NON-SWIMMER EDUCATION AND AQUATIC COMPETENCE: A SYSTEMATIC REVIEW AND BIBLIOMETRIC ANALYSIS

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Systematic review
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Abstract:

Non-swimmer education represents an important public health and pedagogical issue, as the lack of aquatic competence significantly increases the risk of drowning, particularly among children. Despite the growing number of studies on water safety and swimming education, comprehensive analyses of research trends and methodological approaches remain limited. The aim of this study was to analyze scientific trends in non-swimmer education, identify key pedagogical and psychological determinants, and examine research patterns through bibliometric analysis. A systematic review was conducted in accordance with the PRISMA 2020 guidelines, including 36 original studies retrieved from four databases (Web of Science, Scopus, SPORTDiscus, and PubMed). Additionally, a bibliometric analysis was performed on the 36 publications using Excel and VOSviewer. The results indicate that structured swimming programs significantly improve aquatic skills, safety, and motor competence. Psychological factors, particularly fear of water and anxiety, were identified as key determinants of learning success. Play-based and individualized teaching approaches showed higher effectiveness compared to traditional methods. The use of swimming aids demonstrated both facilitating and limiting effects, depending on their application. Bibliometric findings suggest that non-swimmer education and aquatic safety remain prolific research field, characterized by the predominance of English-language publications, geographical concentration of research output, and a relatively small collaboration network. In conclusion, non-swimmer education is a multidimensional process requiring an integrated pedagogical approach. Future research should focus on longitudinal designs, standardized assessment tools, and improved global collaboration to enhance the effectiveness and accessibility of aquatic education programs.

Keywords: *non-swimmer education, aquatic competence, water safety, swimming education, bibliometric analysis*

Introduction

Non-swimmer education represents an important public health and pedagogical issue, as inadequate aquatic competence increases the risk of drowning, one of the leading causes of mortality among children and adolescents. Beyond its preventive role, swimming contributes to physical and mental health, social inclusion, and overall quality of life (Farrar & Nickerson, 2019). Swimming skills are no longer viewed solely as the ability to perform swimming techniques, but rather as part of the broader concept of aquatic competence, which encompasses motor, cognitive, and affective components (Langendorfer, 2015; Stallman, Junge, & Blixt, 2008; Stallman, Moran, Quan, & Langendorfer, 2017). This perspective highlights the importance of integrated educational programs that promote not only swimming technical proficiency, but also water safety behaviors, self-confidence, and risk assessment in aquatic environments. Although research on water safety and swimming education has expanded considerably, important gaps remain in the systematic understanding of scientific trends, predominant research themes, and patterns of international collaboration. Bibliometric studies focusing on non-swimmer education are still limited, making it difficult to identify the development of the field and existing research gaps. In addition, socioeconomic and cultural factors substantially influence the accessibility and effectiveness of non-swimmer education programs. Previous studies have shown that drowning rates are higher in low- and middle-income countries and among socially vulnerable populations (Bartlett, 2002; WHO, 2014). Consequently, non-swimmer education should be considered not only a public health issue, but also a matter of social equity and educational policy. Addressing this complex issue therefore requires an interdisciplinary approach integrating knowledge from kinesiology, pedagogy, psychology, and public

health. Accordingly, the aims of this study were to analyze scientific trends in non-swimmer education and water safety, identify key research themes and research gaps, examine the characteristics of scientific production through bibliometric analysis, and propose recommendations for improving educational programs and professional practice in the field of aquatic competence.

Methods

Study design

This systematic review aimed to provide a comprehensive synthesis of original research studies focusing on non-swimmer education. In addition to the systematic review, a complementary bibliometric analysis was conducted to provide a broader overview of scientific production in the field. The review was conducted in accordance with the PRISMA 2020 guidelines (Page, et al., 2021) and employed a structured multi-phase methodology that included database searching, duplicate removal, title and abstract screening, full-text eligibility assessment, and data extraction. Four major databases were selected for the literature search: Web of Science Core Collection (WoS CC; Clarivate), Scopus (Elsevier), EBSCO SPORTDiscus with Full Text, and PubMed (National Library of Medicine). The primary search conducted on April 16, 2025, resulted in a total of 503 records. The following search string was used: ("non swimmer" OR "water anxiety" OR "learning to swim" OR "swim aid" OR "swimming education" OR "aquatic education") AND ("education" OR "teaching" OR "instruction" OR "learning" OR "tutoring"). Due to differences in database structures, the following search fields were applied: WoS CC – All fields; Scopus – Title, abstract, keywords; EBSCO SPORTDiscus – All fields; and PubMed – All fields. The inclusion criteria comprised original scientific articles, conference proceedings and early access publications. No filters were applied regarding open access, language, or publication date. The exclusion criteria included studies on animals, studies focused on swimmers, studies addressing swimming as a form of exercise or training, technical reports and review articles, studies comparing swimmers and non-swimmers, philosophical and psychological studies and studies using the term "learning to swim" in contexts unrelated to swimming. Data were analyzed using Microsoft Excel and VOSviewer (version 1.6.18) to examine publication trends, document types, language distribution, geographical distribution patterns, author productivity, collaboration networks, and keyword co-occurrence.

Study selection process

After duplicate removal and screening of 503 abstracts and titles from four databases, 42 studies were assessed for eligibility. Following the full-text evaluation, six studies were excluded—five due to their theoretical-practical nature and one due to irrelevance to the research topic. In total, 36 studies met the inclusion criteria and were included in the final review (Figure 1). The selection process was

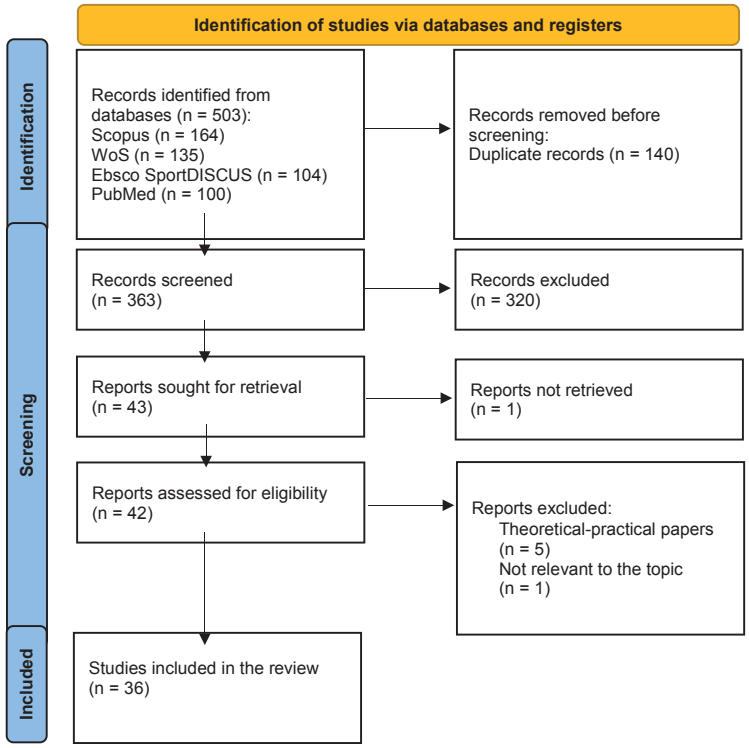

Figure 1. Identification of studies via databases (adapted from The PRISMA 2020 Statement).

