Aquatic Experiences for Young Children: Evaluating Risks and Benefits

Stephen Langendorfer

Aquatic experiences including structured instructional programs for young children have become extremely popular over the past two decades despite opposition and controversy. Surprisingly, this popularity and controversy have not given rise to extensive or sustained research efforts by exercise scientists or aquatic professionals. Most information available for assessing risks and benefits of aquatic experiences for young children must be gleaned from ancillary sources in medical and educational literature. This paper reviews important issues and questions in the medical, developmental, and pedagogical areas of early childhood aquatics. The need for basic and applied research efforts by teams of exercise scientists from physiologic, psychologic, medical, and aquatic backgrounds is apparent.

Starting in the 1960s and continuing to the present, aquatic programs for infants and young children have been increasingly popular in the U.S. Estimates suggest that from 5 to 10 million infants and preschool children may be participating in formal aquatic instructional programs in this country annually (28). The ongoing popularity of these programs is indicated by the number of national agencies including the American and Canadian Red Cross and the YMCA of the USA, which have recently published materials to enable instructors to conduct nationally standardized aquatic programs (3, 7, 70).

Apparently a variety of factors have contributed to the growing popularity and increasing numbers of infants and young children who, with their parents, engage in formal programs of aquatic instruction. Certainly the increased socioeconomic prosperity and expectations of North American society in general have influenced the increase in aquatic facilities and the amount of leisure spent in and around the water. The baby boomers as children, and now as adults, are heading to the water in unprecedented numbers. Fitness trends of the last several decades appear to be extending into the preschool age bracket. The desire of some parents to provide early enrichment experiences for their children is a strong impetus for enrolling them in aquatic programs. Other parents seek aquatic programs simply to provide specific skills such as water safety or swimming strokes for their young children.

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Parents generally assume there are strong benefits to be gained from aquatic programs. Surprisingly, however, there are a number of questions about these programs. In fact, aquatic programs for young children have remained controversial over the past two decades. In the early 1970s the Council for National Cooperation in Aquatics (CNCA) issued a statement recommending that children under the age of 3 years not participate in organized swimming programs for reasons relating to child development (14). Later, the American Academy of Pediatrics (2, 9) issued their own statements that infants did not belong in swimming programs. Most recently the CNCA, in recognizing the popularity of infant swimming programs, issued a set of guidelines to control certain practices and conditions in aquatic programs for children under 3 years of age (10).

This paper reviews some of the current medical, educational, and aquatic literature pertaining to young children in the water. Specifically, it will contrast the known detrimental aspects with the potential benefits to young children. It will pose the known risks and benefits of enrolling young children in aquatic programs and suggest resolutions to some of the controversies. The decision of whether to recommend aquatic experiences for young children should hinge on the demonstration that these programs do substantially more good than harm to young participants.

The Controversy: Risks Versus Benefits

It may seem surprising that a controversial area such as infant and preschool swimming has received little formal research attention (52). Until recently, however, most information about the area came either from how-to books written by experienced instructors for a lay audience or from isolated medical or educational articles (45, 46, 56). As a result of this lack of information and failure to establish lines of research inquiry, the controversy has spread rather than diminished (33, 34, 35, 52).

In general, two groups of persons have been involved on opposite sides of the issues. On the one side, medical professionals concerned about the health and well-being of young children as well as some aquatic administrators concerned about liability issues have insisted that infants and young children were at risk from water exposure and unscrupulous practices. On the other side, aquatic instructors and authors, seeing the popularity and economic benefits, have promoted programs and extolled the benefits of exposing young children to the water at an early age (33, 34). These two groups rarely talked to one another, and few attempts were made either to identify or resolve the conflicts (33, 34, 52).

Issues

In general, the controversy over infant and preschool swimming can be divided into three groups of issues: (a) medical, health, and safety concerns, (b) child development issues, and (c) pedagogical questions (36, 39, 42). The medical concerns have received the most attention by far. At the same time, they provide the greatest promise for resolving some of the controversies (60). In addition, as a result of the medical and public health research, we know much more about the potential risks and detriments to swimming for young children than we know about the benefits, again because of differences in the amount and type of research.
Still, a great deal of information has yet to be gathered in order to build an adequate body of knowledge about the health and safety of young children around the water.

