreciable harm as well as appreciable benefit (set at RR > 1.25 or RR < 0.75 respectively).

References

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Author(s): Anne-Catherine Vanhove, Koen Veys, Dorien O, Emmy De Buck

Question: An educational programme of 12 weeks of combined water safety training (out-of-water) and basic swim skills training (in-water) compared to an educational programme of 8 weeks of combined water safety training (out-of-water) and basic swim skills training (in-water) for drowning prevention in children

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme of 12 weeks of combined water safety training (out-of-water) and basic swim skills training (in-water)	An educational programme of 8 weeks of combined water safety training (out-of-water) and basic swim skills training (in-water)	Relative (95% CI)	Absolute (95% CI)	
Swimming ability (Scale from: 0 to 15)											
1 [1]	randomized trials	very serious [a,b,c,d]	not serious	not serious	serious [e]	none	61	48	-	**MD 0.6 higher** (0.88 lower to 2.08 higher)	⨁◯◯◯ Very Low
Water recovery (Scale from: 1 to 12)											
1 [1]	randomized trials	serious [a,c,d,f]	not serious	not serious	serious [e]	none	61	48	-	**MD 0.01 higher** (1.14 lower to 1.16 higher)	⨁⨁◯◯ Low
Water recovery (follow up: 12 weeks; Scale from: 1 to 12)											
1 [1]	randomized trials	serious [a,c,d,f]	not serious	not serious	serious [e]	none	61	48	-	**MD 1.18 higher** (0.16 higher to 2.2 higher)	⨁⨁◯◯ Low
Jump and swim (Scale from: 1 to 12)											
1 [1]	randomized trials	serious [a,c,d,f]	not serious	not serious	serious [e]	none	61	48	-	**MD 0.77 higher** (0.11 higher to 1.43 higher)	⨁⨁◯◯ Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme of 12 weeks of combined water safety training (out-of-water) and basic swim skills training (in-water)	An educational programme of 8 weeks of combined water safety training (out-of-water) and basic swim skills training (in-water)	Relative (95% CI)	Absolute (95% CI)	
Jump and swim (follow up: 12 weeks; Scale from: 1 to 12)											
1 [1]	randomized trials	serious [a,c,d,f]	not serious	not serious	serious [e]	none	61	48	-	**MD 0.88 higher** (0.2 higher to 1.56 higher)	⨁⨁◯◯ Low
Deck behaviour (Scale from: 1 to 12)											
1 [1]	randomized trials	serious [a,c,d,f]	not serious	not serious	serious [e,g]	none	61	48	-	**MD 0.26 higher** (0.65 lower to 1.17 higher)	⨁⨁◯◯ Low
Deck behaviour (follow up: 12 weeks; Scale from: 1 to 12)											
1 [1]	randomized trials	serious [a,c,d,f]	not serious	not serious	serious [e,g]	none	61	48	-	**MD 0.13 higher** (0.65 lower to 0.91 higher)	⨁⨁◯◯ Low

CI: Confidence interval; **MD:** Mean difference

Explanations

a. Lack of randomization and allocation: unclear (Cochrane risk-of-bias tool).
b. Lack of blinding of participants: unclear. Lack of blinding of personnel: yes. Lack of outcome assessors: yes. (Cochrane risk-of-bias tool)
c. Incomplete accounting of outcome of events: yes, but reasons were provided and there was no differential drop-out between the comparison groups (Cochrane risk-of-bias tool).
d. Other limitations present (Cochrane risk-of-bias tool).
e. Limited sample size.
f. Lack of blinding of participants: unclear. Lack of blinding of personnel: yes. Lack of outcome assessors: no, independent observers assessed these outcomes.
g. Large variability of results.

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1. Asher KN, Rivara FP, Felix D, Vance L, Dunne R. Water safety training as a potential means of reducing risk of young children's drowning. Inj Prev. 1995;1(4):228–233.

