American Red Cross
Scientific Advisory Council

American Red Cross Scientific Advisory Council
Scientific Review
Minimum Age for Swim Lessons

Questions to be addressed:

Original Question:

Does scientific evidence exist to support setting a minimum age for the acquisition of swimming and aquatic skills (commonly referred to as "taking swim lessons" and/or "learning to swim")?

Corollary questions:

Does scientific evidence exist to support an optimal age for beginning to acquire swimming and aquatic skills?

Does scientific evidence exist to identify the most appropriate pedagogical methods for aquatic programs for young children?

Is there evidence that participation in "learn to swim" reduces the risk of drowning especially among young children?

2019 Revised question

Does sufficient scientific evidence exist to support setting a minimum age for swimming lessons?

2019 Revised corollary question:

Does scientific evidence exist to support an optimal age for acquiring swimming and aquatic skills?

2022 Revised corollary questions:

1) Does scientific evidence exist to support an optimal age for acquiring swimming and aquatic skills?
2) What scientific evidence exists demonstrating the benefits of swim lessons for young children, children, adolescents, and adults? and
3) What scientific evidence exists to define the concept of aquatic readiness for swim lessons?

Introduction/Overview:

The earliest and/or optimal age(s) at which aquatic skills should be introduced within structured (a.k.a., formal) swim lessons has remained a controversial issue in the aquatic and pediatric medical fields for over four decades. The controversy in part stems from differing theoretical perspectives underlying the nature of skill acquisition (e.g., maturational, learning, or dynamical theories) as well as the varied purposes for which swim lessons are offered (e.g., aquatic readiness, swim stroke acquisition, drowning prevention).

A *maturational perspective*, often adopted by the pediatric medical profession (i.e., American Academy of Pediatrics), assumes that aquatic skill acquisition closely relates to a person's chronologic age as result of normative hereditary-based processes. In fact, an earlier AAP policy statement (2003) recommended that, while all children should learn to swim, aquatic agencies and parents ought to restrict organized swimming lessons until after a child has reached the age of 4 years (48 months) "*due to general developmental limitations*" (AAP, 2003). The contrasting *learning approach*, more typically adopted by swim instructors and swimming agencies, presumes that learning to swim depends less upon age than upon specific environmentally-based experiences such as structured swim lessons. In contrast, *dynamical systems (a.k.a., chaos) theory*, a more contemporary approach, claims that learning to swim, like acquiring other motor skills, results from an emergent and dynamic process through which physical and psychological factors interact in complex systematic ways. These three very different worldviews strongly influence how persons and organizations understand why and how aquatic skills are acquired.

Aquatic programs and learn to swim lessons along with AAP statements have been indirectly and subtly influenced by the previously-mentioned perspectives. They also have been shaped by their underlying, but often unstated purposes such as to develop aquatic readiness and adjustment skills to eventually promote water safety and enjoyment of swimming; to primarily prevent drowning in infants and toddlers, to promote precocious swimming skills for competition or survival, or even to promote enhanced motor control, coordination, and academic skills. Depending upon the primary purpose(s) of the aquatic programs, different sets of skills are emphasized along with differing teaching approaches.

Abundant research and case reports have illustrated that individual infants and young children indeed can acquire voluntary aquatic behaviors during the second through fifth years of life (e.g., Erbaugh,1980; Langendorfer & Willing, 1985; McGraw, 1939; Newman, 1967; 1968). This is a similar age range during which most young children acquire basic levels of other fundamental locomotor and motor skills such as walking, running, jumping, throwing, or kicking. Asher et al. (1995) found that children approximately 3 years of age demonstrated significant changes in rudimentary aquatic safety behaviors after either 8 or 12 weeks of training. In a case control study, children who had formal swimming lessons had up to an 88% reduction in drowning deaths compared to a matched case sample (Brenner, et al., 2009). Another case control study from China (Yang, et al., 2007) found significant risk factors existed for males and children between the ages of 1-4 years and that close caregiver supervision, experience in water, and wearing flotation devices reduced the risk of drowning among this population. Two epidemiological studies regarding risks of drowning in Bangledesh and effective drowning prevention techniques added further support to the importance of early swimming experiences in reducing risks of drowning especially in low and middle-income countries (LMIC) (Rahman, et al., 2009; Rahman, et al., 2012).

Does evidence exist to support an optimal age for acquiring swimming and aquatic skills?
In the only studies that have evaluated the *optimal age* to begin to learn to swim, children ages 4-6 years were observed to acquire traditional beginner swimming skills more rapidly and efficiently than younger children (Blanksby et al., 1995; Parker & Blanksby, 1997). Based on the lack of other research as well as the complexity of appropriate research variables, at this point no recommendation can be supported to propose whether an optimal age exists during childhood at which to begin swimming lessons. An optimal age for starting water experiences to reduce the

risk of drowning has not been studied, but the Asher et al. (1995) study suggests that some benefits may occur as early as age three years.

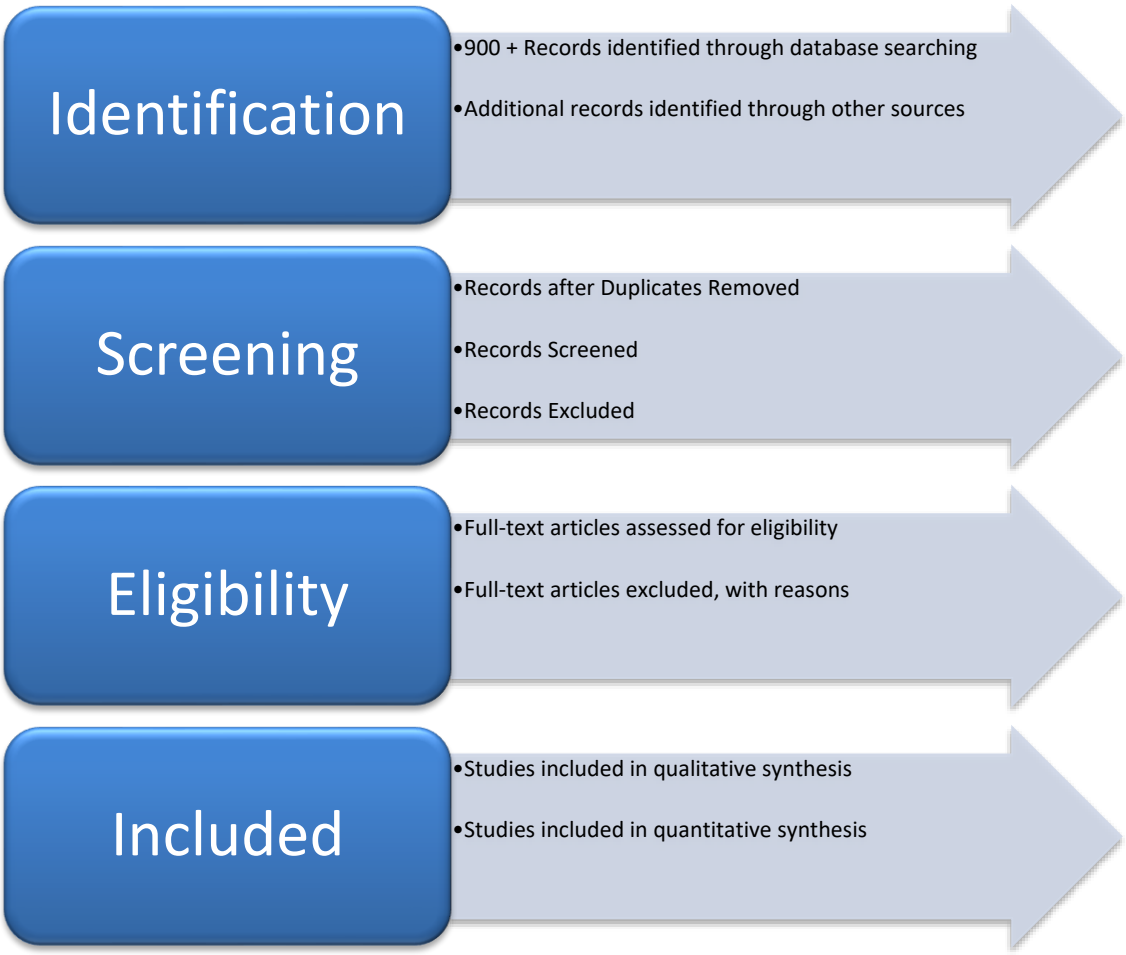
Search Strategy and Literature Search Performed