Research in the child development and pedagogical issue areas lags far behind the popularity of early childhood aquatic programs. Most aquatic programs in the past have claimed rather dramatic benefits for participants, ranging from enhanced overall child development and improved parent/child socialization (15) to specific aquatic skills and water safety benefits (19, 20). Such claims seem to have been based much more on faith and optimism than on solid scientific data (33, 34).

The next sections provide a review of research that pertains directly or peripherally to young children and the water. The intent is to provide a general basis for what we know about the issues and what has yet to be learned.

Health and Safety Concerns

Concerns over health and safety of young children in the water include risk of drowning, spread of communicable diseases, aggravation of existing conditions, and specific water related conditions. Each area has received at least some attention from medical and public health researchers (43, 60). However, interpretations of the research results have varied and led to different conclusions (see Table 1).

Risk of Drowning

Statistically, young children under the age of 5 years, particularly boys, are at high risk from drowning (25, 49, 65, 69). Drowning is the second or third leading cause of accidental death in this age group, with annual deaths in the United States ranging between 400 and 500 children (65). Specifically, most preschool drownings (approximately 300 per year) occur in backyard pools as a result of momentary loss of supervision (35, 66). Actual drowning rates of 3.4–7.9 per 100,000 population, tragic though they are, pale by comparison to the estimated 3,000 to 4,000 submersion incidents and injuries (25.3–26.8 per 100,000) that occur in backyard pools alone each year (54, 66).

There is evidence that these statistics vary geographically, with the highest incidence of drowning occurring in climates that remain moderate all year such as Arizona, Florida, and Southern California (49, 69). However, the drowning risks are not unique to North America; similar findings have been reported from Australia and South Africa (12, 22, 48, 54).

Most of the discussion in the literature about reducing drownings of preschoolers has centered around the need for better pool barriers, alarm systems, parental supervision, and public education (22, 43). One major but often overlooked issue is the role that aquatic education programs may play in this controversy. Aquatic educators and agencies have assumed that effective early childhood swimming and water safety programs reduce the likelihood of child drownings (3, 38, 40). This assumption is based partially on the observed drop in drownings in the early 1900s when the Red Cross first initiated learn-to-swim and lifesaving programs. However, a counter argument is that introducing young children to the water actually enhances the likelihood of drowning or submersion incidents (40). This argument suggests that the rudimentary cognitive and affective development of young children limits their ability to comprehend the danger that
Table 1
Areas of Concern Over Early Childhood Aquatics in the Health, Safety, and Medical Literature

<table>
<thead>
<tr>
<th>Area of concern</th>
<th>Solutions to concerns</th>
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<tr>
<td>Risk of drowning</td>
<td>- Install/use passive safety systems</td>
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<td></td>
<td>- Improve parent education</td>
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<td></td>
<td>- Understand role of swimming programs in causing or deterring drowning</td>
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<tr>
<td>Spread of communicable diseases</td>
<td>- Maintain chemical treatment of water</td>
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<td></td>
<td>- Admit only well children to programs</td>
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<tr>
<td>Aggravation of existing conditions</td>
<td>- Medical clearance for children at risk</td>
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<tr>
<td></td>
<td>- Attention to individual needs</td>
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<tr>
<td></td>
<td>- More research to clarify solutions</td>
</tr>
<tr>
<td>Specific water-related conditions</td>
<td>- Empirical research to establish actual risks and incidences</td>
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<td></td>
<td>- Limit questionable pedagogical practices</td>
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water poses. Since aquatic programs provide rudimentary swimming skills and encourage enjoyment of the water without necessarily enhancing the child’s ability to understand the dangers, the argument goes, aquatic professionals may be creating negligent conditions for which they may be held liable.

Resolution of this issue will require more elaborate manipulation and investigation of current survey data as well as obtaining data from more empirical studies (40, 43). Drowning deaths as well as submersion incidents and injuries need to be coded by experience and skill level of the victim as well as the traditional site, age, and sex categories. It needs to be established whether young victims (both fatalities and survivors) have had previous experience in swimming programs. Specifics of program pedagogical techniques and parent education also are needed to determine whether early childhood aquatic programs curb or contribute to drownings.