Author(s): Anne-Catherine Vanhove, Koen Veys, Dorien O, Emmy De Buck

Question: A broader educational programme containing water safety training (out-of water) compared to no broader educational programme containing water safety training (out-of water) for drowning prevention in children

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	A broader educational programme containing water safety training (out-of water)	No broader educational programme containing water safety training (out-of water)	Relative (95% CI)	Absolute (95% CI)	
Knowledge about good swimming habits (Azeredo et al., 2003)											
1 [1]	observational studies	very serious [a]	not serious	not serious	serious [b]	none	0/0 [c]	0/0 [c]	**χ2 17.6** (0.0 to 0.0) [d]	**-- per 1.000** (from -- to --)	●○○○ Very Low
Knowledge about water safety rules (Azeredo et al., 2003)											
1 [1]	observational studies	very serious [a]	not serious	not serious	serious [b]	none	0/0 [c]	0/0 [c]	**χ2 9.9** (0.0 to 0.0) [d]	**-- per 1.000** (from -- to --)	●○○○ Very Low
Water safety knowledge (Frederick et al., 2000)											
1 [2]	observational studies	serious [e,f]	not serious	not serious	serious [g]	none	542	554	-	**MD 0** (0.12 lower to 0.12 higher) [h]	●●○○ Low
Water safety knowledge (Grade 1) (change score, %) (Greene et al., 2002)											
1 [3]	observational studies	serious [e]	not serious	not serious	serious [b]	none	0 [i]	0 [i]	-	**MD 18.7 higher** (0 to 0) [j]	●●○○ Low
Water safety knowledge (Grade 2) (change score, %) (Greene et al., 2002)											
1 [3]	observational studies	serious [e]	not serious	not serious	serious [b]	none	0 [i]	0 [i]	-	**MD 22.2 higher** (0 to 0) [j]	●●○○ Low
Water safety knowledge (Grade 3) (change score, %) (Greene et al., 2002)											
1 [3]	observational studies	serious [e]	not serious	not serious	serious [b]	none	0 [i]	0 [i]	-	**MD 12.8 higher** (0 to 0) [j]	●●○○ Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	A broader educational programme containing water safety training (out-of water)	No broader educational programme containing water safety training (out-of water)	Relative (95% CI)	Absolute (95% CI)	
Diving safety attitude (Azeredo et al., 2003)											
1 [1]	observational studies	very serious [a]	not serious	not serious	serious [b]	none	0/0 [c]	0/0 [c]	**χ2 7.1** (0.0 to 0.0) [d]	**-- per 1.000** (from -- to --)	●○○○ Very Low
Being able to identify the risk "toddler fall in water" (Frederick et al., 2000)											
1 [2]	observational studies	serious [e,f]	not serious	not serious	serious [g,k]	none	58/564 (10.3%)	34/560 (6.1%)	**RR 1.69** (1.13 to 2.54)	**-- per 1.000** (from -- to --)	●●○○ Low
Being able to identify the risk "playing with a ball near water" (Frederick et al., 2000)											
1 [2]	observational studies	serious [e,f]	not serious	not serious	serious [g]	none	260/564 (46.1%)	314/560 (56.1%)	**RR 0.82** (0.73 to 0.92)	**-- per 1.000** (from -- to --)	●●○○ Low
Being able to identify general water danger (Frederick et al., 2000)											
1 [2]	observational studies	serious [e,f]	not serious	not serious	serious [g,k]	none	58/564 (10.3%)	82/560 (14.6%)	**RR 0.70** (0.51 to 0.96)	**-- per 1.000** (from -- to --)	●●○○ Low
Being able to decide to stop playing near water (Frederick et al., 2000)											
1 [2]	observational studies	serious [e,f]	not serious	not serious	serious [g,k]	none	141/564 (25.0%)	98/550 (17.8%)	**RR 1.40** (1.12 to 1.76)	**-- per 1.000** (from -- to --)	●●○○ Low
Being able to decide not to go near water (Frederick et al., 2000)											
1 [2]	observational studies	serious [e,f]	not serious	not serious	serious [g,k]	none	58/564 (10.3%)	89/550 (16.2%)	**RR 0.64** (0.47 to 0.87)	**-- per 1.000** (from -- to --)	●●○○ Low
Number children who completely or partially agree with "will check the depth of the swimming pool" (Falavigna et al., 2012)											
1 [4]	randomized trials	serious [l,m,n]	not serious	not serious	not serious	none	559/572 (97.7%)	442/477 (92.7%)	**RR 1.05** (1.03 to 1.08)	**-- per 1.000** (from -- to --)	●●●○ Moderate