Key Words Used
"swimming," "age," "development," and "drowning"

Inclusion Criteria (time period, type of articles and journals, language, methodology)

Exclusion Criteria (only human studies, foreign language, etc.)

Databases Searched and Additional Methods Used (references of articles, texts, contact with authors, etc.)
Google Scholar, Nexus-Lexus, Medline, and PubMed.
The references also included theoretical developmental resources from personal library and Biomechanics/Motor Behavior Laboratory library and film collection, Bowling Green State University, Bowling Green, OH. Other references were located from references and citations of initial references.



Review Process and Literature Search of Evidence Since Last Approval Performed

2016 Update:
Performed a general literature review associated with "swimming," "age," "development," "developmentally appropriate practices," "drowning," and "drowning prevention" using Google Scholar, Nexus-Lexus, Medline, and PubMed. Number of "hits" exceeded 900 references/abstracts of mixed quality and application to this review. Special focus on dates between 2005 – 2015.

The references also included theoretical developmental resources from personal library and Biomechanics/Motor Behavior Laboratory library and film collection, Bowling Green State University, Bowling Green, OH. Other references were located from references and citations of initial references.

2022 Update:
PubMed, SportDiscus, Medline databases accessed through BGSU Libraries and Indiana University Libraries using key words of minimum age, swim lessons, learn-to-swim for dates of 2017 – 2022.

Scientific Foundation:

Earlier AAP statements (2000; 2003) both called for a minimum age of 4 years before children should enroll in formal swimming lessons because "children are generally not developmentally ready…until after their fourth birthday." In holding to a minimum age, the AAP has implied that "developmental readiness" is primarily defined from a maturational, "age-determined" perspective. The statements fail to adequately define "developmental readiness" from the learning (experiential) and systems theoretical perspectives or acknowledge that research demonstrates many children in fact can and do learn to swim at ages younger than four years. While there is no evidence that aquatic experiences prior to the first year of age provide any longstanding, persistent benefits either to skill acquisition or to reduce the risk of drowning, the same cannot be said of experiences during the second, third, and fourth years of life.

The 2003 AAP statement does acknowledge the existence of individual differences related to differing rates of learning, but primarily in a negative direction (e.g., some children who have disabilities may not be ready to begin formal swimming lessons until after age 4). The 2003 statement does not appear to recognize that as an "ontogenetic" skill, swimming skill acquisition may be significantly influenced by specific experiences (i.e., familiarity and experience in the water), not just individual rates of learning. Also, the statement ignores the bi-directionality of individual differences (i.e., if individual children may be delayed, others may in fact be ready earlier than four years for swimming lessons). In point of fact, chronologic age alone is a poor criterion upon which to base decisions about the appropriateness of beginning swimming experiences.

Virtually all learn-to-swim programs are based upon the use of prerequisite skill level (i.e., readiness) rather than age as the most appropriate criterion to make decisions about when and what children are ready to learn in the water. Obviously, the purposes for which the aquatic experiences are oriented determine an individual child's readiness and the prerequisite skills. Programs designed for providing aquatic readiness or aquatic therapy experiences certainly may be developmentally appropriate for infants, toddlers, and preschool children younger than four years of age. As suggested by the CNCA guidelines (1985), minimum prerequisites for introducing infants to the water environment should include prerequisite skills such as upright head and trunk control and ability to voluntarily maintain breath control. As suggested by McGraw (1945), Mead (1930), and Langendorfer & Bruya (1995), in order to begin acquiring basic aquatic locomotion (e.g., dog paddle or beginner stroke), toddlers and young children probably should have acquired independent sitting, standing balance and independent stepping. Swimming lessons designed for the purpose of acquiring formal swimming skills such as crawl stroke or for adequately preventing drowning require much more advanced prerequisite motor and cognitive skills including advanced dynamic postural and land locomotion (jumping, running, galloping) and ability to follow simple water safety rules and appreciate basic risks (McGraw, 1945; Langendorfer & Willing, 1985; Langendorfer & Bruya, 1995). Although a small group of "drownproofing" advocates might argue that rolling over and floating are sufficient to prevent drowning, there is absolutely no published evidence to support such an anecdotal claim. Such a claim is not in line with the historical developmental evidence (McGraw, 1939; 1945).

While not plentiful, the developmental research clearly indicates that

- many basic aquatic skills (e.g., voluntary breath control, water entry and exit skills, dog paddle) can be acquired between 18 and 60 months of age;
- basic aquatic skills acquired during the preschool period primarily serve a role as foundational or readiness skills for later and more advanced swimming skill and stroke acquisition;
- skills acquired during the 12-30 month period are largely ineffective as the primary means for learning strokes or preventing drowning.
- associated readiness skills (e.g., sitting, standing, walking, jumping on land plus developmentally earlier levels of basic aquatic skills) are more acceptable criteria for making individual decisions about starting aquatic experiences than age alone.

Despite this limited evidence, the answer to whether a minimum age for starting swimming lessons exists and, if so, at what age that could be remains a matter of strong differences of opinion in aquatics and medicine. The National Association for the Education of Young Children (NAEYC) emphasizes that parents are the first and best teachers of their children. By extension, it is incumbent upon aquatic and medical experts to provide parents with consensus evidence-based information so that parents may make informed decisions about when and what aquatic experiences their young child should receive. The use of the concepts of *developmental readiness* and *developmentally appropriate practices* (DAP) hold promise for reframing the issue and possibly achieving a consensus among health care professionals and aquatic practitioners.

