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## Revised Scientific Review: Minimum Age for Swim Lessons

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### **Cover Page Footnote**

This revised scientific review was reviewed and approved by the American Red Cross Scientific Advisory Council at its January 19, 2019 meetings in Washington, D.C. The author acknowledges the thoughtful feedback and assistance provided by members of the aquatic sub-council of SAC, specifically Louise Kublick, Dr. Linda Quan, Dr. Peter Wernicki, and Connie Harvey from the NHQ staff.

## **ARC SAC Triennial Scientific Review - Minimum Age for Swim Lessons**

### **Scientific Issue/Question/Topic Abstract**

The question addressed in the original scientific review (2009) was rephrased as *Does sufficient scientific evidence exist to support setting a minimum age for swimming lessons?* for this triennial review. Addressing the research question is significant because strong differences of opinion about the appropriate age(s) for initiating learn-to-swim lessons have existed among the pediatric medical profession, aquatic professionals and agencies, and proprietary programs and swim schools for over four decades. The question has implications for the appropriate purposes, pedagogies, and outcomes associated with swimming experiences for infants and young children that will be addressed in a subsequent review. The revised statement now supports as a *guideline* that children older than 1 year of age can benefit from swim lessons with a lower risk of drowning; parents should make their decision to enroll based upon individual child considerations as proposed in this review.

### **Questions to be addressed:**

#### Original Question:

*What scientific evidence exists to support setting a minimum age for swimming lessons?*

#### Revised question

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

#### Revised corollary question:

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

### **Review Process and Literature Search of Evidence Since Last Approval Performed**

#### **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 Bangladesh 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.

#### **Summary of Scientific Foundation:**

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

The developmental research literature indicates that

- many basic aquatic skills (e.g., voluntary breath control, water entry and exit skills, dog paddle) can begin to be acquired between 18 and 60 months of age with wide individual differences (Erbaugh, 1978; 1980; 1982; 1986; Langendorfer & Willing, 1985; McGraw, 1939; 1945);
- basic aquatic skills acquired during the preschool period primarily serve a role as foundational readiness skills for later and more advanced swimming skill and stroke acquisition (Erbaugh, 1978; 1980; 1982; 1986; Langendorfer & Bruya, 1995);
- skills acquired after the first 12-36 months may have some impact on later learning of swim strokes at adult levels or preventing drowning (Asher, et al., 1995; Brenner, et al., 2003; 2009; A. Rahman, et al., 2009; F. Rahman, et al., 2012; Yang, et al., 2007);
- associated readiness skills (e.g., balance, sitting, standing, walking, jumping, plus cognitive and social adaptability) may be more appropriate criteria for making individual decisions about starting aquatic experiences than chronological age alone (Langendorfer & Bruya, 1995).
- one longitudinal German study (Diem, 1973; 1982) identified cognitive and academic benefits associated with early childhood experiences in swimming and gymnastics.

Earlier American Academy of Pediatrics statements (2000; 2003) called for a minimum age of 4 years before children should be allowed to enroll in formal swimming lessons because “children are generally not developmentally

ready...until after their fourth birthday.” The earlier statements had not relied adequately upon scientific evidence and had not considered individual differences that may allow children at ages younger than four years to begin to learn to swim. The most recent 2010 American Academy of Pediatrics “Technical Report – Prevention of Drowning” relaxed the earlier policy recommendation (2000; 2003) by recognizing that “evidence no longer supports an advisory against early aquatic experience and swim lessons for children of any specific age.” The report did warn that insufficient evidence currently exists to recommend that all one- to four-year-old children should receive swim lessons although the report did incontrovertibly state that “all children should eventually learn to swim.” They further suggested that parents decide on an individual basis when a child ought to begin swim lessons. The report did call for more research to determine which types of swim lessons and aquatic skills are most effective in preventing drowning. In re-affirming and revising the original 2009 SAC Scientific Review on *Minimum Age for Swim Lessons*, the 2010 AAP Technical Report noted that parents need to make individual decisions about when and how to start swim lessons for young children as well as what type of swim lessons are appropriate. While there had been very limited direct 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 (McGraw, 1939; 1945; Newman, 1967; 1969), the same cannot be said of aquatic experiences during the second, third, and fourth years of life (Asher, et al., 1995; Brenner et al., 2003; Brenner et al., 2009; Yang et al., 2007).

### **Summary:**

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.

**Updated Scientific Foundation:**

*(Please provide a summary of the science from the last approval and of any new evidence. If new evidence exists please comment whether this would support or alter the previously approved statement)*

Since the previous triennial review (2012) 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. 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*.