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	A broader educational programme containing water safety training (out-of water)	No broader educational programme containing water safety training (out-of water)	Relative (95% CI)	Absolute (95% CI)	
Number children who completely or partially agree with "will check the depth of the swimming pool" (Falavigna et al., 2012) (follow up: 5 months)											
1 [4]	randomized trials	serious [l,m,n]	not serious	not serious	not serious	none	531/572 (92.8%)	429/477 (89.9%)	**RR 1.03** (0.99 to 1.07)	**-- per 1.000** (from -- to --)	●●●○ Moderate

CI: Confidence interval; **MD:** Mean difference; **RR:** Risk ratio

Explanations

a. Serious risk of bias due to confounding (ROBINS-I).
b. Lack of data.
c. Number of completed surveys not available per group.
d. No 95% CI available. P < 0.01 for all results.
e. Moderate risk of bias due to confounding (ROBINS-I).
f. Moderate risk of bias due to missing data (ROBINS-I).
g. Limited sample size.
h. Maximum score not reported.
i. Number of students not available per grade.
j. No SD's available, CI cannot be calculated. P < 0.05 for all results according to the authors.
k. Low number of events.
l. Lack of randomization: unclear. Lack of allocation concealment: unclear. (Cochrane risk-of-bias tool).
m. Lack of blinding: participants and personnel not blinded; unclear who the outcome assessors are. (Cochrane risk-of-bias tool).
n. Other limitations present. (Cochrane risk-of-bias tool).

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Question: An educational programme containing water safety training (out-of-water) compared to only handbook education for drowning prevention in children

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	An educational programme containing water safety training (out-of-water)	Only handbook education	Relative (95% CI)	Absolute (95% CI)	
Drowning prevention knowledge and attitude score (Scale from: 0 to 2)											
1 [1]	randomized trials	serious [a]	not serious	not serious	not serious	none	841	661	-	**MD 0.05 higher** (0.1 lower to 0.2 higher)	●●●○ Moderate

CI: Confidence interval; **MD:** Mean difference

Explanations

a. Lack of randomization: unclear. Lack of allocation concealment: unclear. Lack of blinding for participants, personnel and outcome assessors: unclear. Incomplete accounting of outcome events: yes. Other limitations: yes. (Cochrane risk-of-bias tool).

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Annex 4:
Day-care GRADE Table

Question: Formal day-care programmes compared to no day-care programmes for prevention of drowning in children in low- and middle-income countries

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Formal day-care programmes	No day-care programmes	Relative (95% CI)	Absolute (95% CI)	
Risk of death from drowning											
1	observational studies	serious [a]	not serious	not serious	not serious [b]	none	3/19084 (0.0%)	158/117493 (0.1%)	**adjusted RR 0.181** (0.570 to 0.577) [c]	**-- per 1,000** (from -- to --)	●●●○ Moderate
Risk of death from injuries											
1	observational studies	serious [a]	not serious	not serious	not serious [b]	none	-/19084 [d]	-/117493 [d]	**adjusted RR 0.123** (0.039 to 0.390) [c]	**-- per 1,000** (from -- to --)	●●●○ Moderate
Risk of death from other causes than injuries											
1	observational studies	serious [a]	not serious	not serious	not serious [b]	none	-/19084 [d]	-/117493 [d]	**adjusted RR 0.8290** (0.0565 to 1.2160) [c]	**-- per 1,000** (from -- to --)	●●●○ Moderate
Risk of overall deaths											
1	observational studies	serious [a]	not serious	not serious	not serious [b]	none	27/19084 (0.1%)	697/117493 (0.6%)	**adjusted RR 0.556** (0.388 to 0.797) [c]	**-- per 1,000** (from -- to --)	●●●○ Moderate