McGraw (1939) demonstrated that infants can acquire very rudimentary swimming locomotor skills such as face-in paddling in parallel to and approximately on the same time scale as they acquire terrestrial locomotor skills (e.g., creeping, standing, initial independent walking). As with terrestrial locomotion in which a child first takes one or two awkward steps, then toddles with outstretched arms, and only gradually acquires more adult-like control and coordination of walking and running, individual swimming skills change very gradually from early levels such as brief face entry, momentary or supported flotation, and front paddling to more advanced skills including longer submersion and rhythmic breathing, extended flotation and rudimentary strokes. Erbaugh (1978; 1980; 1986) observed that most preschool children under the age of 4.5 years did not achieve sufficiently advanced levels of skill to swim 10-15 feet combined with entering and exiting the water. Asher *et al*. (1995) observed significant changes in 3 year old children after a water safety training program. Brenner et al. (2009) found that it was significantly more likely that children from control families where a drowning had not occurred had taken swim lessons and had swimming skill than in families where a drowning had occurred. She interpreted this as associated with an 88% reduction in risk of drowning among 1-4 year old children although the 95% confidence intervals ranged from 3% to 99%. Parker and Blanksby (1996) discovered that starting swim lessons at younger ages (e.g., four and five years) was not associated with the most efficient (shortest) acquisition period. Starting swimming lessons after age five produced more rapid skill acquisition. Lessons at all ages ended up promoting learning aquatic skills although starting at younger ages took longer to achieve a baseline skill level.

Conclusion: The empirical research evidence does not support prohibiting early aquatic experiences at any specific age. An increasing body of literature is demonstrating the efficacy of swim lessons in preventing drowning beginning with 3-5 year-olds. At the same time, no evidence exists that children younger than 15-18 months acquire aquatic skills to any degree of water competence nor is there evidence that very early experience provides any reduction in drowning. Two studies are supporting some cognitive and physical benefits from early swimming experiences. The limited evidence suggests that minimum proficiency as well as cognitive appreciation of hazards and danger is generally not acquired prior to 4.5 years old. The most appropriate objectives, skills, and methods for facilitating the achievement of such activities have received little or no empirical examination.

Does evidence exist to support an optimal age for acquiring swimming and aquatic skills?
McGraw (1935) demonstrated that earlier swimming experiences provided to one twin up through 23 months offered earlier and qualitatively superior acquisition of some motor skills including swimming during the second year of life compared to the control twin. It is important to note, however, that the control twin still acquired all the same skills, but at later ages and with somewhat reduced degrees of motor control. The motor milestones normally acquired during the first year of life were not influenced by early experiences. Diem (1982) and Jorgenson (2013) provided evidence that swimming experiences during the first four years of life appeared to contribute to enhanced academic and psychomotor performance. The effect on school-age swimming skills and drowning prevention has not studied closely. According to Parker and Blanksby (1996), the later preschool years appeared to provide the shortest acquisition time period for acquiring rudimentary swimming stroke proficiency. They did not study the quality of the swimming pattern, so it is possible that earlier experience may lend itself to improved control and coordination, as observed by McGraw.

Conclusion: Age does appear to interact to a modest degree with the efficiency and effectiveness of swimming skill acquisition. The choice of dependent variables studied seems to alter that conclusion. Based upon limited evidence, later preschool ages (4-6 years) appear to allow the most rapid acquisition of traditional swimming skills such as floating, rhythmic breathing, and crawl stroke. The later preschool years may represent an optimal age for introducing traditional learn-to-swim lessons (e.g., to acquire formal swimming strokes) if the goal is to maximize efficiency (i.e., in the shortest time period). The optimal age for introducing a child to the water for the purpose of providing aquatic readiness and water acclimation seems to be earlier ages (e.g., 1-4 years). An optimal age for starting water experiences to reduce the risk of drowning has not been studied, but the Asher et al. study suggests that some limited benefits may occur around age three years.

Does evidence exist to support a universal order of acquisition for swimming and aquatic skills?
Only two studies have focused on the order of skill acquisition. Both employed Guttman's scalogram technique using convenience cross-sectional samples. Harrod & Langendorfer (1990) found that a number of Red Cross beginner swim items were presented in a less than optimal order. The most surprising result was that gliding and rudimentary paddling skills should be presented to children prior to presenting simple floating skills. Also, the use of a 10 second breath holding skill was the most difficult beginner skill. As a consequence, the Red Cross revised and re-ordered the skills associated with their beginner levels of learn-to-swim program

(American Red Cross, 1992). Langendorfer, Chaya, and Swank (in press) examined a broader set of more advanced swimming items ranging from submersion and floating to formal strokes in a young adult sample. The order currently being used by the Red Cross (2004) produced the highest coefficient of reproducibility (i.e., 0.93). It is unclear whether these studies studying swimming behaviors of elementary-aged children and young adults apply to young children (1-5 years).

Conclusion: From the two limited studies, insufficient information about individual variability exists associated with the order of acquisition of aquatic skills. Only minimal differences appear to exist in the order in which items can be presented to elementary age children vs. adults, but at least some children seem to benefit from learning gliding and paddling skills prior to floating. Adults appear to acquire skills in a more traditional order of floating followed by gliding and paddling. Children also found extended breath holding (i.e., 10 seconds) to be much more difficult than did young adult beginners.

Does evidence exist to identify the most appropriate purposes and methods for aquatic programs for young children?

The issue about the most appropriate purposes and methods for infant and young child aquatic programs represents a very controversial and insufficiently-studied area of research. As identified earlier, at least four program purposes exist in aquatic programs for infants and children: 1) create "drownproofing" skills as the primary drowning prevention strategy; 2) develop aquatic readiness skills in preparation for learning later skills; 3) promote precocious acquisition of skills for competitive swimming development and survival; and 4) use water as a therapeutic environment. No current research exists that compares or contrasts these purposes or their relationship to age or readiness. Understanding the appropriateness and effectiveness of different purposes for young child aquatic programs is an important area for future research.

Only one study, a doctoral dissertation (Illuzi, 1990), has examined the effectiveness of different methods of teaching swimming. Illuzi found no significant differences in the degree of aquatic learning among preschoolers when taught by traditional, direct methods (i.e., command style) versus indirect, guided discovery methods. The indirect teaching method provided more learning time than the direct teaching method, but the improvement in swimming skills was similar across the techniques. Several important questions need to be addressed through larger, prospective studies including "Are some swim program purposes more or less appropriate than others?" "Are some methods more effective than others for achieving different lesson purposes?" "Specifically, what appropriate roles should parents play in children's swimming programs?" and "Are some methods more appropriate for different skill and age groups?"

2022 Updated Scientific Foundation

Since the last triennial review only a modest number of peer-reviewed articles related to the minimum age for swim lessons have been published (N=7). None of them alter the previous recommendations with a single exception.

A retrospective longitudinal study by Anderson and Rodriguez (2019) examined the corollary question of this review, i.e., whether an optimum age exists for taking swim lessons. They found that while 3-years-olds demonstrated an earlier achievement of initial swim proficiency (a.k.a., water competence), it took them a much longer time period and many more lessons to achieve

that proficiency than did 4–8-year-old-children. They concluded that the optimum age for beginning formal swimming lessons was between 5-7-years-of-age. These are among only 2 other studies which have examined the issue of optimum starting age for swim lessons.