**Selected References****Critical periods/ages, order, instructional techniques for swimming acquisition and drowning**

- 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.
- 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.
- Bredenkamp, S. (Ed.) (1997). *Developmentally appropriate practices for young children ages birth to 8 years* (2<sup>nd</sup> 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: A case control study. *Archives of Pediatric and Adolescent Medicine*, *163*(3), 203-210.

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

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.

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.

Robertson, M.A., & Halverson, L.E. (1984). *Developing children: Their changing movement*. Philadelphia: Lea & Febiger.

Robertson, M.A. (1993, February). *Developmentally appropriate practices*. Paper presented to the Midwest Association for Health, Physical Education, Recreation, and Dance, Toledo, OH.

- Robertson, 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.
- Robertson, 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.

**Table 1.** Updated Scientific Foundations as employed in Table 2 to categorize studies and publications

Levels of Evidence	Definitions
Level 1a	Population based studies, randomized prospective studies or meta-analyses of multiple studies with substantial effects
Level 1b	Large non-population based epidemiological studies or randomized prospective studies with smaller or less significant effects
Level 2a	<u>Prospective</u> , controlled, non-randomized, cohort or case-control studies
Level 2b	<u>Historic</u> , non-randomized, cohort or case-control studies
Level 2c	<u>Case series</u> ; convenience sample epidemiological studies
Level 3a	Large observational studies
Level 3b	Smaller observational studies
Level 4	Animal studies or mechanical model studies
Level 5	Peer-reviewed, 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.

**Table 2.** Summary of Key Articles/Literature Found and Level of Evidence (see Table 1 categories)

Author(s)/ Pub. Date	Full Citation (APA format)	Summary of Article	Level of Evidence
American Academy of Pediatrics (2003)	American Academy of Pediatrics. (2003). Policy statement: Prevention of drowning in infants, children, and adolescents. <i>Pediatrics</i> , 112(2), 437-439.	AAP policy statement from the Committee on Sports Medicine and Fitness as well as on Injury and Poison Prevention argued for no organized, formal swimming instruction for children younger than 4 years “for developmental reasons.”	Level 5
American Academy of Pediatrics (2000)	American Academy of Pediatrics, Committee on Sports Medicine and Fitness and Committee on Injury, Violence, and Poison Prevention. (2000). Swimming programs for infants and toddlers. <i>Pediatrics</i> , 105(4 pt 1), 868-870.	AAP policy statement from Committee on Injury, Violence, and Poison Prevention expanded upon and modified 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 recommended that children 5 years and older need to be taught to swim for water safety and drowning prevention reasons. It maintained prohibition on formal swimming lessons for children less than 4 years of age. It introduced the concept of individualizing age to start swimming lessons.	Level 5
American Academy of Pediatrics, J. Weiss (Ed.) Committee on Injury, Violence, Poison Prevention (2010)	AAP - Weiss, J. (Ed.) (2010). Technical Report – Prevention of drowning. <i>Pediatrics</i> , 126(1), e253-e262.	Drowning is a leading cause of injury-related death in children. In 2006, approximately 1100 US children younger than 20 years died from drowning. 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 5

Asher, Rivera, Felix, Vance, & Dunne (1995)	Asher, K.N., Rivera, F.P., Felix, D., Vance, L., & Dunne, R. (1995). Water safety training as a potential means of reducing risk of young children's drowning. <i>Injury Prevention, 1</i> (4):228-33.	This sample of 109 young children (~35.2 mos) tested pre- and post- water safety training experiences lasting 8 or 12 weeks. Significant changes observed for deck safety behaviors, recovery in water, and jump and swim measures. Authors concluded need for more study, but water safety training potentially reduced drowning.	Level 3b
Blanksby, Parker, Bradley, & Ong (1995)	Blanksby, B.A., Parker, H.E., Bradley, S., & Ong, V. (1995). Children's readiness for learning front crawl swimming. <i>Australian Journal of Science and Medicine in Sport, 27</i> (2):34-37.	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 2b
Parker & Blanksby (1997)	Parker, H.E., & Blanksby, B.A. (1997). Starting age and aquatic skill learning: Mastery of pre-requisite water confidence and basic aquatic locomotion skills. <i>Australian Journal of Science and Medicine in Sport, 29</i> (3), 83-87.	In a subsequent study to (Blanksby, et al., 1995), this study examined starting age and swim lessons of different lengths (daily vs. weekly). No significant differences in skill acquisition existed between daily vs. weekly swim lessons, but slightly older preschoolers acquired more proficient basic locomotor skills.	Level 2b
Brenner, Saluja, & Smith (2003)	Brenner, R.A., Saluja, G., & Smith, G.A. (2003). Swimming lessons, swimming ability, and the risk of drowning. <i>Injury Control and Safety Promotion, 10</i> (4), 211-216.	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 5