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Formal day-care programmes	No day-care programmes	Relative (95% CI)	Absolute (95% CI)	
Overall mortality rate at 1 year of age											
1	observational studies	very serious [e]	not serious	not serious	serious [f]	none	[g]	[g]	**Rate ratio 0.52** (0.13 to 2.09)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Overall mortality rate at 2 years of age											
1	observational studies	very serious [e]	not serious	not serious	serious [f]	none	[g]	[g]	**Rate ratio 1.29** (0.70 to 2.38)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Overall mortality rate at 3 years of age											
1	observational studies	very serious [e]	not serious	not serious	serious [f]	none	[g]	[g]	**Rate ratio 0.53** (0.25 to 1.14)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Overall mortality rate at 4 years of age											
1	observational studies	very serious [e]	not serious	not serious	serious [f]	none	[g]	[g]	**Rate ratio 0.30** (0.11 to 0.83)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Overall mortality rate at 5 years of age											
1	observational studies	very serious [e]	not serious	not serious	serious [f]	none	[g]	[g]	**Rate ratio 0.57** (0.18 to 1.82)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Drowning mortality rate at 1 year of age											
1	observational studies	very serious [e]	not serious	not serious	serious [f]	none	[g]	[g]	**Rate ratio 0.54** (0.03 to 8.78)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low

Certainty assessment							Number of participants		Effect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Formal day-care programmes	No day-care programmes	Relative (95% CI)	Absolute (95% CI)	
Drowning mortality rate at 2 years of age											
1	observational studies	very serious [e]	not serious	not serious	serious [f]	none	[g]	[g]	**Rate ratio 0.59** (0.08 to 4.36)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Drowning mortality rate at 3 years of age											
1	observational studies	very serious [e]	not serious	not serious	serious [f]	none	[g]	[g]	**Rate ratio 0.17** (0.01 to 2.71)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Drowning mortality rate at 4 years of age											
1	observational studies	very serious [e]	not serious	not serious	serious [f]	none	[g]	[g]	**Rate ratio 0.17** (0.01 to 2.83)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Drowning mortality rate at 5 years of age											
1	observational studies	very serious [e]	not serious	not serious	serious [f]	none	[g]	[g]	**Rate ratio 1.59** (0.37 to 6.93)	**-- per 1000 patient(s) per years** (from -- to --)	●○○○ Very Low
Cost-effectiveness (cost (US$)/death averted)											
1	observational studies	serious [a]	not serious	not serious	not serious	none	19084	117493	-	**27606 higher** (20028 higher to 60379 higher)	●●●○ Moderate
Cost-effectiveness (cost (US$)/DALY averted)											
1	observational studies	serious [a]	not serious	not serious	not serious	none	19084	117493	-	**812 higher** (589 higher to 1777 higher)	●●●○ Moderate

CI: Confidence interval

Explanations

a. Moderate bias due to confounding according to ROBINS-I tool.
b. We decided not to downgrade for imprecision since for the overall mortality risk enough events were available, and there was no large variability in results for none of the outcomes.
c. Adjusted risk ratios, using a stratified Cox proportional hazards model.
d. Number of events not reported.
e. Serious bias due to confounding according to ROBINS-I tool.
f. Imprecision due to large variability in results.
g. Not available.

Annex 5: Evidence summary for additional aspects of evidence relating to swim skills not addressed in main guideline text

Narrative evidence conclusions for studies comparing different settings, educational approaches, and schedules, and for studies where water safety training (out-of-water) was part of a broader educational programme.

Basic swim skills training: different settings, educational approaches, and schedules

Different content of basic swim skills training: use of motility stories

A swim skills programme with motility stories may have little to no effect on aquatic motor competence compared to an approach without motility stories, but the evidence is very uncertain (very low-certainty evidence; Moreno-Murcia et al., 2016).

Different schedules of basic swim skills training: daily vs weekly

Ten daily swimming lessons may have little to no effect on the front crawl swimming skill rate of improvement compared to 10 weekly swimming lessons, but the evidence is very uncertain (very low-certainty evidence; Bradley et al., 1996).