Two other notable related publications occurred in the past two years, both a product of the Council on Injury, Violence, and Poison Prevention from the American Academy of Pediatrics. The first, titled "Prevention of Drowning" (2019) appeared as a Policy Statement in *Pedatrics* while the second (2021) by the same title was published as a Technical Report which contained slightly updated and expanded information on drowning prevention. They both contained sections addressing the role of swim lessons in drowning prevention among young children older than 1 year of age and they reiterated the latest AAP statement that supports swim lessons for children older than 1 year of age.

Summary:

The longstanding tradition for swimming lessons to use criterion-referenced approaches (i.e., focus on existing skill level to predict what to learn next, a.k.a., readiness) remains the most appropriate way to make decisions about when individual children are ready to begin aquatic experiences and what skills they should learn. The literature contains little definitive research to either restrict swimming experiences to the *minimum age* of four years as promoted by AAP or to necessitate early experience in swimming. Some limited research (e.g., McGraw, Diem) suggests that regular, persistent experiences across the preschool period provide some longer term qualitative aquatic benefits. A single study by Parker and Blanksby suggested that starting swim lessons between the ages of 5-6 years resulted in a shorter period of skill acquisition than starting at young ages. The review indicated the need for additional larger prospective studies to be conducted to address issues and questions related to efficiency, optimality, quality, readiness, and appropriate pedagogy for swimming skill acquisition by young children.

2019 Summary Update:

Recent research evidence concurs with the American Academy of Pediatrics 2010 recommendation that no specific minimum age should limit early aquatic experiences and swim lessons. Although research evidence is still somewhat limited and correlative, it is sufficient as a **guideline** that the minimum age of older than 1 year should be established for initiating aquatic experiences for young children with the goal of reducing drowning risk and increasing eventual proficiency in basic aquatic tasks. In addition, parents should make the decision about starting aquatic experiences on an individual basis considering factors such as each child's receptivity to water, socio-emotional readiness, demonstration of voluntary breath control, postural control, response to directions, healthful characteristics of the facility (e.g., appropriate air/water temperatures, depth, hygiene), child's health status and contraindications, and other individual differences.

Overview of Recommendation:

2019 Overview of Recommendation:

The preponderance of published research evidence included in this review has supported a change in eliminating the minimum four-years-of-age for formal swim lessons among children and young children in favor of allowing individual parental decisions about when each child may be ready to start swim lessons. These individual considerations may include a child's receptivity to water experiences, appropriate health status and lack of contraindications, adequate socio-emotional responses, acquisition of related motor skills such as voluntary breath control, minimum postural control, and capacity to follow directions, and appropriate health and safety characteristics of the aquatic facility (e.g., higher air/water temperatures, shallower depths, hygienic conditions). Importantly, the 2010 American Academy of Pediatrics Technical Report and Policy Statement that focused primarily on drowning prevention, recommended removing the restriction of the four-year-old minimum age and recognized that recent research evidence indicated that swim lessons for children older than one year of age may reduce the risk of drowning. The recommendation is revised *from an option to* ***a guideline***.

This **guideline** recommendation results from recent research evidence that has demonstrated

- individual infants and young children can acquire selected basic aquatic skills such as entering, voluntarily self-submerging, rolling over, floating and gliding, and primitive paddling during the second through fifth years of life but not to the same skill or competence levels as older children and adults;
- sufficient research evidence now exists affirming that early introduction to swim lessons (i.e., between 1 to 4 years) appears to provide benefits related to reduced risk of drowning as well as swimming proficiency;
- Currently, research evidence is lacking to suggest that young children acquire more advanced levels of proficiency or lower risks of drowning as a result of water experiences or swim lessons prior to 12 months of age.

The preponderance of expert and agency opinion also supported the following recommendations:

- Learning to swim (a.k.a., developing basic and minimal water competence), while *eventually* an important factor in reducing the risk of drowning, is neither an adequate nor sufficient sole means for preventing drowning.
- Adequate drowning prevention strategies require multiple layers of redundant preventive steps including four-sided fencing with self-latching gates as well as childproof locks on all external doors and windows from the residence. The single most important factor in preventing child drowning must be constant appropriate and qualified adult supervision of all young children. The characteristics of "qualified adult supervision" has been defined in a separate statement.
- Water safety education for parents/guardians of children of all ages must be an integral component of all aquatic and learn-to-swim programs to facilitate water safety and drowning prevention.

2022 Updated Overview of Recommendation

The scientific evidence continues to support the previous Triennial Review as well as the AAP recommendation that all children, beginning as early as 1-year-of-age, should learn to swim. The AAP policy statement and technical report, however, emphasized that currently no evidence exists to support infant swim lessons (i.e., for young children under the age of 1 year). The

current scientific evidence, albeit limited, continues to show that young children 2-5 years of age who have taken swim lessons show a reduced risk of drowning.

Therefore, it is the recommendation of this triennial review that we **reaffirm** the question and support the value of developmentally appropriate group swim lessons for children 1-5 years of age as currently offered by the American Red Cross through the Parent-Child Aquatics and Preschool Aquatics programs.

Specific Recommendations and Strength (using table below):

Class	Descriptions	Implications	Level of Evidence
I	Convincingly justifiable on scientific evidence alone.	Usually supports Standard	One or more Level 1 studies are present (with rare exceptions). Study results consistently positive and compelling
II	Reasonably justifiable by scientific evidence and strongly supported by expert opinion.	Usually supports Guideline but if volume of evidence is great enough and support from expert opinions is clear may support standard	Most evidence is supportive of guideline. Level 1 studies are absent, or inconsistent, or lack power. Generally higher levels of evidence. Results are consistently supportive of guideline.
III	Adequate scientific evidence is lacking but widely supported by available data and expert opinion.	Usually supports Option.	Generally lower or intermediate levels of evidence. Generally, but not consistently results are supportive of opinion.
IV	No convincing scientific evidence available but supported by rational conjecture, expert opinion and/or non peer-reviewed publications	Usually does not support standard, guideline, or option. Statement may still me made which presents what data and opinion exists. In some cases and in conjunction with rational conjecture may support option.	Minimal evidence is available. Studies may be in progress. Results inconsistent, or contradictory.

Standards: None

Guidelines: (Class II). Sufficient research evidence exists that after 3 years of age, learning to swim contributes to reduction of risk in preventing drowning
No evidence exists that learning voluntary aquatic skills prior to 1 year of age produces a functional level of proficiency, advantage in preventing drowning, or other benefits

Option: (Class III). The limited, but growing research evidence demonstrates that

- individual infants and young children are capable of acquiring selected basic aquatic skills during the first two to five years of life at a rudimentary level of development/proficiency;
- limited evidence exists that introduction to swim lessons by age 3 years provides some drowning prevention benefits;

- no current research evidence suggests that early swimming lessons increase the likelihood of drowning;
- the research evidence related to issues of program purpose/outcomes, functionality of skills, developmental level, or degree of competence, efficiency of acquisition, and methodology for that acquisition process is insufficient to support either a standard or guideline relative to a minimum age or other criteria;
- based on the consensus of opinion from major aquatic agencies and experts, infants and young children between the ages of 1 and 5 years may optionally start swim lessons for the purpose of building aquatic readiness and water acclimation on an individual basis. Individual considerations in addition to age should include child-specific cognitive, social, and psychomotor readiness factors including prerequisite skills such as voluntary breath control, upright head and trunk control, maintaining upright balance, and independent walking.