Table 1. Studies included in the review

Authors (year)	Country, language	Participants (age, sex)	Participants age	Methodology	Statistics	Time duration	Results
Anderson & Rodriguez (2014)	USA, English	272 children (138 boys, 134 girls) at swimming school in Northern California	3-8 years	30-min lessons and assessment of proficiency	Two-way ANOVA with *post-hoc* tests (Tukey, Welch, Games-Howell) used to compare age groups on proficiency outcomes.	months	Children who begin formal swimming lessons between the ages of 5 and 7 acquire swimming proficiency more efficiently than those who start earlier (younger children may develop inefficient habits such as incorrect breathing patterns).
Asher et al. (1995)	USA, English	109 children (54% male, 46% female) from middle income Seattle area childcare centers	24-42 months	randomized design with repeated measures at four times; swimming and water safety instruction lessons (out-of-water safety behavior ('deck behavior'); swimming ability; and in-water safety skills)	Repeated measures ANOVA were used to assess the effects of water safety training on swimming ability, water recovery, and jump-and-swim skills over time.	12 or 8 weeks	Swimming and water safety training effectively improves in-water safety skills among preschool-aged children but does not influence out-of-water safety behavior. Therefore, constant adult supervision and physical barriers remain crucial. The findings support incorporating such training into broader drowning prevention strategies, provided further studies confirm its effectiveness.
Badruzaman et al. (2022)	Indonesia, English	60 students at Indonesia University of Education General Course of Physical education, men 44 and women 16 who could not swim 25 m	19–22 years	Three types of instruments, namely questionnaires, behavioral observations, and tests: measuring the level of anxiety in water using the Sport Competition Anxiety Test Modification (SCAT-M) instrument, anxiety behavior observation (ABO) and performance test (PT) as predictors	The descriptive analysis included the average, standard deviation (SD), and range; the inferential analysis of validity with internal validity for each instrument with a total score was based on the bivariate Person correlation.	1 week	SCAT-M, ABO, and performance tests show strong validity and reliability for assessing water-related anxiety, with high anxiety linked to poorer swimming performance and low anxiety predicting greater aquatic skill. SCAT-M, in particular, offers a practical tool for identifying anxiety in beginners, helping instructors customize instruction and anticipate swimming ability prior to in-water assessment.
Bitang et al. (2021)	Romania, English	16 (12 boys, 4 girls)	5-7 years	A three-month intervention involved structured swimming instruction that focused on mastering basic technical elements and the crawl stroke.	Descriptive statistics (arithmetic mean, amplitude, standard deviation, and coefficient of variability) were used to track progress and homogeneity across three testing points—initial (September 1), intermediate (October 1), and final testing (December 1).	3 months	The results confirmed that systematically applied training methods significantly improved children's swimming technique and led to greater performance consistency, highlighting the effectiveness of technical instruction during early learning stages.
Bovi et al. (2008)	Italy/Spain, Spanish	426 children (216 male, 210 female)	3-8 years	Experimental study comparing traditional (systemic) vs. playful (ludic) swimming teaching methods; randomized groups based on age; 25 swimming sessions per child	Two-way ANOVA (method × age) with significance testing ($p < 0.05$); effect sizes calculated (partial eta squared)	4 months, 25 sessions of 50 minutes	The playful method was significantly more effective than the traditional method in swimming skill acquisition across all ages, with stronger motivation and reduced learning time.
Button et al. (2020)	New Zealand/ Canada, English	98 (54 male, 44 female)	7-11 years	Free water safety program provided over a school summer holiday period in three test phases consisting of 6 tasks.	Non-parametric statistics were used, including Friedman's test for repeated measures across three time points and Wilcoxon signed-rank tests with Bonferroni correction ($p < .017$) for post hoc comparisons.	3 months	The study reveals generally low but varied water safety competencies among young New Zealand children and provides evidence that open water–based education programs can significantly enhance and sustain these skills. Instruction in real-world aquatic environments is shown to be an effective method for building essential water safety competencies in early childhood.

Continuation of Table 1

Authors (year)	Country, language	Participants (age, sex)	Participants age	Methodology	Statistics	Time duration	Results
Calverley et al. (2021)	Australia/ USA, English	105 children in primary schools in Victoria, Australia (59% male, and 41% female of Under 9s; 56% male, 44% female of Under 12s)	8-9 (Under 9s), 11-12 (Under 12s)	The Bush Nippers program was evaluated through surveys, observations, and interviews with parents, instructors, and community members to assess participants' water safety knowledge and skills.	Statistical analysis included descriptive statistics for demographic and competency data, and paired samples t-tests to assess changes in knowledge scores between pre- and post-tests, supported by normality testing; qualitative survey responses were analyzed thematically using Braun and Clarke's deductive approach.	5 consecutive days or weekly over a 10-week school term	The Bush Nippers program demonstrated a positive impact on children's water safety knowledge and was well received by parents, instructors, and communities, supporting its broader implementation. Its alignment with best practice, suitability for inland and regional settings, and cost-effectiveness highlight its feasibility, though further research is needed to assess long-term outcomes.
Morgado et al. (2023)	Belgium/ Portugal/ Finland/UK/ Australia, English	120 children (55,8% girls, 44,2% boys) from three voluntary participating schools of the French speaking part of Belgium	5-8 years	The PSPWC tool with 17 illustrated aquatic skill scenarios with three progressive levels was used. Initial face validity testing with 50 Belgian children led to adaptations of several illustrations to improve clarity and age-appropriateness, resulting in a revised version used in subsequent research.	Statistical analyses were conducted using Excel and TIBCO Statistica (v13.2), employing non-parametric tests including Spearman's rank correlation, Kruskal–Wallis, and Mann–Whitney U tests ($p < 0.05$). Face validity was interpreted using predefined percentage thresholds, while content validity was assessed via the Content Validity Index (CVI), with a cut-off score of 0.77 based on expert consensus.	one time	The study confirmed that the PSPWC tool has acceptable face and content validity for assessing perceived water competence in children aged 5 to 8 years. Minor adjustments improved clarity, and expert feedback supported its cross-cultural applicability, with one skill deemed optional; further validation is recommended in low- and middle-income countries and varied educational contexts.
Grigoniene & Skyriene (2006)	Lithuania, Russian	126 students (57 girls and 69 boys) from primary and secondary schools in Kaunas	9-11 years	10-lesson intensive swimming program combining dryland exercises, aquatic skill acquisition, and play-based learning to evaluate the development of swimming abilities.	The statistical processing of results included the calculation of group means ($x\bar{}$), standard deviation (δ), and the student's t-test to assess the reliability of differences between groups.	2 weeks: 10 lessons, held five times a week, with each session lasting 1.5 hours	This study concluded that the majority successfully mastered preparatory water skills, with girls acquiring swimming abilities more rapidly than boys; by the end of the program, 90.2% of boys and 77.3% of girls were able to swim 25 meters, highlighting the program's effectiveness and the need for continued research within the "I Am Learning to Swim" initiative.
Hopkins & Fleming (1981)	Australia, English	50 children (27 boys, 23 girls)	9,2-10,6 years	Sears (1964) Self-Concept Inventory before and after a 10-day swimming program; 25-item swimming ability skills checklist, with a control group for comparison.	A repeated measures t-test compared pre- and post-treatment self-esteem scores across four groups, revealing significant increases only among children who learned to swim during the program.	10 days	The findings suggest that success in learning to swim significantly enhances self-esteem, supporting the view that achievement experiences positively influence children's self-concept.