Spreading of Communicable Diseases

Another health concern frequently expressed about infant and preschool swimming is the likelihood of becoming infected or of spreading communicable diseases such as viral, bacterial, or parasitic infections through the water (11, 27). The relevant literature suggests that chemically treated water adequately controls the spread of communicable diseases in children. There was at least one incident in which so-called fresh water appeared to be the source of a contagion (11). In fact, one pool chemistry expert suggests that in properly maintained facilities the water offers little risk to or from young children (64).
Recent studies have reported several incidences of giardiasis related to swimming facility use (24, 27, 55). In the earliest case (27), giardiasis infection was limited to a single class of young children and was not spread to other swimmers using the facility within a half hour of the class. Indications were that the parasite cysts most likely were spread from direct contact rather than through the water. In the more recent pool case (55), giardiasis was spread to several groups, primarily those using the pool at the same time as the contaminated person. However, pool chlorine levels were not established on the day of the fecal accident and were 0.0 ppm on the next day. Cases of giardia infection due to use of a hotel water slide (24) indicated poor circulation design in which the toddler wading pool water emptied into the water slide pool. Although the slide pool water was filtered and treated with bromine, chemical levels were not reported in the study.

These articles warn that contracting giardiasis through poorly designed or maintained swimming facilities is a distinct possibility. However, they also indicate rather simple and straightforward means for preventing infection, especially for young children (see below). Implementation of these measures by pool operators, along with participant education and awareness, should prevent future outbreaks.

- Monitor pool chlorine or bromine levels (as required by law) and maintain disinfectants at stable levels of 1.0 parts per million or above.
- Prohibit persons with suspected cases of giardiasis or other diarrhea from pool use.
- Temporarily evacuate pools for 30 minutes or more in the case of any fecal accident.
- Conduct infant and preschool classes in well-maintained chemically treated facilities only, not in untreated bodies of water such as rivers, lakes, or ponds.

**Aggravation of Existing Conditions**

Medical authorities have cited swimming and immersion in water, particularly contaminated water, as a principle factor in aggravating some existing medical conditions. The primary concerns in this regard have been dermatological conditions and ear infections (60).

There are few articles relative to the dermatological area that focus primarily on young children. However, several articles have cited outbreaks of follicular dermatitis or otitis externa caused by pseudomonas aeruginosa (29, 57); these outbreaks occurred in pools or whirlpools. Other articles cited outbreaks of swimmer’s ear or swimmer’s itch that were related to problems with water quality (51). Dermatological concerns, like concerns about communicable diseases, can be addressed with water quality control. There do not appear to be significant differences in susceptibility between young children and older swimmers.

One of the most persistent concerns relative to swimming and young children has been that of otitis media, especially in those children who received myringotomies and tympanostomy tubes. The frequency of this condition among young children is related to their tendency to have narrow Eustachian tubes that do not permit middle ear drainage when moderate inflammation of mucous membranes is present. Unfortunately, the tendency has been to associate swimming with ear infections even though the problem is primarily anatomical. Nevertheless, until recently the general inclination of most pediatricians has been to forbid swim-
ming by children suffering from middle ear infections or those who have had a myringotomy and subsequent implantation of ear tubes (or "grommets").

However, recent evidence demonstrates dramatically that the prohibition against swimming either with ear infections or ear tubes largely has been unnecessary (4, 5, 8, 13, 16, 61, 68). Originally, some of these studies suggested that anti-bacterial drops be used after swimming as a precaution (4, 16, 62). Several recent studies fail to demonstrate the need for even this precaution (5, 61). In fact, two studies actually found lower rates of reinfection among swimmers taking no precautions than among groups of swimmers using earplugs or among non-swimming controls (5, 13).