Knowledge Gaps and Future Research

. For all of the above options, additional focused, prospective research must be conducted to address whether these expert opinions merit reclassification as guidelines.

Implications for American Red Cross Programs

Summary of Key Articles/Literature Found and Level of Evidence/Bibliography:

Level of Evidence	Definitions (See manuscript for full details)
Level 1a	**Experimental and Population based studies -** population based, randomized prospective studies or meta-analyses of multiple higher evidence studies with substantial effects
Level 1b	**Smaller Experimental and Epidemiological studies -** Large non-population based epidemiological studies or randomized prospective studies with smaller or less significant effects
Level 2a	**Prospective Observational Analytical** - Controlled, non-randomized, cohort studies
Level 2b	**Retrospective/Historical Observational Analytical** - non-randomized, cohort or case-control studies
Level 3a	**Large Descriptive studies** – Cross-section, Ecological, Case series, Case reports
Level 3b	**Small Descriptive studies** – Cross-section, Ecological, Case series, Case reports
Level 4	**Animal studies or mechanical model studies**
Level 5	**Peer-reviewed Articles** - state of the art articles, review articles, organizational statements or guidelines, editorials, or consensus statements

Level 6	**Non-peer reviewed published opinions -** such as textbook statements, official organizational publications, guidelines and policy statements which are not peer reviewed and consensus statements
Level 7	**Rational conjecture** (common sense); common practices accepted before evidence-based guidelines
Level 1-6E	**Extrapolations** from existing data collected for other purposes, theoretical analyses which is on-point with question being asked. Modifier E applied because extrapolated but ranked based on type of study.

American Academy of Pediatrics, 2003

Summary of Article: AAP policy statement from the Committees on Sports Medicine and Fitness as well as on Injury and Poison Prevention that argues for no organized, formal swimming instruction for children younger than 4 years "for developmental reasons."
Level of Evidence: Level 5

American Academy of Pediatrics, 2008

Summary of Article: AAP policy statement from Committee on Injury, Violence, and Poison Prevention expands upon the previous statement with a series of age-related recommendations for infants and children through 4 years, children 5-12 years, and adolescents 13-19 years. It recommends that children 5 years and older need to be taught to swim for water safety and drowning prevention reasons. It maintains prohibition on formal swimming lessons for children less than 4 years of age. It does introduce the concept of individualization for when to start swimming lessons.
Level of Evidence: Level 5

Asher, Rivara, Felix, Vance, & Dunne, 1995

Summary of Article: This sample of 109 young children (~35.2 mos) tested pre- and post- water safety training experiences of 8 or 12 weeks. Significant changes were observed for deck safety behaviors, recovery in water, and jump and swim measures. Authors concluded need to do more studies, but water safety training potentially reduced drowning.
Level of Evidence: Level 3b

Brenner, Saluja, & Smith, 2003

Summary of Article: Article reviews the limited evidence regarding the positive relationships among swimming ability, swim lessons, and risk of drowning. It also reviews recommendations for swimming instruction and needs for future research.
Level of Evidence: Level 5

Brenner, Taneja, Haynie, Trumble, Qian, Klinger, & Klebanoff, 2009

Summary of Article: A case control study that estimated the association between swimming lessons and the risk of drowning among children 1-19 years. Families who had experienced a child drowning were interviewed and compared to control families with not children drowning. Admittedly imprecise results found 88% reduction in risk of drowning among 1-4 year olds associated with having taken swim lessons with a 95% CI from 3%-99%.
Level of Evidence: Level 2A

McGraw, M.B., 1975/1935

Summary of Article: Co-twin case study illustrated that experimental twin could achieve rudimentary front locomotion during first twenty-three months of life with regular experience
Level of Evidence: Level 2B

McGraw, M.B., 1939

Summary of Article: Identified three phases of rudimentary swimming behavior through which infants and young children passed.
Level of Evidence: Level 2B

McGraw, M.B., 1945/1963

Summary of Article: Book overviews a wide variety of developmental changes in infant motor behavior including swimming phases (see McGraw, 1939).
Level of Evidence: Level 5

Erbaugh, S.J., 1978

Summary of Article: Study identified a developmental instrument ofr assessing aquatic skills in preschool children.
Level of Evidence: 2B

Erbaugh, S.J., 1980

Summary of Article: Initial report of some cross-sectional age differences in swimming skills observed among pre-school children enrolled in twice-weekly gym-swim program.
Level of Evidence: Level 2B

Erbaugh, S.J., 1981

Summary of Article: Dissertation demonstrating developmental changes in swimming skills among preschool children, aged 2-4.5 years.
Level of Evidence: Level 2B

Erbaugh, S.J., 1986a

Summary of Article: Peer-reviewed version of Erbaugh dissertation (1981).
Level of Evidence: Level 2B

Langendorfer et al., 1987

Summary of Article: Study using videotaped observations of developmental differences in arm and leg actions and body position in swimming among young children.
Level of Evidence: Level 3B

Langendorfer & Willing, 1985

Summary of Article: Overview article integrating previous motor development research related to swimming to recommendations about swimming instructional programs.
Level of Evidence: Level 5

Harrod & Langendorfer, 1990

Summary of Article: Scalogram analysis (Guttman, 1950) that identified “best order” for presenting beginning swimming skills to children. Used as one basis for altering the Red Cross swimming levels in 1992.
Level of Evidence: Level 2A

Langendorfer, Chaya, & Swank, (in press)

Summary of Article: Study examined the robustness of the order of acquisition of 13 swimming skills in college-age young adults. The order of acquisition was similar to that already used in the American Red Cross learn-to-swim program for children.
Level of Evidence: Level 2A

Parker & Blanksby, 1997

Summary of Article: This only studied the explicitly examined relationship of starting age and the efficacy with which children acquired rudimentary aquatic skills and water confidence. Later preschool age was the most efficacious age at which to begin lessons on the basis of time to acquire a basic level of competency.
Level of Evidence: Level 2A

Council for National Cooperation in Aquatics, 1985

Summary of Article: This published version of the CNCA guidelines modified several earlier versions and provided a rationale for each of the 10 guidelines.
Level of Evidence: Level 5

American Red Cross, 1988

Summary of Article: This was the first instructional materials published by the American Red Cross on a national level oriented toward infant and preschool swimming readiness programs. [2004 version is contemporary reference and program is currently called "Parent-Child Program."]
Level of Evidence: Level 6

YMCA of USA, 1987

Summary of Article: The Y Skippers program was the first published official national aquatic instructional program for infants and young children. It expanded upon a previous parent-child program "1, 2, and You." Like the Red Cross IPAP program, it focused on developing aquatic readiness skills; unlike the Red Cross IPAP program, Y Skippers was more closely integrated with the Y Swim Lessons for older children, particularly in 1999 version.
Level of Evidence: Level 6