Continuation of Table 1

Authors (year)	Country, language	Participants (age, sex)	Participants age	Methodology	Statistics	Time duration	Results
Jidovtseff et al. (2024)	Belgium/ Portugal/ Finland/UK/ Australia, English	124 children (56% girls, 44% boys) from three public Belgian schools—one urban school (moderate to high-income) and two rural schools (middle-income)	5-8 years	Mixed-method design using the PSPWC to assess perceived water competence in children, including a test-retest reliability subsample and an actual aquatic skill assessment (AAST) to examine the relationship between perceived and actual competence.	Descriptive statistics (means ± SD, frequencies), weighted kappa for item-level agreement, Wilcoxon paired tests for non-parametric comparisons, Pearson correlations for score relationships, and ICC and CV for test-retest reliability; significance set at $p < .05$.	one time	PSPWC demonstrated good test-retest reliability and moderate correlation with actual aquatic skills; children generally estimated their competence accurately, with slight overestimation in specific skills, supporting the tool's relevance for aquatic education and drowning prevention.
Leite et al. (2007)	Brazil, English	181 (80 male, 101 female) students	not specified - students at Physical Education Faculty/ UNICAMP	Pedagogical swimming program based on synthetic teaching using playful, general-to-specific movement-based exercises (verbal, visual, and tactile instruction).	Pedagogical swimming program based on synthetic teaching using playful, general-to-specific movement-based exercises, combining verbal, visual, and tactile instruction, including filming for feedback.	classes held 2–3 times/ week for 60 minutes over 16 weeks	Program emphasizing water adaptation and playful methods improved confidence and motor skill acquisition in beginners, promoted enjoyment, and showed high acceptance, supporting its effectiveness for swimming initiation and physical literacy.
Mekkaoui et al. (2025)	France/ Germany/ Belgium/ Hungary/ Norway/ Poland/ Portugal, English	219 experts from 8 European countries	6-12 years	A three-round Delphi method using online questionnaires was employed to evaluate aquatic curricula aimed at promoting safe and sustainable participation of children in aquatic activities.	Thematic analysis was applied to qualitative comments across rounds, while cumulative frequencies of 'relevant' and 'very relevant' responses were converted to consensus percentages. A 55% agreement threshold was used to determine criterion retention.	one time	The study established expert consensus on eight key categories for evaluating aquatic curricula, resulting in the ACAT framework, which supports policy development by linking physical activity promotion and drowning prevention in children aged 6–12.
Misimi et al. (2023b)	Kosovo/ Slovenia/ Croatia, English	40 children (20 boys, 20 girls) of elementary schools in Slovenia	10-11 years	A 4-week learn-to-swim intervention with 5 sessions/week (45 minutes each), comparing the effect of using goggles and snorkels (GS) versus no aids (NGS) in non-swimmers, with aquatic skills assessed pre- and post-intervention by trained experts via video analysis.	Kruskal–Wallis tests, Friedman and Wilcoxon signed-rank tests for within-group changes, and ANOVA for between-group comparisons of pre–post delta scores; Levene's and Welch's tests used for variance assumptions; significance set at $p < .05$.	5 sessions in one week	Use of goggles and snorkels did not improve most aquatic skills in non-swimmers without fear of water; significantly lower progress in learning to blow bubbles suggests these aids are not suitable for teaching breathing skills in early swim instruction.
Misimi, Kajtna & Kapus (2023a)	Kosovo/ Slovenia, Slovenian	40 children (20 girls and 20 boys) from Slovenia	10-11 years	Experimental learn-to-swim program, comparing two groups of children with high fear of water—one using swimming goggles and a snorkel, and one without (11 standardized tests to assess water adaptation and swimming skills pre- and post-intervention)	Data was analyzed using descriptive statistics and comparison of pre- and post-intervention test scores; specific statistical tests were not detailed in the provided text.	4-week intervention: 5 sessions per week (45 minutes each)	The use of goggles and snorkel helped reduce fear of water and supported learning of body position and buoyancy, boosting motivation and confidence; however, their use was not appropriate for teaching breathing skills and may hinder development of independent aquatic competence if overused.

Continuation of Table 1

Authors (year)	Country, language	Participants (age, sex)	Participants age	Methodology	Statistics	Time duration	Results
Misimi et al. (2022)	Kosovo/ Slovenia, English	40 children (20 boys, 20 girls) from elementary schools in Kosovo	10-11 years	Experimental study comparing two learn-to-swim interventions for children with fear of water, using a between-groups design (goggles/snorkel vs. no equipment), with pre- and post-intervention assessments of aquatic skills based on validated observation protocols and video analysis.	Kruskal–Wallis tests for baseline differences, Friedman and Wilcoxon signed-rank tests for within-group time effects, one-way ANOVA for group comparisons of change scores (Δ), with Levene's and Welch adjustments as needed; significance set at $p < .05$; analyses conducted in SPSS v20.	five 45-minute learning sessions per week for four weeks	The use of goggles and snorkel facilitated improved comfort with water entry, facial immersion, and body position in children with fear of water, though it was less effective for learning underwater expiration; findings suggest targeted benefits for using these aids in early swim instruction except for breathing skill acquisition.
Moravec & Kapus (2017)	Slovenia, English	39 children from Pedenjped kindergarten in Zalog (Ljubljana)	6.0 ± 0.5 years	Quasi-experimental study with preschool children undergoing an learn-to-swim program in a deep-water pool, comparing experimental and control groups—with and without the use of mask and snorkel—using seven progressively difficult aquatic skill tests and structured observation.	Chi-square tests for nominal variables (e.g., head submersion, underwater viewing, exhalation); means, standard deviations, and Kolmogorov–Smirnov tests for interval data; paired and independent-samples t-tests and ANCOVA used to assess intra- and inter-group differences.	8 swimming sessions, each lasting 120 minutes, totaling 16 hours of instruction	The use of a mask and snorkel supported horizontal body position and facilitated initial swimming movements, but their removal disrupted progression in tasks such as underwater viewing and exhalation; findings suggest that such aids may delay essential water adaptation stages and require more extended instruction for effective integration.
Ondrušová & Koláriková (2016)	Slovakia, English	1160 respondents (494 boys and 666 girls) from the Faculty of Chemical and Food Technology, Slovak Univerzity of Technology in Bratislava.	first-year university students; exact age range not reported	Swimming ability was assessed using a 100-meter freestyle test in a 25-meter indoor pool.	Descriptive statistics were used to analyze minimum, maximum, mean, and median swim times by sex and year. Comparison with national standards was conducted.	one year (2 semesters)	Swimming ability among students improved over time, with a significant decrease in non-swimmers. Average swim performance remained stable over the decades and was comparable to national standards.
Ostrowski et al. (2022)	Poland/ Ukraine, English	271 children (137 girls and 134 boys) from elementary schools in Krakow	10-year-old	A longitudinal study was conducted using structured swimming instruction and direct observation-based tests to assess swimming skills, fear of water, and physical characteristics.	Descriptive statistics, Spearman's rank correlation, Pearson's chi-square test, t-test, and Mann–Whitney U-test were used to analyze swimming achievement in relation to somatic, functional, and coordination variables.	once a week for 45 min from September to June	Children with better coordination abilities, higher body height, and lower fear of water achieved higher swimming proficiency; fear of water, particularly among girls, was a major limiting factor.
Parker & Blanksby (1997)	Australia, English	264 children (140 boys, 124 girls) enrolled in a private swimming school in Perth, Western Australia	2-7 years	Retrospective analysis of swimming school records, evaluating duration, age, number of lessons, and skill acquisition (Levels 1 and 2) in children, grouped by starting age.	General Linear Model (Start Age × Gender), ANOVA, effect size calculation, and significance level set at $p < .05$ were used to assess differences in age at skill achievement, number of lessons, and instruction duration.	1 to 15 months depending on age group and skill level	Children starting at age 4 showed the most efficient progression through basic aquatic skills; very early starters (age 2–3) required significantly more lessons and time to achieve the same competencies.