<p>Brenner, Taneja, Haynie, Trumble, Qian, Klinger, &amp; Klebanoff (2009)</p>	<p>Brenner, R.A., Taneja, G.S., Haynie, D.L., Trumble, A.C., Qian, C., Klinger, R.M., &amp; Klebanoff, M.A. (2009). Association between swimming lessons and drowning in childhood: A case-control study. <i>Archives of Pediatric and Adolescent Medicine</i>, 163(3), 203-210.</p>	<p>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 no child 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%.</p>	<p>Level 2a</p>
<p>Centers for Disease Control and Prevention (2012)</p>	<p>Centers for Disease Control and Prevention (CDC). (2012). Drowning – United States, 2005-2009. <i>Morbidity and Mortality Weekly Reports</i>, 61(19), 344-347.</p>	<p>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</p>	<p>Level 2b</p>

		be used by all boaters and weaker swimmers; all caregivers and supervisors should have training in CPR.	
McGraw, (1932)	McGraw, M.B. (1935/1975). <i>Growth: A study of Johnny and Jimmy</i> . New York: Arno.	Co-twin case study illustrated that experimental twin could achieve rudimentary front locomotion during first twenty-three months of life with regular experience	Level 2c
McGraw, (1939)	McGraw, M.B. (1939). Swimming behavior of the human infant. <i>Journal of Pediatrics</i> , 15(4), 485-490.	Identified three phases of rudimentary swimming behavior through which infants and young children passed during first 600 days of life.	Level 2c
McGraw, (1945)	McGraw, M.B. (1945/1963). <i>Neuromuscular maturation of the human infant</i> . New York: Hafner.	Book overviewed a wide range of developmental changes in infant motor behavior including swimming phases (see McGraw, 1939).	Level 5
Erbaugh, (1978)	Erbaugh, S.J. (1978). Assessment of swimming performance of preschool children. <i>Perceptual and Motor Skills</i> , 47, 1179-1182.	Study identified a developmental instrument for assessing aquatic skills in preschool children.	Level 2a
Erbaugh, (1980)	Erbaugh, S.J. (1980). The development of swimming skills of preschool children. In C. Nadeau, K. Newell, G. Roberts, & W. Halliwell (Eds.), <i>Psychology of motor behavior and sport-1979</i> (pp. 324-335). Champaign, IL: Human Kinetics.	Initial report of some cross-sectional age differences in swimming skills observed among pre-school children enrolled in twice-weekly gym-swim program.	Level 2a
Erbaugh, (1981)	Erbaugh, S.J. (1981). The development of swimming skills of preschool children over a one and one-half year period.	Dissertation demonstrating developmental changes in swimming skills among preschool children, aged 2-4.5 years.	Level 2a

	<i>Dissertation Abstracts International</i> , 42, 2558A.		
Erbaugh, (1986a)	Erbaugh, S.J. (1986a) Effects of aquatic training on swimming skill development of preschool children. <i>Perceptual and Motor Skills</i> , 62, 439-446.	Peer-reviewed version of Erbaugh dissertation (1981).	Level 2a
Irwin, Irwin, Ryan, & Drayer, (2009)	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. <i>Injury Prevention</i> , 15, 234-239.	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 3a



Langendorfer Roberts, & Ropka, (1987)	Langendorfer, S.J., Roberts, M.A., & Ropka, C.R. (1987). A developmental test of aquatic readiness. <i>National Aquatics Journal</i> , 3(2), 8-9, 12.	Small observation qualitative study based on videotaped observations of developmental differences in arm and leg actions and body position in swimming among young children. Used as basis for development of Aquatic Readiness Assessment (ARA).	Level 3b
Langendorfer & Willing (1985)	Langendorfer, S.J., & Willing, E. (1985). The impact of motor development research upon issues in infant and preschool aquatics. <i>National Aquatics Journal</i> , 1(1), 14-15.	Overview article integrating previous motor development research related to swimming to recommendations about swimming instructional programs.	Level 5
Harrod & Langendorfer (1990)	Harrod, D.K., & Langendorfer, S.J. (1990). A scalogram analysis of the American Red Cross Beginner swimming skill items. <i>National Aquatics Journal</i> , 6, 10-16.	Scalogram analysis (Guttman, 1950) that identified “best order” for presenting beginning swimming skills to children. Used to modify the American Red Cross beginning swimming levels in 1992.	Level 3b
Langendorfer & Bruya (1995)	Langendorfer, S.J., & Bruya, L.D. (1995). <i>Aquatic readiness: Developing water competence in young children</i> . Champaign, IL: Human Kinetics.	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 6
Parker & Blanksby (1997)	Parker, H.E., & Blanksby, B.A. (1997). Starting age and aquatic skill learning: Mastery of pre-	This only study the explicitly examined the relationship of starting age and the efficacy with which children acquired rudimentary aquatic skills and water confidence. Later	Level 2a