**Water Related Conditions**

The final medical category of concerns about infant and preschool swimming programs has focused specifically on hyponatremia, so-called water intoxication. Hyponatremia is a relatively rare condition related to inadequate renal response to either the ingestion of large amounts of water or the loss of significant amounts of electrolytes, especially sodium, or both simultaneously. Symptoms range from lethargy, irritability, to vomiting, and in extreme cases, convulsions. In the early 1980s several highly publicized case studies were published (6, 23, 31) of hyponatremia resulting from infant swim lessons; however, no permanent injury resulted. As a result, warnings were issued about the dangers of submerging children under the ages of 3 years (2, 10). In some cases the total banning of structured infant swim programs was advocated (2). Warnings in the media and in the medical literature have persisted (47).

Examination of the three case studies reveals several interesting commonalities: the victims were under 1 year of age and thus had a small body size, a large body volume-to-weight ratio, and perhaps an immature renal system; they had been in the water for a relatively long period of time (>30 minutes) and presumably were fatigued; and they all had endured repeated submersion. Elimination of any of these factors presumably would have prevented the condition (see Table 2).

### Table 2

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<thead>
<tr>
<th>Hyponatremia factors</th>
<th>Suggested means for prevention</th>
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<tr>
<td>Less than 12 mos of age</td>
<td>Restrict submersion for infants under 12 mos</td>
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<tr>
<td>Weight under 10 kg</td>
<td>Restrict submersion for infants under 10 kg</td>
</tr>
<tr>
<td>Prolonged exposure in water</td>
<td>Limit in-water session to 30 min or less</td>
</tr>
<tr>
<td>Cold, fatigue</td>
<td>Teach in water temperatures above 82 °F (28 °C)</td>
</tr>
<tr>
<td>Repeated submersion</td>
<td>Maintain air temperature 3 °F above water temperature</td>
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<tr>
<td></td>
<td>Limit submersions in young children to 6 or less per session</td>
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Interestingly, perusal of recent literature failed to reveal further reported cases of hyponatremia (53). Several explanations may exist for this: (a) The condition is indeed rare and has not been diagnosed any more; (b) the medical literature no longer will publish case studies of hyponatremia since it is no longer novel; (c) aquatic professionals as a group have heeded the CNCA guidelines and have restricted the number of submersions of infants; or (d) a combination of the above. Regardless of the explanation, further research and information is needed. For example, aquatic and medical professionals alike need to know how much ingested fluid puts infants or children of different sizes at risk to hyponatremia. Aquatic professionals also should know the factors that may produce the condition, specifically the length of lessons and number of submersions.

Benefits

The above mentioned concerns primarily have focused, from a medical perspective, on possible detrimental effects or risks to infants and preschoolers from swimming. Several recent studies have cited potential medical and health benefits to young children that may result from swimming and aquatic exercise. For instance, young children may have altered levels of adipose tissue as a result of early aquatic training (1). Contrary to the concerns over swimming with ear infections, Desterbeck et al. (13) reported that children who swam actually had improved nasal patency, indicating better middle ear ventilation. It was predicted that this improved ventilation might decrease the incidence of otitis and sinusitis. Finally, Szentagothai et al. (63) indicated that children with chronic bronchial asthma decreased the severity and incidence of attacks when they engaged in physical exercises including swimming. Other correlated behaviors such as absenteeism, hospitalization, and need for medication all decreased over the 2 years of the study.

Obviously there is a need to continue medical research exploring both risks and benefits of aquatic activities to young children (33, 34, 35, 36, 39, 52). It appears that potentially beneficial effects in particular need to be emphasized.

Developmental Issues

There are a number of potential developmental issues and controversies in early childhood aquatics. Only three major ones will be reviewed here: the minimum age question, the generalized influence of aquatics on child development, and the early experience effect on psychomotor and aquatic skill development. Several related issues are discussed under the subsequent pedagogy section.

Minimum Age for Aquatic Experiences

One intriguing aspect of early childhood aquatics to the general public and aquatic professionals alike has been the fascination with young children’s ability to swim. McGraw (44) first reported the swimming reflex in newborn children as well as other mammals. She described how this primitive behavior shifted over time, and with practice became a voluntary skill (44). Subsequent swimming manuals often have touted the young child’s ability to master aquatic skills that often frustrate adults themselves (45, 46, 56).