Continuation of Table 1

Authors (year)	Country, language	Participants (age, sex)	Participants age	Methodology	Statistics	Time duration	Results
Parker et al. (1999)	Australia/ Singapore, English	19 children (11 boys, 8 girls) (10 in buoyancy aide group, 9 in self-support group)	6-7 years	Quasi-experimental study comparing swimming skill acquisition in two matched groups of children taught with either multiple buoyancy aides or minimal aide (kickboard only).	Repeated measures ANOVA (Group × Lesson), three-way ANOVA (Group × Task × Lesson), and post hoc contrasts were used to assess skill progression.	0 daily 40-minute swimming lessons over a two-week period	Both groups showed significant improvement in leg and arm actions by Lessons 3 and 5 respectively; however, the use of multiple buoyancy aides did not result in superior unsupported swimming performance compared to kickboard-only instruction.
Pečaver et al. (2014)	Slovenia, English	90 participants: 71 swimming instructors, 16 teachers, and 3 coaches (57.8% women and 42.2% men)	-	Cross-sectional survey study using a 15-item questionnaire on the use of swimming aids, completed by professionals during a national licensing seminar.	Data were analyzed using SPSS 19.0; reliability was assessed via Cronbach's alpha (0.72–0.816), and inferential statistics included Mann–Whitney and chi-square tests (α = 0.05).	one time	Systematic national approaches significantly improved swimming proficiency in Slovenia; however, didactic motor games and flotation devices remain underutilized in teaching practice despite their pedagogical value.
Petrass et al. (2021)	Australia, English	179 students (n = 68 regional, n = 111 metropolitan) schools in Victoria, Australia	11 years	Mixed methods; swimming and water safety program; pre/post self-report surveys; semi-structured interviews with principals/ teachers/managers; focus groups with swim instructors and classroom teachers.	Wilcoxon signed-rank test (pre-post differences); Mann–Whitney U test (between-group comparisons); Kruskal–Wallis H test (multiple groups); Spearman's correlation (skill associations); thematic analysis for qualitative data.	10 one-hour sessions across one school term; interviews ~40 mins; focus groups ~30 mins	Significant improvement in aquatic knowledge and skills; positive stakeholder feedback; student-centered pedagogy effective; iterative refinements made; increased school engagement and learning readiness noted.
Pilgaard et al. (2020)	Sweden, English	3,468 children from Malmö public schools: pre-intervention cohort (1695 - 50% male, 50% female), post-intervention cohort (1773 - 50,8% male, 49,2% female)	8-9 years	Quasi-experimental, community-level intervention; compulsory 3-week swimming program in grade 2; data from health exams in grade 4 and questionnaires (children and parents); socioeconomic and demographic variables included	Logistic regression (univariate and multivariable) assessing odds of self-reported ability to swim 200 m; stratified by cohort; adjustment for sociodemographic variables	Intervention 3 weeks (15 × 45-min sessions); follow-up data collected 2 years later	Increased swimming ability post-intervention, but persistent inequalities by socioeconomic background; swimming ability lower in children from disadvantaged schools and families; intervention uptake high, but effect limited by absence of early (preschool) water comfort program.
Pratt et al. (2024)	UK, English	107 children (52 boys, 55 girls) from five primary schools in central England	7.8 ± 0.63 years	Cluster-randomized controlled trial: aquatic motor competence intervention vs. control (standard PE). Assessments: TGMD-3 (dryland motor competence), AMP (aquatic competence), anthropometrics, and questionnaires on fear of drowning	Mixed-model ANOVA (group × time); repeated measures ANOVA and ANCOVA with Greenhouse–Geisser correction; Shapiro–Wilk, Levene's test; Pearson correlations; paired-sample t-tests for post-hoc analyses	6-week intervention; pre/post testing within 8-week school term; 1 session/ week aquatic intervention replacing 1 PE class	Significant improvements in both aquatic and general motor competence in both groups; greater gains observed in intervention group; strong association between aquatic exposure and motor skill development; fear of water negatively associated with competence
Rastovski et al. (2023)	Croatia/ Serbia, English	77 children (35 boys and 42 girls) from elementary schools	11.0±0.71	Pre-post intervention study using the standard Croatian method (Grčić-Zubčević, 1996); swimming lessons; swimming knowledge and anxiety levels measured at baseline and post-intervention	Descriptive statistics (mean, SD, range, median); variable normalization; correlation analysis (Pearson) between anxiety subscales (cognitive, somatic, self-confidence) and swimming learning outcomes; significance at $p < 0.05$ (SPSS v19).	10 weeks (20 sessions × 45 min; 2 sessions/ week).	Significant negative correlations found between anxiety levels and swimming learning outcomes; higher anxiety (in all three subscales) associated with lower swimming test scores and reduced progress.

Continuation of Table 1

Authors (year)	Country, language	Participants (age, sex)	Participants age	Methodology	Statistics	Time duration	Results
Ryan et al. (2011)	USA, English	543 children, sex not specified, primarily from low-income, minority households across six U.S. metropolitan areas	ages 4–17	Cross-sectional survey study using parent/ caregiver reports on perceived child swimming ability and awareness of aquatic barriers, conducted through YMCA programs.	One-way ANOVA with Tukey's HSD post hoc; Levene's test for homogeneity; significance at $p < .05$; partial eta squared for effect size; descriptive statistics (SPSS v15).	One-time data collection via surveys (duration of data collection period not reported).	Greater parent/caregiver awareness of local swimming facilities was significantly associated with higher perceived child swimming ability, highlighting knowledge as a key factor in promoting swimming competence and safety among underserved populations.
Scott (1954)	USA, English	154 college women non-swimmers	-	Experimental instructional study using a standardized progression of swimming lessons aimed at teaching basic water safety and swimming skills; learning assessed via a 15-minute endurance swim test and instructor ratings.	Descriptive statistics; correlational analysis (Pearson's r) between motor ability, early performance, and final outcomes; $r = .60$ between first-lesson success and final rating; $r = –.46$ between early success and number of lessons to pass.	Up to 8 weeks (typically 11 lessons; range 5–17 lessons); 30 min per lesson, 2–4 times per week depending on group.	Majority of participants passed the swimming test within 15 lessons; early performance strongly predicted final competence and learning rate; no significant difference between small and regular class outcomes when instruction was well organized; individual learning rates varied widely.
Sheyko (2015)	Ukraine, Russian	37 adults with no or minimal swimming ability and varying levels of aquaphobia	22–45 years	Quasi-experimental design; two groups (control and experimental); experimental group used individualized and group-based floating aids.	Expert evaluation (10-point scale); comparison of means using Student's t-test; significance at $p < 0.01$ or $p < 0.001$.	12 weeks, 36 swimming lessons (3×/ week, 45 min each)	59% of the experimental group mastered four swimming styles vs. 18% in the control group; significantly better technique and distances in experimental group; use of support tools helped reduce fear and improve outcomes
Sundan et al. (2025)	Norway, English	2,421 (1,187 girls and 1,234 boys) from 69 public primary schools	9–10 years old	A cross-sectional survey design was used, and swimming competence was assessed using the standardized Swimming Competence Assessment Scale (SCAS).	Data was analyzed using chi-square tests, Cramér's V for effect size, and multiple imputations to address missing data.	6 weeks to 9 months	Overall, 62.5% of students met the national swimming competence standard, with front and back swimming and floating identified as key skills.
Torlaković (2009)	BIH, English	88 (55 girls (62.5%) and 33 boys (37.5%) elementary school pupils from two schools in BIH	9.3 years old on average (±7 months)	A 12-hour intensive swimming program was implemented, with assessments based on water adaptation skills and categorization from non-swimmer to swimmer.	Data were analyzed using descriptive statistics (frequencies and percentages) and paired-sample t-tests for initial, transitional, and final comparisons.	12 consecutive working days	Participants showed significant improvement in swimming skills, with measurable progression in swimming distance and ability classifications across all levels.
Torlaković & Kebat (2015)	BIH, English	20 adult female volunteers enrolled in a swimming training program for non-swimmers	26 to 59 years of age	A two-point, pre-post intervention design was applied, measuring swimming-related variables before and after participation in the program. The swimming training was individualized, conducted in a pool with a slight incline and water at 29.3°C.	A paired sample t-test was used to analyze changes between initial and final testing, with significance set at $p < .05$; Eta-squared was used to estimate effect size.	approximately 4 weeks (5 days per week) delivered in 20 sessions (1 session/day, 60 minutes each)	Participants showed statistically significant improvements in swimming knowledge, skill performance, and comfort in water, successfully overcoming initial fear. The program proved effective for adult female non-swimmers in overcoming fear and acquiring basic swimming skills, supporting the need for structured adult swim education.