	requisite water confidence and basic aquatic locomotion skills. <i>The Australian Journal of Science and Medicine in Sport</i> , 29(3), 83-87.	preschool age was the most efficacious age at which to begin lessons on the basis of time to acquire a basic level of competency.	
Quan & Cummings (2003)	Quan, L. & Cummings, P. (2003). Characteristics of drowning by different age groups. <i>Injury Prevention</i> , 9(2), 163-168.	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 2b
Rahman, Mashreky, Chowdhury, Giashuddin,	Rahman, A., Mashreky, S.R., Chowdhury, S.M., Giashuddin, M.S., Uhaa, I.J., Shafinaz, S. et al. (2009). Analysis of the	Study determined 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	Level 1b

Uhaa, Shafinaz, et al. (2009)	childhood fatal drowning situation in Bangladesh: Exploring prevention measures for low-income countries. <i>Injury Prevention, 15</i> : 75-79.	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.	
Rahman, Bose, Linnan, Rahman, Mashreky, Haaland, & Finkelstein, (2012)	Rahman, F., Bose, S., Linnan, M., Rahman, A., Mashreky, S., Haaland, B., & Finkelstein, E. (2012). Cost-effectiveness of an injury and drowning prevention program in Bangladesh. <i>Pediatrics, 130</i> (6), 31621-e1628.	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 [ $n = 79\,421$ 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	Level 1b

		<p>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 (<math>P = .004</math>). The relative risk of all-cause mortality was 0.56 (<math>P = .001</math>). For SwimSafe, the relative risk of a drowning death was 0.072 (<math>P &lt; .0001</math>). The relative risk of all-cause mortality was 0.750 (<math>P = .024</math>). For Anchal, the cost per disability-adjusted life-year (DALY) averted is \$812 (95% confidence interval: \$589\{2013\}\$1777). For SwimSafe, the cost per DALY averted is \$85 (\$51\{2013\}\$561). Combined, the cost per DALY averted is \$362 (\$232\{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.</p>	
<p>Rahman, Linnan, Mashreky, Hossain, &amp; Rahman, (2014)</p>	<p>Rahman, A., Linnan, M., Mashreky, S.R., Hossain, M.J., &amp; Rahman, F. (2014). The prevalence of naturally acquired swimming ability among children in Bangladesh: A cross sectional survey. <i>BMC Public Health</i>, 14(1), 1-11. DOI: 10.1186/1471-2458-14-404</p>	<p>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</p>	<p>Level 3a</p>

		<p>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.</p>	
<p>Yang, Nong, Li, Feng, &amp; Lo, (2007)</p>	<p>Yang, L., Nong, Q-Q., Li, C-L., Feng, Q-M., &amp; Lo, S.K. (2007). Risk factors for childhood drowning in rural regions of a developing country: A case-control study. <i>Injury Prevention, 13</i>: 178-182.</p>	<p>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</p>	<p>Level 2a</p>

		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 focus on constant adult supervision and the use of flotation devices when children play in and near water.	
Council for National Cooperation in Aquatics (1985)	Council for National Cooperation in Aquatics (1985). Guidelines for infant and preschool swim programs. <i>National Aquatic Journal</i> , 1(2), 11-12	This published version of the CNCA guidelines modified several earlier versions and provided a rationale for each of the 10 guidelines for infant and preschool swim lessons and programs.	Level 5
American Red Cross (1988)	American Red Cross (1988). <i>Infant-Preschool Aquatic Program manual</i> . St. Louis: Mosby. [(2004). Water safety instructor manual. Yardley, PA: Lifeline.]	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 6

YMCA of USA (1987)	YMCA of USA (1987). <i>Y Skippers Program Manual</i> . Champaign, IL: Human Kinetics (Y Program Store) [1999 is most contemporary version of program offered by YMCA.]	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 6
Newman, (1967; 1969)	Newman, V.H. (1967). <i>Teaching an infant to swim</i> . New York: Harcourt Brace & Jovanovich. Newman, V.H. (1969). <i>Teaching young children to swim and dive</i> . New York: Harcourt Brace & World	The 1967 book was 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 6

### **Textual Summary of Recommendation for Revision, Reaffirmation or Retire**

Based on the consensus of major agencies offering swim programs (e.g., American Red Cross, YMCA of USA), expert opinion (American Academy of Pediatrics, 2010), and recent research, we revise our recommendation to a **guideline** that young children (above 1 year of age) can benefit from formal aquatic experiences (including developmentally appropriate swim lessons in which the tasks meet the needs of the individual child) as judged by parents/caregivers on an individual basis. 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).

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.