Different didactic materials: use of buoyancy aids

Swimming instruction with multiple buoyancy and propulsion aids may have little to no effect on water safety skills (leg action, front crawl arm action and swim-leg action) or water safety behaviour (aquatic readiness) compared to swimming instruction with kickboard only (mainly self-support), but the evidence is very uncertain (very low-certainty evidence; Parker et al., 1999).

Another study compared three buoyancy aids: a kiflot, cuffs and a flotation belt. Which device is used may have little to no effect on the swimming ability, but the evidence is very uncertain (very low-certainty evidence; Bautista et al., 2018).

Different settings: shallow vs deep water

The evidence suggests that swimming skills training in shallow water compared to training in deep water results in little to no difference in the following aquatic motor skills: water orientation and adjustment at vertical position, breath control – immersion of the face and eye opening, autonomous in deep pool (legs and arms displacement) (low-certainty evidence; Costa et al., 2012). Evidence from the same study suggests that shallow water training may increase other aquatic motor skills: water entry, horizontal buoyancy, body position at ventral gliding, body position at dorsal gliding, body position at longitudinal rotation in gliding, body position at front and back somersaults, leg kick with breath control at ventral body position with flutter boards, leg kick with breath control at ventral body position without any flutter device, leg kick with breath control at dorsal body position with flutter boards, leg kick with breath control at dorsal body position without any flutter device, feet-first entry, head-first entry, vertical buoyancy at deep water and deep-water immersion (low-certainty evidence; Costa et al., 2012).

Combined water safety training (out-of-water) and basic swim skills training (in-water): number of weeks of training

One RCT compared educational programmes with both water safety and basic swim skills training of differing lengths. A 12-week training programme compared to an 8-week training programme may have little to no effect on swimming ability but the effect is very uncertain (very low-certainty evidence; Asher et al., 1995). The evidence suggests that a 12-week programme results in little to no difference in water recovery at the end of the programme but may result in an increase in water recovery at 12-week follow-up compared to an 8-week programme (low-certainty evidence; Asher et al., 1995). A 12-week programme may improve “jump and swim” skill both at the end of training and at 12 weeks follow-up compared to an 8-week programme (low-certainty evidence; Asher et al., 1995). A 12-week training programme may, however, result in little to no difference in deck behaviour compared to an 8-week programme both at the end of training and at 12-week follow-up (low-certainty evidence; Asher et al., 1995).

Water safety training (out-of-water) as part of a broader educational programme

Water safety training (out-of-water) as part of a broader educational programme vs no training

Three studies reported knowledge outcomes comparing educational injury prevention programmes containing a water safety component to no training. The first study reported that these programmes may increase knowledge about good swimming habits and knowledge of water safety rules, but the evidence is very uncertain (very low-certainty evidence; Azeredo et al., 2003). Another study reported that such an educational injury prevention programme may result in little to no difference in water safety knowledge (low-certainty evidence; Frederick et al., 2000). The final study reports water safety knowledge separately for three grades: grade 1, grade 2 and grade 3. For each of these grades the evidence suggests that an injury prevention programme with a water safety component increases water safety knowledge (low-certainty evidence; Greene et al., 2002).

Three studies, one RCT and two observational studies reported water-safety behaviour outcomes for this comparison. An educational injury programme with a water safety component may improve diving safety attitudes, but the evidence is very uncertain (very low-certainty evidence; Azeredo et al., 2003). Another observational study reported that an educational injury prevention programme may result in an increase in being able to identify the risk "toddler fall in water" and being able to decide to stop playing near water compared to no programme (low-certainty evidence; Frederick 2000). Surprisingly, such an educational programme may decrease being able to identify the risk "playing with a ball near water", being able to identify general water danger, and being able to decide not to go near water compared to no training (low-certainty evidence, Frederick et al., 2000). According to results from an RCT, an injury prevention programme probably results in an increase in the number of children who completely or partially agree with "will check the depth of the swimming pool" compared to no programme immediately after the programme, but probably results in little to no difference at 5 months follow-up (moderate-certainty evidence; Falavigna et al., 2012).