Continuation of Table 1

Authors (year)	Country, language	Participants (age, sex)	Participants age	Methodology	Statistics	Time duration	Results
Usra (2018)	Indonesia, English	42 university students from Sriwijaya University (sex not specified)	exact age not specified	Classroom action research design conducted across three learning cycles, using rope-assisted swimming instruction in a pool setting. A rope-supported swimming instruction model was applied progressively: cycle 1 focused on floating, cycle 2 on freestyle with a rope, and cycle 3 on freestyle without aid.	The study did not use inferential statistical testing; evaluation was based on qualitative reflection and observed behavioral improvement across cycles.	single 100-minute session, with sessions held weekly on June 6, 13, and 20, 2016	With continued rope-assisted instruction, most students improved floating ability and began executing freestyle movements while remaining engaged and motivated. By the third cycle, most students were able to perform freestyle swimming without rope assistance, with high levels of active participation and enjoyment reported. The rope-assisted swimming model led to a visible progression in student ability and confidence, culminating in independent swimming among former non-swimmers.
Vogt & Staub (2020)	Germany/ Japan, English	22 children non-swimmers volunteers (12 boys and 10 girls)	6.95 ± 1.03	A test battery of 19 sequential aquatic tasks for assessing five levels of basic aquatic competence. Performances were video recorded from standardized perspectives and later evaluated by 809 swimming teaching peers via an online survey.	Interrater reliability was assessed using Krippendorff's alpha (Kα), suitable for large samples with missing data and ordinal-level assessments.	12 weeks	The assessment tool was found to be feasible and reliable for identifying stages of aquatic competence and supporting early in-water skill development. The tool enables practical evaluation of basic aquatic skills in children, supporting the development of water competency and aquatic literacy within sports education.
Vranešić-Hadžimehmedović et al. (2012)	BIH, English	35 girls enrolled in a school swimming program	6 to 9	The study implemented a structured experimental program to teach breaststroke, freestyle, and backstroke using nine performance variables, with instructions tailored to age through individualized grouping, parental involvement, and age-appropriate teaching methods.	Paired-samples t-tests were used to assess pre- and post-intervention differences in swimming performance variables.	three months: 36 swimming sessions (3×/ week, 90 minutes each)	Significant improvements were observed in all measured swimming technique variables, indicating successful transformation from non-swimmers to swimmers. The program proved effective in teaching basic swimming skills to young girls, highlighting the importance of structured, diverse, and professionally guided training.
Willcox-Pidgeon et al. (2025)	Australia/ South Africa, English	4914 adults (44.2% female, 27.9% male, 27.9% gender unknown)	15-84 years (mean = 38)	Retrospective cross-sectional study (2018-2021). Data collected from 10 swim schools across Australia. Assessment against national benchmarks (5 m and 50 m swim).	Descriptive statistics and Chi-square analysis using IBM SPSS Statistics V27.	10 weeks (average of 9 lessons; ~4.5 hours total). Lessons are mostly 30-60 min weekly. Time in lessons varied from 1 week to 12+ months.	The study concludes that while adults of all ages in Australia are participating in swimming lessons, most do not stay long enough to achieve essential swimming and water safety benchmarks, highlighting the need for targeted, accessible, and sustained programs to effectively reduce drowning risk.

conducted independently by two researchers, and any discrepancies were resolved through discussion and consensus. Inter-rater reliability across the screening stages was assessed using Cohen's kappa coefficient ($\kappa = 0.91$), indicating almost perfect agreement. From the included studies, the following data were extracted: authors and year of publication, country and language of publication, sample characteristics (the number and sex of participants), participants' age, research methodology, statistical analysis used, duration of intervention, and key findings.

Studies published in languages other than English were translated into English to ensure consistency in screening and data extraction. Due to heterogeneity in study design, participants, interventions, and outcomes, a narrative synthesis approach was applied. The analyzed studies included diverse populations, comprising preschool and school-aged children, adolescents, and adult non-swimmers, with considerable heterogeneity in methodological approaches, intervention duration, and instruments.

Results

Effects of swimming education programs

The reviewed literature indicates that non-swimmer education programs have a positive effect on the development of swimming skills and aquatic competence (Asher, Rivara, Felix, Vance, & Dunne, 1995; Bitang, Macarie, Dulceanu, & Bitang, 2021; Button, Button, Jackson, Cotter, & Maraj, 2020; Pratt, Duncan, & Oxford, 2024; Torlaković, 2009). Intervention studies consistently demonstrated improvements in basic aquatic skills, including floating, breathing, and coordination (Asher, et al., 1995; Torlaković, 2009), as well as increased levels of water safety (Button, et al., 2020; Calverley, et al., 2021; Petrass, Simpson, Blitvich, Birch, & Matthews, 2021). Additionally, improvements in motor abilities were observed across several studies (Pratt, et al., 2024; Rastovski, Zoretić, Šiljeg, & Jorgić, 2023). Intervention duration varied considerably, ranging from several weeks to several months of varying volumes (Parker & Blanksby, 1997; Pilgaard, et al., 2020; Willcox-Pidgeon, Leggat, Devine, & Franklin, 2025).

Psychological factors in learning to swim

Psychological factors were identified as important components in the process of learning to swim, with fear of water, anxiety levels, and self-confidence being the most frequently examined variables (Badruzaman, et al., 2022; Ostrowski, et al., 2022; Rastovski, et al., 2023). The findings consistently indicate a negative association between anxiety and swimming performance (Badruzaman, et al., 2022; Rastovski, et al., 2023) as well as changes in fear levels following educational interventions (Sheyko, 2015; Torlaković & Kebat, 2015). In addition, improvements in self-confidence were observed following the acquisition of swimming skills (Hopkins & Fleming, 1981). Perceived aquatic competence was also examined in several studies (Jidovtseff, et al., 2024; Morgado, et al., 2023).

Pedagogical approaches

The analysis of pedagogical approaches shows that various teaching models were applied across studies, including both traditional and play-based methods (Bovi, Palomino Martín, & González Henríquez, 2008; Leite, dos Anjos, Gemente Galdi, & Gonçalves, 2007). Individualized teaching approaches were identified in several studies (Bitang, et al., 2021; Grigoniene & Skyriene, 2006), as well as the combination of different instructional methods within the same program (Leite, et al., 2007). Furthermore, the relationship between age and swimming learning outcomes was examined in multiple studies (Anderson & Rodriguez, 2014; Parker & Blanksby, 1997).

Use of swimming aids

Research findings on the use of swimming aids, such as goggles, snorkels, and flotation devices, indicate varying effects depending on the type and mode of application. The use of swimming aids during the early stages of learning was frequently reported (Misimi, Kajtna, & Kapus, 2022; Moravec & Kapus, 2017; Sheyko, 2015), while the other studies identified differences in the development of specific skills when aids were used (Kjendlie, 2009; Misimi, et al., 2022; Misimi, , Kajtna, & Kapus, 2023a). In addition, comparisons between learning with and without aids were reported (Parker, et al., 1999; van Duijn, et al., 2021).

To complement the systematic review findings, a bibliometric analysis was conducted to provide a broader overview of publication trends and research characteristics in the field of non-swimmer education and aquatic safety.

Bibliometric analysis

Despite the growing number of studies on drowning prevention and aquatic safety, bibliometric analyses focusing specifically on non-swimmer education remain limited. To address this gap, a bibliometric analysis was conducted on 36 publications related to non-swimmer education and aquatic safety.

Publication trends

The temporal distribution of publications revealed a relatively low and uneven research output across the observed period. A total of 36 publications were identified, with the highest number recorded in 2023 (n = 4). The years 2020, 2021, 2022, and 2025 each contributed three publications, while most other years were represented by one or two papers. Although publication activity appears to have become more frequent in recent years, the overall volume of research remains limited, indicating that non-swimmer education and aquatic safety is still a relatively underexplored field (Figure 2).

Document types and language

Figure 3 shows the distribution of publication languages. English was the predominant language of publication, accounting for 32 papers. Russian, Slovenian, and Spanish were represented by only a few publications. This pattern suggests that English serves as the primary language for disseminating research in the field of non-swimmer education and aquatic safety.

Publication sources

Publications were distributed across a range of publication sources. Perceptual and Motor Skills contributed the highest number of papers (n = 3), while eight sources each published two papers.