Newman, V.H., 1967/1969

Summary of Article: This was the first published text to illustrate how infants could be taught to swim. The author claimed that an infant could learn to swim (i.e., dog paddle) with 100 hours of instruction. Second text describes Newman's instructional techniques with preschool children.
Level of Evidence: Level 6

<u>Update 2016</u>

American Academy of Pediatrics, Jeffrey Weiss, Committee on Injury, Violence and Poison Prevention, 2010

Summary of Article: Drowning is a leading cause of injury-related death in children. In 2006, approximately 1100 US children younger than 20 years died from drowning. A number of intervention strategies (including adult supervision, pool fencing, pool covers and alarms, lifeguards, CPR training, and swimming instruction/water-survival training, and PFDs) are available to prevent these tragedies. As educators and advocates, pediatricians can play an important role in the prevention of drowning.
Level of Evidence: Level 5

Centers for Disease Control and Prevention, 2005-2009

Summary of Article: Drowning is a leading cause of unintentional injury death worldwide, and the highest rates are among children. Overall, drowning death rates in the United States have declined in the last decade; however, drowning is the leading cause of injury death among children aged 1-4 years. To update information on the incidence and characteristics of fatal and nonfatal unintentional drowning in the United States, CDC

analyzed death certificate data from the National Vital Statistics System and injury data from the National Electronic Injury Surveillance System--All Injury Program (NEISS-AIP) for 2005-2009. Death rates and nonfatal injury rates were highest among children aged ≤4 years; these children most commonly drowned in swimming pools. The drowning death rate among males (2.07 per 100,000 population) was approximately four times that for females (0.54). To prevent drowning, all parents and children should learn survival swimming skills. Lifejackets should be used by all boaters and weaker swimmers; and all caregivers and supervisors should have training in cardiopulmonary resuscitation.

Level of Evidence: Level 2A

Irwin, Irwin, Ryan, & Drayer, 2009

Summary of Article: Study examined swimming ability and variables associated with swimming for US inner-city, minority children. Empirical research on minority children's swimming ability is non-existent, and drowning rates for this population are high. A large sample (n=1680) was gathered, which targeted poor, minority children. Parents of children aged 4–11 years and adolescents (12–17 years) completed surveys. African–American respondents reported a 57.5% "at risk" (unable to swim or uncomfortable in deep end of pool) swimming ability. Hispanic/Latino children confirmed a 56.2% "at risk" level as compared with 30.9% for white subjects. Age, sex, child's lunch program, parental education and race variables were all significantly ($p<0.05$) related to swimming ability. Poor minority children, specifically African–American and Hispanic/Latino, are at a significant disadvantage concerning swimming ability. Female subjects were notably more "at risk" regarding their swimming ability than male subjects. Age, race and socioeconomic factors were significantly associated with children who have low swimming ability.

Level of Evidence: Level 3A

Quan & Cummings, 2003

Summary of Article: A retrospective review of the characteristics of drowning victims and their drowning incidents obtained from death certificates, medical examiner, pre-hospital, emergency department, and hospital records. Study subjects included residents who died (n=709) of unintentional drowning within the study region during 1980 through 1995. Age specific counts, proportions, and rates per million person years were estimated for and compared among six age groups with the results. Results: Rates varied by age group: 0-4 (30.5), 5-14 (11.6), 15-19 (29.9), 20-34 (21.5), 35-64 (12.5), and 65 years or older (21.2). Among those 0-4 years, the proportions that drowned in pools, bathtubs, and open water were nearly equal. But from age 5-64 years, over 69% of deaths were in open water. Among those 65 years and older, the deaths were almost evenly divided between bathtub and open water; bathtub drowning rates were highest in this age group, 10.9. The characteristics of drowning episodes vary greatly by age. Different prevention strategies may be needed for different age groups.

Level of Evidence: Level 2B

A.Rahman, et al., 2009

Summary of Article: Study determined the epidemiology of child drowning in order to propose possible interventions for Bangladesh and other similar low-income countries. About 352 000 children 0–17 years were selected from over 171 000 households, using multistage cluster sampling. Drowning was the leading cause of death (28.6 per 100 000

child-years) in children aged 1–17 years. The highest incidence (86.3 per 100 000 child-years) was in children aged 1–4 years. More than two-thirds of drownings occurred in ponds and ditches. Most drownings (85%) happened in daylight. In more than one-third of cases of drowning, the child was alone. In the two-thirds of cases in which the child was accompanied, almost half were with children who were 10 years or below. Only 7% of drowned children over 4 years of age knew how to swim. Drowning is a major cause of childhood mortality in Bangladesh. Creating drowning-safe homes, improving supervision of children, modifying the environment, and developing water safety skills for children and the community may be effective interventions for drowning prevention.
Level of Evidence: Level 1B

F. Rahman, et al., 2012

Summary of Article: This study presents the cost-effectiveness of a low-cost, scalable injury and drowning prevention program called Prevention of Child Injuries through Social-Intervention and Education (PRECISE) in Bangladesh. Between 2006 and 2010, the 2 components of PRECISE (Anchal, which sequestered children in crèches [*n* = 18 596 participants], and SwimSafe, which taught children how to swim [*n* = 79421 participants]) were implemented in rural Bangladesh. Mortality rates for participants were compared against a matched sample of nonparticipants in a retrospective cohort analysis. Effectiveness was calculated via Cox proportional hazard analysis. Cost-effectiveness was estimated according to World Health Organization–Choosing Interventions that are Cost Effective guidelines. Anchal costs between $50.74 and $60.50 per child per year. SwimSafe costs $13.46 per child. For Anchal participants, the relative risk of a drowning death was 0.181 (*P* = .004). The relative risk of all-cause mortality was 0.56 (*P* = .001). For SwimSafe, the relative risk of a drowning death was 0.072 (*P* < .0001). The relative risk of all-cause mortality was 0.750 (*P* = .024). For Anchal, the cost per disability-adjusted life-year (DALY) averted is $812 (95% confidence interval: $589\x{2013}$1777). For SwimSafe, the cost per DALY averted is $85 ($51\x{2013}$561). Combined, the cost per DALY averted is $362 ($232\x{2013}$1364).