Nevertheless, medical and aquatic organizations have warned about the dangers of young children learning to swim, especially in “organized group programs of instruction” (2, 9, 14). In particular, on the basis of recommenda-
tions by the American Academy of Pediatrics, the CNCA recommended that “the minimum age for organized swimming instruction be set at age three [years] . . . because certain considerations affecting the child’s learning and safety require a degree of development not attained by most children before they are three years old” (14, p. 59). Apparently the greatest concern at the time was that parents would “develop a false sense of security if they know that their young infant can swim a few strokes” (p. 58). “It is imperative that parents be made to realize that even though pre-schoolers may learn to swim, no young child, particularly the pre-schooler, can ever be considered ‘water safe’ and must be carefully supervised when in or around water” (p. 59). A similar warning about “water safe” recently has been issued by Langendorfer (33, 34).

This stand against early introduction to structured classes stood until the mid-1980s when several developmentalists took issue with the arbitrary nature of the 3-year-age restriction (20, 42). Age is a convenient but poor marker for developmental change, even in infancy (58). It was apparent that concerns for child safety and drowning were inappropriately influencing developmental statements about when and how a child could learn to swim. In addition, the statements and warnings did not appear to stem the popularity of organized infant aquatic programs. In fact, rebuttal of the age warning may have had the effect of rejecting other warnings that had stronger bases in fact (33).

Consequently, the CNCA stand on under-3 aquatic programs shifted to permit programs to be conducted under a set of 10 general guidelines (10). Partly in response to this shift in attitude, major aquatic organizations developed their nationally standardized programs of instruction for infants over the age of 6 months (3, 7, 70). A major benefit of these programs is their ability to educate parents on a large standardized scale about the need for careful supervision of young children. Each program has built a significant parent orientation and education component along with the in-water skills for the children.

**Generalized Influence on Child Development**

One of the most popular claims by proponents of early childhood aquatic programs has been that many aspects of development (cognitive, social, emotional, and psychomotor) are enhanced by participation in the water (45, 46, 56). According to Langendorfer (33, 34), these claims belong in the category of myths because there is little if any evidence to support them beyond wishful thinking on the part of aquatic professionals and parents.

In fact, evidence that early swimming experiences influence overall child development has come mainly from German (15) and Soviet (1) researchers. A small pilot study by Langendorfer (32) did not indicate any significant effects on infants’ motor development. Diem’s longitudinal evidence is intriguing, but as yet is uncorroborated in North America. She claims that the youngest infants (2 months at first experience) showed greater independence and intelligence than older toddlers (2 years at first experience) or nonswimming controls (15). Several Soviet studies have been reported in the literature but are generally not available in English. Whether they demonstrate the same positive results as Diem must await translations.

Studies such as Diem’s (15) are critical for assessing the effects of early childhood aquatics on child development. If there is an early critical period during which aquatic (or other movement) experiences positively influence a child’s...
overall development, the effects must be described and investigated with carefully designed and controlled empirical studies. Conversely, if there are no definite benefits to early aquatic experiences, aquatic professionals and parents must reevaluate their rationale for promoting early swim lessons.

**Early Experience in Swimming Skill**

Another claim frequently made about early childhood aquatic programs has been that young children learn swimming skills faster, better, and more easily than older children and adults (46, 56). This is an area ripe for investigation but one that surprisingly so far has failed to produce any significant studies. However, several related areas have been investigated and can be reviewed here.

Several studies demonstrated that infants and young children showed remarkable in-water kicking skills that differed from those of adults (50, 67). The kicking behaviors varied from crooked-legged reflexive movements to rapid “running” or “bicycling” actions traditionally associated with terrestrial locomotion. How these movements may change during later swimming has not yet been reported. Older preschoolers do begin demonstrating skills associated with aquatic kicking behaviors such as the flutter kick (18, 19, 41).

Several studies have demonstrated that young children acquire swimming skills in regular, ordered sequences that are not altered by teaching techniques or experience (17, 18, 19, 36, 37, 39, 41). These studies suggest that aquatic skills are acquired in much the same developmental fashion as fundamental motor skills such as hopping, jumping, or throwing (58). In a subsequent study, Erbaugh (19) discovered that children with early experience in fact were advanced in their swimming skills compared to nonswimming controls. However, body size and mass was a better predictor of swimming performance than were age, gender, or experience (20). Whether comparatively earlier experiences alter the developmental sequences or the rate of progress has not yet been demonstrated.