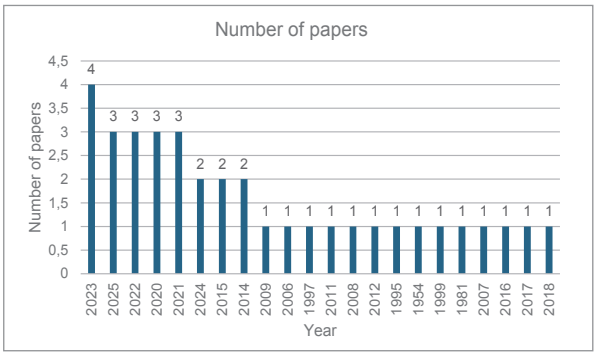

Figure 2. The number of publications (in descending order) over time.

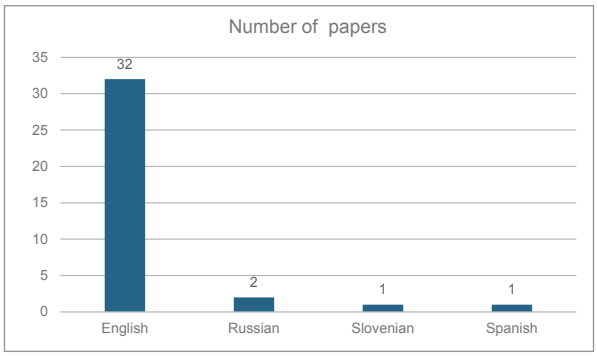

Figure 3. Language of the included papers.

Table 2. Most productive publication sources

Publication title	Number of papers
Perceptual and Motor Skills	3
Šport	2
Homosporticus	2
Children	2
Journal of Physical Education and Sport	2
European Physical Education Review	2
Physical Activity Review	2
Health Promotion Journal of Australia	2
International Journal of Aquatic Research and Education	2
Australian Journal of Sport Sciences	1
Research Quarterly of the American Association for Health, Physical Education and Recreation	1
Homo Sporticus	1
Human Movement	1
Slobozhanskyi Herald of Science and Sport	1
Apunts Educacion Fisica y Deportes	1
Australian Journal of Science and Medicine in Sport	1
The Sport Journal	1
Proceedings of the First Indonesian Communication Forum of Teacher Training and Education Faculty Leaders International Conference on Education 2017	1
Arena—Journal of Physical Activities	1
Scandinavian Journal of Public Health	1
Journal of Motor Learning and Development	1
Sport Mont	1
Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports	1
Pediatric Exercise Science	1
International Journal of Environmental Research and Public Health	1
Injury Prevention	1
Total	**36**

All remaining sources, including one conference proceeding book, were represented by a single publication, suggesting that research on non-swimmer education and aquatic safety is spread across diverse publication outlets rather than concentrated within a small number of specialized journals.

Geographical distribution of papers

Analysis of author affiliations revealed broad international participation in research on non-swimmer education and aquatic safety. Australia recorded the highest number of affiliation occurrences (n = 17), followed by Slovenia and Indo-

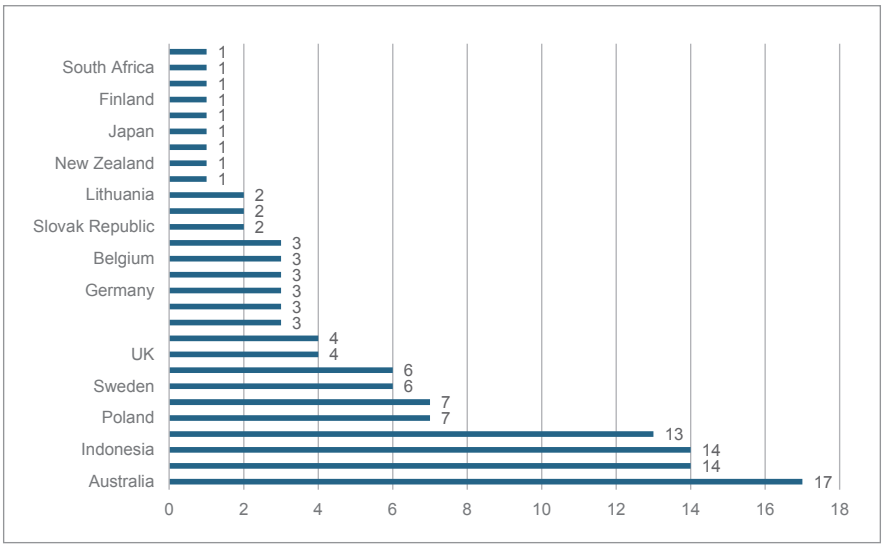

Figure 4. Geographical distribution of the papers.

nesia (n = 14 each) and the United States (n = 13). Additional contributions originated from Poland and Croatia (n = 7 each), Sweden and Bosnia and Herzegovina (n = 6 each), as well as a range of other countries with lower levels of representation (Figure 4). These findings indicate that research activity in this field is geographically diverse, although it is concentrated within a relatively small number of countries.

Author productivity and collaboration

A total of 104 unique authors contributed to the 36 publications included in the dataset. Author productivity was generally low, with most authors contributing to a single publication. Kapus was the most productive author, contributing to four papers, followed by Misimi and Kajtna with three publications each. Several authors, including Birch, Morgado, Sääkslahti, Howells, Barnett, D'Hondt, Costa, Jidovtseff, Staub, Vogt, Zoretić, Parker, Blanksby, and Torlaković, each contributed to two publications. These findings suggest that research on non-swimmer education and aquatic safety is characterized by a relatively dispersed authorship structure, with only a small number of recurring contributors.

The co-authorship analysis identified a small but interconnected collaboration network within the field. Four authors met the inclusion threshold and formed a single collaboration cluster (Figure 5). Jernej Kapus occupied the most central position in the network, maintaining collaborative links with all the other authors. Strong co-authorship relationships were observed among Kapus, Misimi, and Kajtna, reflecting their repeated joint contributions to research on swimming instruction and aquatic skill acquisition. The inclusion of Zoretić further extended the network through collaborative publications. The relatively small size of the co-authorship network is consistent with the findings of the

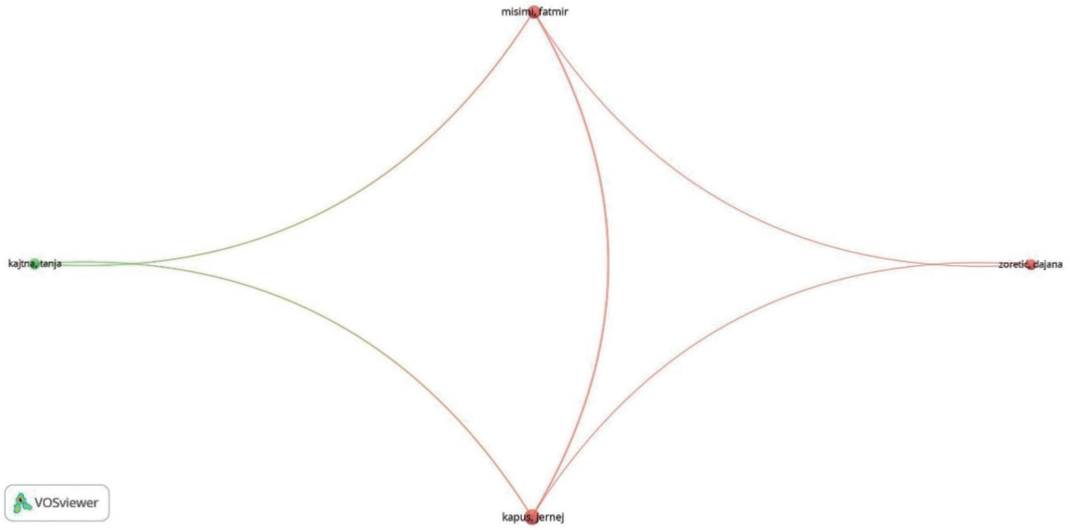

Figure 5. Co-authorship network.