Based on World Health Organization criteria, PRECISE is very cost-effective and should be considered for implementation in other areas where drowning is a significant problem.
Level of Evidence: Level 1B

Yang et al., 2007

Summary of Article: Study examined risk factors associated with childhood drowning in rural China. Participants included parents of all children aged 1–14 years who died of drowning between 2002 and 2004 in 20 districts in GuangXi Province, and two age- and gender-matched controls each. Behavioral characteristics of the child and the children's caregivers were collected using a questionnaire and analyzed using logistic regression. Boys (60%) and children aged 1–4 years (48%) were over-represented among the cases; 62% occurred within 500 m of the school or home. Protective fencing or warning signs were found at only two sites. None of the children's caregivers knew how to perform cardiopulmonary resuscitation. For children aged 1–4 years significant risk factors included poor health of the caregiver (OR 3.1; 95% CI 1.9 to 5.8), not using flotation devices (OR 2.3; 95% CI 1.4 to 4.5) and no proper swimming lessons (OR 1.8; 95% CI 1.1 to 5.5). For children aged 5–14 years, the main risk factors were that the child did not have the experience of playing near or in water regularly (OR 2.7; 95% CI 1.8 to 7.4) and

lack of close supervision (OR 1.9; 95% CI 1.3 to 5.6). Risk factors identified in this study suggest that childhood drowning in rural areas in developing countries could be prevented by providing safety educational programs, which should focus on constant adult supervision and the use of flotation devices when children play in and near water.
Level of Evidence: Level 2A

Update 2019

Blanksby, Parker, Bradley, & Ong., 1995

Summary of Article: The authors compared convenience samples of different-age children learning front crawl swimming. Children ages 6-7 acquired more proficient front crawl performance than younger children. Other foundational aquatic skills (e.g., floating, gliding, simple paddling) were not studied.
Level of Evidence: Level 2B

Centers for Disease Control and Prevention, 2012

Summary of Article: Drowning is a leading cause of unintentional injury death worldwide, and the highest rates are among children. Overall, drowning death rates in the United States have declined in the last decade; however, drowning is the leading cause of injury death among children ages 1-4 years. To update information on the incidence and characteristics of fatal and nonfatal unintentional drowning in the United States, CDC analyzed death certificate data from the National Vital Statistics System and injury data from the National Electronic Injury Surveillance System--All Injury Program (NEISS-AIP) for 2005-2009. Death rates and nonfatal injury rates were highest among children aged ≤4 years; these children most commonly drowned in swimming pools. The drowning death rate among males (2.07 per 100,000 population) was four times that for females (0.54). To prevent drowning, parents and children should learn survival swimming skills. Lifejackets should be used by all boaters and weaker swimmers; all caregivers and supervisors should have training in CPR..
Level of Evidence: Level 2B

Langendorfer & Bruya, 1995

Summary of Article: This scholarly-oriented practitioner aquatic text employed a developmental perspective to address aquatics for young children. Its innovations included the Aquatic Readiness Assessment (ARA), aquatic readiness guides for developing skills, espousing indirect instruction through exploration and games, and an extensive inventory of developmentally appropriate aquatic games for young children
Level of Evidence: Level 6

Rahman, Linnan, Mashreky, Hossain, & Rahman, 2014

Summary of Article: Most rural homes in Bangladesh have ponds nearby to serve as household water sources. Children of all ages are exposed to water bodies on a daily basis. Children learn to swim early in childhood from peers and relatives in a natural process that involves play and structured learning. In a large, national injury survey in Bangladesh, the ability to swim was associated with reduced risk of drowning. This study determines the prevalence of swimming ability in children in Bangladesh as a step in assessing whether this is a potential component of a national drowning prevention program. A descriptive study design using a subset of a national sample survey determined the prevalence of naturally acquired swimming ability (NASA) reported by children of rural and urban communities in Bangladesh. A total of 2,598 households

(1,999 rural and 599 urban) housing 4,336 children (2,263 male and 2,073 female) aged 5-17 years were chosen from 4 randomly selected districts using multistage random sampling. NASA was defined as the ability to cross 25 meters of water deeper than the child's height using any body movement for self-propulsion. Reported NASA was greater in males (55.6%) than females (47.9%) and among rural children (57.8%) than urban children (25.5%) for children 5-17 years. The proportion reporting NASA increased with increasing age. At age 5, 5.8% of males and 6.3% of females reported NASA, rising to 84.3% of males and 70.7% of females by age 17. By age 17, 83.1% of rural children and 57.5% of urban children reported NASA. Most children in Bangladesh report being able to swim 25 meters and learning it by middle childhood. Reported NASA is higher for males than females and for rural children than urban children. High rates of swimming appear to be achievable in the absence of pools and a swim-teaching industry. This may facilitate development of a low cost, national drowning prevention program with swimming an integral part.

Level of Evidence: Level 3A

Council for National Cooperation in Aquatics, 1985

Summary of Article: This published version of the CNCA guidelines modified several earlier versions and provided a rationale for each of the 10 guidelines.

Level of Evidence: Level 5

REFERENCES

<u>Critical periods/ages, order, and instructional techniques for swimming acquisition</u>

American Academy of Pediatrics. (2000). Position statement: Swimming programs for infants and toddlers. *Pediatrics, 105*(4), 868-870.

American Academy of Pediatrics. (2003). Policy statement: Prevention of drowning in infants, children, and adolescents. *Pediatrics, 112*(2), 437-439.

American Red Cross (1988). *Infant-Preschool Aquatic Program Manual*. St. Louis: Mosby.

Asher, K.N., Rivara, F.P., Felix, D., Vance, L., & Dunne, R. (1995). Water safety training as a potential means of reducing risk of young children's drowning. *Injury Prevention, 1*(4): 228-233.

Bredekamp, S. (Ed.) (1997). *Developmentally appropriate practices for young children ages birth to 8 years* (2nd Ed.). Washington, D.C.: National Association for the Education of Young Children.

Brenner, R.A., Saluja, G., & Smith, G.A. (2003). Swimming lessons, swimming ability, and the risk of drowning. *Injury Control and Safety Promotion, 10*(4), 211-216.

Brenner, R.A., Taneja, G.S., Haynie, D.L., Trumble, A.C., Qian, C., Klinger, R.M., & Klebanoff, M.A. (2009). Association between swimming lessons and drowning in childhood. *Archives of Pediatric and Adolescent Medicine, 163*(3), 203-210. Approved by ACFASP June 2009 16

Clevenger, C. (1986). *Infant swimming: The gentle water play method for teaching child to swim*. New York: St. Martin's.

Council for National Cooperation in Aquatics. (1985). Guidelines for infant and preschool swim programs. *National Aquatic Journal, 1*, 6-8.

Diem, L. (1973). *Sport fur Kinder*. Munich: Kosel Verlag.