Whether there are critical periods that enhance optimal learning or that can influence other aspects of child development has received practically no research attention. Comprehensive studies in this area are needed in order to understand the potential benefits or risks. At present too little is known to make informed judgments (35, 52).

**Pedagogical Issues**

Most of the emphasis by aquatic professionals in early childhood aquatic programs has been on curricular and pedagogical areas (3, 33, 36, 38, 39, 45, 46, 56, 70). It is an area that has produced a great deal of discussion, heated debate, and controversy, but practically no research. There is a dearth of either short-term or long-range information about which teaching philosophies and instructional techniques produce the best results, which ones may be best suited for which age groups, and whether certain techniques should be avoided.

**Conditioning and Drownproofing Versus Water Adjustment**

The most acrimonious debate has occurred between advocates of instrumental or operant conditioning and those of water adjustment or play techniques (33, 34). The conditioning philosophy of learning suggests that the most efficient and
A economical way for young children to learn to swim is through operant conditioning techniques (sometimes called behavior modification). Usually these techniques go hand in hand with the so-called “drownproofing” philosophy, which suggests that the best way to reduce drowning rates in young children is to make the child water safe. Water safe implies that the young child has a built-in minimum set of skills to stay afloat or get out of the water if accidentally submerged.

All the main national agencies including the American Academy of Pediatrics, American Red Cross, Council for National Cooperation in Aquatics, and the YMCA have published statements disproving both conditioning and drownproofing (2, 3, 7, 9, 10, 70). As mentioned earlier, it is felt that terms such as water safe and drownproof give parents a false sense of security about their child’s safety in the water (14). The national programs all favor the water adjustment and play techniques promoted by child development experts (36, 39, 58).

Influences of Other Factors and Techniques

Only one study could be found that actually and empirically tested differences in swim teaching techniques for preschoolers (59). Its results were inconclusive. Another interesting study investigated whether parents of either sex used different techniques in interacting in the water with their preschoolers (21), and found that fathers reacted differently than mothers did. Several other pedagogical studies are currently in progress (26, 30). Perhaps in a few years comparative statements about competing pedagogical techniques can be offered. Until then, instructors must continue to use common sense and rely on pragmatic observations of what seems to work best.

One pedagogical hypothesis suggested by developmental sequence studies (17, 18, 39, 41) has been that the most rapid progress in learning should occur when the observed natural order of development matches the teaching order of skill progressions. So far, no studies have been organized to specifically test this hypothesis. However, the developmental sequence studies did note that the developmental sequences deviated from typical teaching progressions in several important ways. For instance, researchers in both types of studies observed that children seemed to prefer doing rudimentary swimming strokes before submerging their heads and floating or gliding. In addition, most children chose to dog-paddle prior to attempting formal stroking such as the crawl. Further research is needed to test whether naturalistic developmental changes can be paired effectively with teaching techniques.

Summary and Conclusions

Infant and preschool swimming has become a popular activity in western society. The research literature offers a series of medical concerns about exposing infants and young children to the water. Several of the concerns, especially the need for constant supervision by parents, are important considerations for aquatic professionals and parents. However, none of these concerns appears to offer strong evidence that should bar young children from the water within the limits of common sense. On the other hand, developmental and pedagogical studies as yet have been unable to demonstrate the need to introduce young children to the water at an early age. Some researchers feel strongly that important benefits may be gained, but these hunches await further research demonstration.
The major conclusion of this review should be obvious. There is a desperate need for more research in the area of early childhood aquatics. Research studies focusing on both benefits and risks in the medical, developmental, and pedagogical areas are all needed. With the exception of several researchers investigating child drownings or aquatic developmental sequences, most of our knowledge of early childhood aquatics has arisen typically from single, isolated studies. In order to promote a scientific knowledge base, we need interdisciplinary teams of researchers to conduct continuing lines of inquiry about young children in the water. Only such efforts will advance our knowledge of the benefits and risks of early aquatic experiences for young children.

References


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