Table 3. Author productivity

Author	No. of papers	Affiliation	H-index
Kapus, J.	4	University of Ljubljana Faculty of Sport, Slovenia	6
Misimi, F.	3	University of Ljubljana, Slovenia	/
Kajtna, T.	3	University of Ljubljana Faculty of Sport, Slovenia	9
Birch, R.	2	Life Saving Victoria University of Melbourne, Australia	4
Morgado, L. S.	2	University of Liege, Belgium	3
Sääkslahti, A.	2	University of Jyvaskyla, Finland	22
Howells, K.	2	Canterbury Christ Church University, United Kingdom	7
Barnett, L. M.	2	Deakin University, Victoria, Australia	53
D'Hondt, E.	2	Vrije Universiteit Brussel, Belgium	0
Costa, A. M.	2	Universidade da Beira Interior, Covilha, Portugal	20
Jidovtseff, B.	2	University of Liege, Belgium	14
Staub, I.	2	German Sport University Cologne, Germany	4
Vogt, T.	2	German Sport University Cologne, Germany	16
Zoretić, D.	2	University of Zagreb Faculty of Kinesiology, Croatia	4
Parker, H. E.	2	Department of Human Movement, University of Western Australia, Crawley, Australia	21
Blanksby, B. A.	2	University of Western Australia, Crawley, Australia	25
Torlaković, A.	2	University of Sarajevo, Bosnia and Herzegovina	/

author productivity and publication source analyses. Together, these results suggest that research on non-swimmer education and aquatic safety remains a relatively narrow and fragmented field, characterized by a limited number of recurring contributors and research groups. In particular, the Slovenian research group centered around Kapus appears to represent one of the few sustained and productive collaborative networks within the identified literature (Figure 5; Table 3).

Citation analysis

The citation analysis identified several influential publications within the field of non-swimmer education and aquatic safety. The study by Asher et al. (1995), which examined water safety training as a strategy for reducing childhood drowning risk, was the most cited publication in the dataset, receiving 81 citations in Scopus. Studies focusing on aquatic skill development, swimming instruction, and swimming competence also attracted notable attention, including Button et al. (2020), Parker et al. (1999), and Pilgaard et al. (2020). In contrast, many recent publications recorded relatively low citation counts, which is expected given their recent publication dates. These findings suggest that water safety, drowning prevention, and the development of aquatic competence represent the most influential themes within the literature identified in this review (Table 4).

Keyword co-occurrence

The keyword co-occurrence analysis revealed three interconnected thematic clusters within the literature (Figure 6). The largest cluster was centered on the keyword swimming, which occupied the most prominent position in the network and was strongly linked to terms such as learning, children, and water. This cluster reflects the educational and skill-acquisition focus of the field. The second cluster was associated with water safety and drowning prevention, connecting terms such as drowning, child, male, female, and human. These keywords indicate the importance of injury prevention and public health perspectives within the literature. The third cluster was related to physical education and swimming competence, linking keywords such as schoolchildren, swimmers, physical fitness, and physical training and conditioning. This theme highlights the role of swimming within educational and physical development contexts.

Overall, the network suggests that research on non-swimmer education and aquatic safety is structured around three complementary areas: swimming skill acquisition, drowning prevention and water safety, and the development of swimming competence through physical education and training. The central position of the keyword swimming demonstrates its role as the primary connecting concept across these thematic domains. The relatively small number of keywords and the

Table 4. Most cited papers

Reference	Citations in the Web of Science	Citations in the Scopus
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. https://doi.org/10.1136/ip.1.4.228	Not in the database	81
Button, C., Button, A.J., Jackson, A.-M., Cotter, J.D., & Maraj, B. (2020). Teaching foundational aquatic skills to children in open water environments. International Journal of Aquatic Research and Education, 13(1), 1. https://doi.org/10.25035/ijare.13.01.01	Not in the database	24
Calverley, H.L.M., Birch, R., Strugnell, G., Santiago, A.C., Baker, S., & Matthews, B.L. (2021). Bush Nippers: Evaluating the effectiveness of the Nipper education program in regional inland Victoria, Australia. Health Promotion Journal of Australia, 33(3), 852-860. https://doi.org/10.1002/hpja.566	8	7
Morgado, L.S., Martelaer, K., Sääkslahti, A., Howells, K., Barnett, L.M., D'Hondt, E., Costa, A.M., & Jidovtseff, B. (2023). Face and content validity of the Pictorial Scale of Perceived Water Competence in young children. Children (Basel, Switzerland), 10(1), 2. https://doi.org/10.3390/children10010002	7	8
Grigoniene J.J., & Skyriene V. (2006). Формирования Навыков Плавания У Детей В Рамках Проекта «Я Учусь Плавать. [Formation of swimming skills of children in project "I am learning to swim".] Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports, (12), 43-46.	6	Not in the database
Jidovtseff, B., Morgado, L.S., Sääkslahti, A., Howells, K., Barnett, L.M., D'Hondt, E., Costa, A.M., & De Martelaer, K. (2024). An evaluation of the reliability of the Pictorial Scale of Perceived Water Competence and its relationship with actual water competence. Perceptual and Motor Skills, 131(4), 1063-1079. https://doi.org/10.1177/00315125241248552	3	3
Mekkaoui, L., Potdevin, F., Derigny, T., Gandrieau, J., Staub, I., DeMartelaer, K., Kovács, Z., Olstad, B.H., Rejman, M., Soares, S., & Vogt, T. (2025). Towards a consensus on the development of the aquatic curricula analysis tool using an ecosystem approach: A Delphi Method. Physical Activity Review, 13(1), 141-155. https://doi.org/10.16926/par.2025.13.13	2	2
Misimi, F., Kajtna, T., & Kapus, J. (2022). The effect of using goggles and snorkel for aquatic skills acquisition in youth learn-to-swim programs. Perceptual and Motor Skills, 129(5), 1525-1545. https://doi.org/10.1177/00315125221112258	6	9
Misimi, F., Kajtna, T., Štirn, I., Zoretić, D., Misimi, S., & Kapus, J. (2023b). More on the use of goggles and snorkel in learning-to-swim: New results for children without fear of water. Perceptual and Motor Skills, 130(4), 1714-1731. https://doi.org/10.1177/00315125231171795	3	4
Ondrušová, L., & Koláriková, A. (2016). The level of swimming ability of students at FCHPT STU for the last 30 years. Physical Activity Review, 4, 178-183. http://dx.doi.org/10.16926/par.2016.04.22	2	Not in the database
Ostrowski, A., Stanula, A., Swinarew, A., Skaliy, A., Skalski, D., Wiesner, W., Ambroży, D., Kaganek, K., Rydzik, Ł., & Ambroży, T. (2022). Individual determinants as the causes of failure in learning to swim with the example of 10-year-old children. International Journal of Environmental Research and Public Health, 19(9), 5663. https://doi.org/10.3390/ijerph19095663	3	7
Parker, H.E., & Blanksby, B.A. (1997). Starting age and aquatic skill learning: Mastery of pre-requisite water confidence and basic aquatic locomotion skills. Australian Journal of Science and Medicine in Sport, 29(3), 83-87.	8	15
Pilgaard, F.I.H., Östergren, P.O., Olin, A., Kling, S., Albin, M., & Björk, J. (2020). Socioeconomic differences in swimming ability among children in Malmö, southern Sweden: Initial results from a community-level intervention. Scandinavian Journal of Public Health, 48(5), 495-501. https://doi.org/10.1177/1403494818821478	10	13
Pratt, N.A., Duncan, M.J., & Oxford, S.W. (2024). The effects of a 6-week swimming intervention on gross motor development in primary school children. Children, 11(1), 1. https://doi.org/10.3390/children11010001	7	9