Water safety training (out-of-water) as part of a broader educational programme: programme vs handbook

An educational intervention programme containing a water safety component compared to handbook education only probably results in little to no difference in drowning prevention knowledge and attitude (moderate-certainty evidence; Cao et al., 2015).

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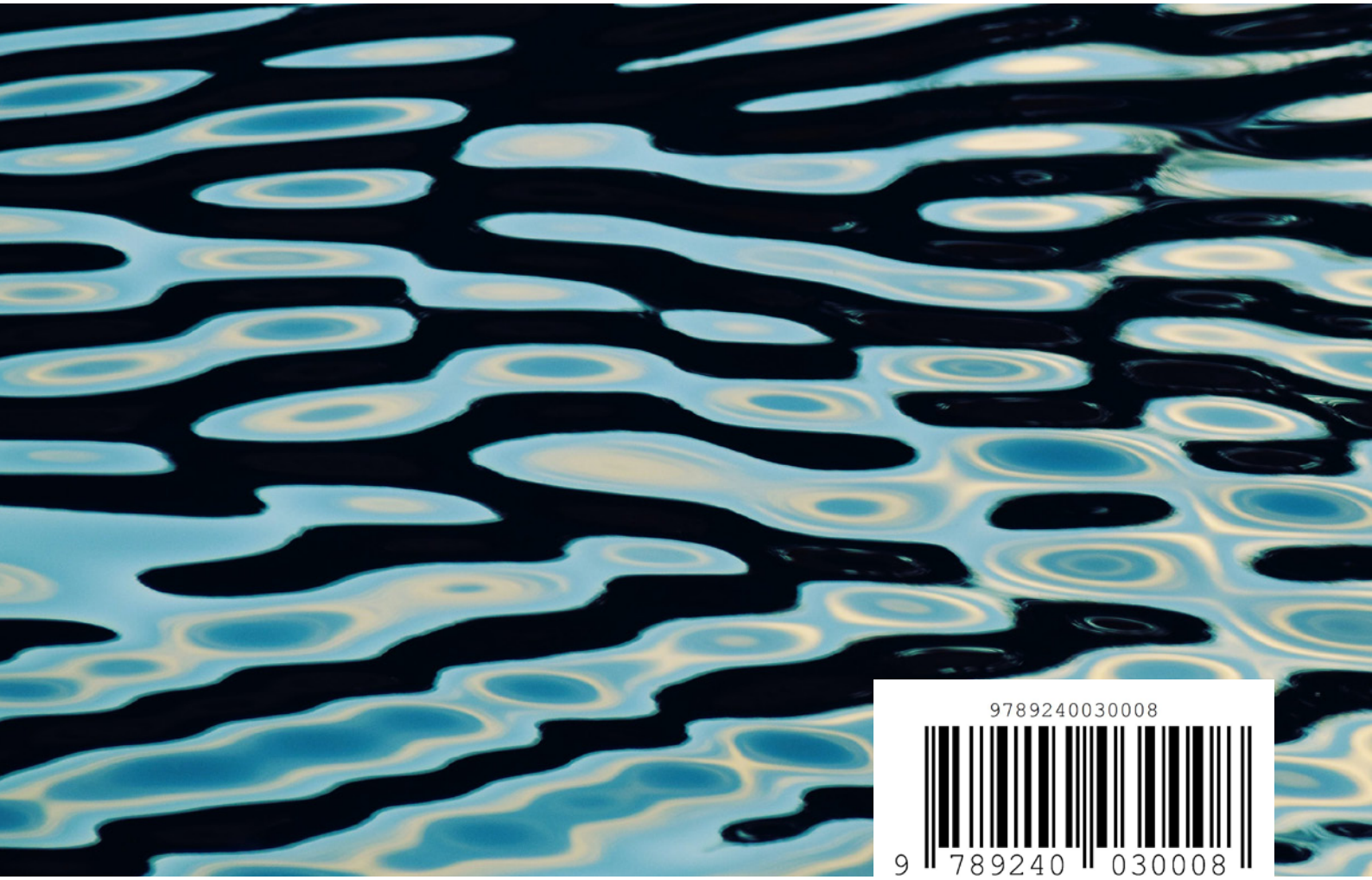

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