Diem, L. (1982). Early Motor Stimulation and Personal Development. A Study of Four- to Six-Year-Old German Children. *Journal of Physical Education, Recreation, and Dance, 53*(9), 23-25.
Erbaugh, S.J. (1978). Assessment of swimming performance of preschool children. *Perceptual and Motor Skills, 47*, 1179-1182.
Erbaugh, S.J. (1980). The development of swimming skills of preschool children. In C. Nadeau, K. Newell, G. Roberts, & W. Halliwell (Eds.), *Psychology of motor behavior and sport-1979* (pp. 324-335). Champaign, IL: Human Kinetics.
Erbaugh, S.J. (1981). The development of swimming skills of preschool children over a one and one-half year period. *Dissertation Abstracts International, 42*, 2558A.
Erbaugh, S.J. (1986) Effects of aquatic training on swimming skill development of preschool children. *Perceptual and Motor Skills, 62*, 439-446.
Fergusson, D.M., & Horwood, L.J. (1984). Risks of drowning in fenced and unfenced domestic swimming pools. *New Zealand Medical Journal, 97*(767), 777-779.
Harrod, D.K. (1991). *A scalogram analysis of the American Red Cross Beginner swimming skill items*. Unpublished Masters thesis, Kent State University, Kent, OH.
Harrod, D.K., & Langendorfer, S.J. (1990). A scalogram analysis of the American Red Cross Beginner swimming skill items. *National Aquatics Journal, 6*, 10-16.
Langendorfer, S.J., & Willing, E. (1985). The impact of motor development research upon issues in infant and preschool aquatics. *National Aquatics Journal, 1*(1), 14-15.
Langendorfer, S.J., Roberts, M.A., & Ropka, C.R. (1987). A developmental test of aquatic readiness. *National Aquatics Journal, 3*(2), 8-9, 12.
Langendorfer, S.J., Chaya, J., & Swank, K. (in press). Scalogram analysis of the order for selected swimming skills. *International Journal of Aquatic Research and Education*,
Logan, P., Branche, C.M., Sacks, J.J., Ryan, G., & Peddicord, J. (1998). Childhood drownings and fencing of outdoor pools in the United States, 1994. *Pediatrics, 101*(6),
McGraw, M.B. (1975/1935). *Growth: A study of Johnny and Jimmy*. New York: Arno.
McGraw, M.B. (1939). Swimming behavior of the human infant. *Journal of Pediatrics, 15*(4), 485-490. Approved by ACFASP June 2009 17
McGraw, M.B. (1945/1963). *Neuromuscular maturation of the human infant*. New York: Hafner.
Mead, M. (1930). *Growing up in New Guinea: A comparative study of primitive education*. New York: New American Library.
Moran, K., & Stanley, T. (2006). Parental perceptions of toddler water safety, swimming ability, and swimming lessons. *International Journal of Injury Control and Safety Promotion, 13*(3), 139-143.
Newman, V.H. (1968). *Teaching an infant to swim*. New York:
Parker, H.E., & Blanksby, B.A. (1997). Starting age and aquatic skill learning: Mastery of pre-requisite water confidence and basic aquatic locomotion skills. *The Australian Journal of Science and Medicine in Sport, 29*(3), 83-87.
Pitt, W.R., & Balanda, K.P. (1991). Childhood drowning and near-drowning in Brisbane: The contribution of domestic pools. *Medical Journal of Australia, 154*(10), 661-665.
Shank, C. (1983). *A child's way to water play*. West Point, NY: Leisure Press.
Smith, G.S. (1995). Drowning prevention in children: The need for new strategies. *Injury Prevention, 1*(4), 216-217.

Thompson, D.C., & Rivara, F.P. (2000). Pool fencing for preventing drowning in children. *Cochrane Database Systems Review,* 2, CD001047.
YMCA of USA. (1987). *Y Skippers Program Manual*. Champaign, IL: Human Kinetics.
Zelazo, P.R., & Weiss, M.J. (2006). Infant swimming behaviors: Cognitive control and the influence of experience. *Journal of Cognition and Development, 7*(1), 1-25.

Conceptual/Theoretical Sources

Bronfenbrenner, U. (1979). *The ecology of human development*. Cambridge, MA: Harvard University Press.
Gibson, J.J. (1964). The contribution of experimental psychology to the formulation of the problem of safety—a brief for basic research. In: W. Haddon, E.A. Suchman, & D. Klein (Eds.), *Accident research: methods and approaches*. New York: Harper & Row.
Haddon, W., Suchman, E.A., & Klein, D. (1964). *Accident research: methods and approaches*. New York: Harper & Row.
Haddon, W. (1999). The changing approach to the epidemiology, prevention, and amelioration of trauma: the transition to approaches etiologically rather than descriptively based. *Injury Prevention, 5*:231–5. Approved by ACFASP June 2009 18
Haddon, W. (1972). A logical framework for categorizing highway safety phenomena and activity. *Journal of Trauma, 12*:193–207.
Haddon, W. (1973). Energy damage and the ten countermeasure strategies. *Journal of Trauma, 13*:321–31.
Haddon, W. (1980). Advances in the epidemiology of injuries as a basis for public policy. *Public Health Reports, 95*:411–21.
Langendorfer, S.J., & Bruya, L.D. (1995). *Aquatic readiness: Developing water competence in young children*. Champaign, IL: Human Kinetics.
Newell, K.M. (1986). Constraints on the development of coordination. In M.G. Wade and H.T.A. Whiting (Eds.), *Motor development in children: Aspects of control and coordination* (pp. 341-360). Boston: Martinus Nijhoff.
Roberton, M.A., & Halverson, L.E. (1984). *Developing children: Their changing movement*. Philadelphia: Lea & Febiger.
Roberton, M.A. (1993, February). *Developmentally appropriate practices*. Paper presented to the Midwest Association for Health, Physical Education, Recreation, and Dance, Toledo, OH.
Roberton, M.A. (1989). Developmental sequences and developmental task analysis. In J. Skinner, et al. (Eds.), *Future directions in exercise and sport science research* (pp. 369-381). Champaign, IL: Human Kinetics.
Roberton, M.A., Halverson, L.E., & Harper, C.J. (1997). Visual/verbal modeling as a function of children's developmental level. *Motor Development: Research and Reviews, 1,* 122-147.
Runyan, C.W. (2003). Introduction: Back to the future-Revisiting Haddon's conceptualization of injury epidemiology and prevention. *Epidemiologic Reviews, 25*, 60-64.
Wohlwill, J. (1973). *The concept of development*. New York: Academic Press.

Update 2016:

Centers for Disease Control and Prevention (CDC). (2012). Drowning – United States, 2005-2009. *Morbidity and Mortality Weekly Reports, 61*(19), 344-347.

Irwin, C.C., Irwin, R.L., Ryan, T.D., & Drayer, J. (2009). Urban minority youth swimming (in)ability in the United States and associated demographic characteristics: Toward a drowning prevention plan. *Injury Prevention, 15*, 234-239.

Rahman, A., Mashreky, S.R., Chowdhury, S.M., Giashuddin, M.S., Uhaa, I.J., Shafinaz, S. et al. (2009). Analysis of the childhood fatal drowning situation in Bangladesh: Exploring prevention measures for low-income countries. *Injury Prevention, 15*: 75-79.

Rahman, F., Bose, S., Linnan, M., Rahman, A., Mashrevky, S., Haaland, B., & Finkelstein, E. (2012). Cost-effectiveness of an injury and drowning prevention program in Bangladesh. *Pediatrics, 130*(6), 31621-e1628.

Weiss, J. (2010). Technical Report – Prevention of drowning. *Pediatrics, 126*(1), e253-e262.

Yang, L., Nong, Q-Q., Li, C-L., Feng, Q-M., & Lo, S.K. (2007). Risk factors for childhood drowning in rural regions of a developing country: A case-control study. *Injury Prevention*, 13: 178-182.

Update 2019:

Blanksby, B.A., Parker, H.E., Bradley, S., & Ong, V. (1995). Children's readiness for learning front crawl swimming. *Australian Journal of Science and Medicine in Sport, 27*(2):34-37.