Continuation of Table 4

Reference	Citations in the Web of Science	Citations in the Scopus
Rastovski, D., Zoretić, D., Šiljeg, K., & Jorgić, B. (2023). Correlation between anxiety and success in swimming training program for non-swimmers. Sport Mont, 21(2), 59-62. https://doi.org/10.26773/smj.230709	Not in the database	2
Scott, M.G. (1954). Learning rate of beginning swimmers. Research Quarterly of the American Association for Health, Physical Education and Recreation, 25(1), 91-99. https://doi.org/10.1080/10671188.1954.10624947	Not in the database	2
Sundan, J., Haga, M., & Lorås, H. (2025). Swimming competence of 9-10-year-old Norwegian primary school children: A cross-sectional study of physical education. European Physical Education Review, 31(1), 53-69. https://doi.org/10.1177/1356336X241246521	6	7
Vogt, T., & Staub, I. (2020). Assessment of basic aquatic skills in children: Inter-rater reliability of coaches, teachers, students and parents. Journal of Physical Education and Sport, 20(2), 577-583. https://doi.org/10.7752/jpes.2020.02085	0	10
Willcox-Pidgeon, S., Leggat, P.A., Devine, S., & Franklin, R.C. (2025). Measuring the swimming skills of adults attending swimming lessons in australia as a drowning prevention measure. Health Promotion Journal of Australia, 36(2), e70010. https://doi.org/10.1002/hpja.70010	3	3

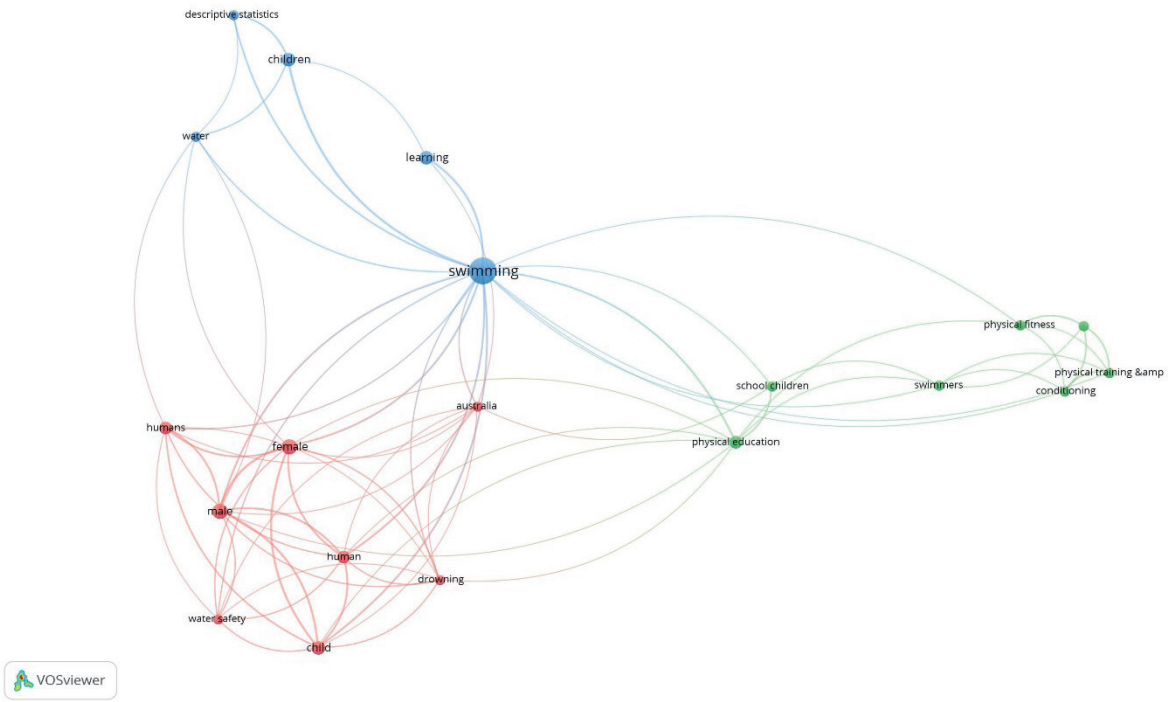

Figure 6. Keyword co-occurrence.

clear separation of thematic clusters further support the conclusion that this remains a specialized and emerging research field.

Discussion and conclusions

The present review demonstrates that non-swimmer education represents a complex and multi-dimensional process that extends beyond the acquisition of basic motor skills, encompassing psychological, social, and pedagogical components of aquatic competence. This perspective is consistent with the concept of aquatic competence, which emphasizes the integration of motor, cognitive, and affective factors to enable safe and functional movement in aquatic environments (Langendorfer, 2015; Moran & Gilmore, 2018; Stallman, et al., 2008).

The reviewed literature indicates that non-swimmer education programs have a positive effect on the development of swimming skills and water safety, as demonstrated by numerous

studies involving both children and adults (Asher, et al., 1995; Button, et al., 2020; Pratt, et al., 2024; Torlaković, 2009). As summarized in Table 1, the studies that reported participants' age and program duration provide additional evidence regarding the most appropriate period for learning to swim and the time required to develop safe swimming. The available findings do not indicate a single universal age for all children, but rather a developmental window in which formal instruction is more efficient. Early exposure to water before the age of four may support water familiarization, reduction of fear, and basic safety behaviors (Asher, et al., 1995). However, children who begin formal lessons at a very early age often require more time and a higher number of lessons to achieve comparable aquatic competences. Parker and Blanksby (1997) found that children starting at approximately four years of age progressed most efficiently through prerequisite water confidence and basic aquatic locomotion skills, whereas children who started at two to three years required more lessons and longer instruction. In line with this, Anderson and Rodriguez (2014) reported that children beginning formal swimming lessons between five and seven years of age acquired swimming proficiency more efficiently than younger beginners. Therefore, late preschool and early primary school age, approximately between four and seven years, may be considered the most favorable period for structured learn-to-swim programs, while earlier participation should primarily be interpreted as preparation for water comfort and safety rather than as a guarantee of independent swimming proficiency.

The aggregated data also show that the time required to achieve safe swimming varies considerably across studies because the included research used different age groups, intervention designs, assessment criteria, and definitions of swimming competence. Short intense programs, consisting of approximately 10 to 15 lessons or 10 to 15 instructional hours, were associated with measurable improvements in water adaptation, floating, breathing, aquatic knowledge, and basic swimming performance (Grigoniene & Skyriene, 2006; Petrass, et al., 2021; Pilgaard, et al., 2020; Torlaković, 2009). However, more stable and functional aquatic competence appears to require longer and continuous instruction. Studies with the interventions lasting six to twelve weeks or several months reported improvements in aquatic and motor competence, swimming technique, confidence, and safety-related skills (Asher, et al., 1995; Bitang, et al., 2021; Button, et al., 2020; Pratt, et al., 2024; Rastovski, et al., 2023; Vogt & Staub, 2020). These findings suggest that a minimum block of approximately 10 to 20 structured lessons may be sufficient to produce initial measurable progress, but safe swimming should be understood as a broader and longer-term outcome that includes not only the ability to swim a certain distance, such as 25, 50, or 200 meters, but also floating, breathing control, entry and exit skills, self-rescue, confidence, and water safety knowledge (Langendorfer, 2015; Stallman, et al., 2008, 2017). However, the effectiveness of these programs is not uniform and largely depends on individual characteristics of participants, particularly psychological factors. Fear of water and anxiety were identified as key limiting factors in learning to swim (Badruzaman, et al., 2022; Ostrowski, et al., 2022; Rastovski, et al., 2023). Higher levels of anxiety are consistently associated with lower performance in swimming skill acquisition, highlighting the importance of pedagogical approaches that include gradual water adaptation and emotional support (Sheyko, et al., 2015; Torlaković & Kebat, 2015). Furthermore, successful learning to swim has been associated with increased self-confidence, emphasizing the importance of the psychological dimension of aquatic education (Hopkins & Fleming, 1981).

Pedagogical approaches also play a critical role in the effectiveness of non-swimmer education. The findings suggest that play-based and participatory teaching methods appear to be more effective than traditional approaches, particularly among children (Bovi, et al., 2008; Leite, et al., 2007). Such approaches enhance engagement, motivation, and skill acquisition, while individualized programs allow for better adaptation to the specific needs of learners (Bitang, et al., 2021; Grigoniene & Skyriene, 2006).

The use of swimming aids requires particular attention. While aids may reduce fear and facilitate initial adaptation to water (Misimi, et al., 2022; Moravec & Kapus, 2017), excessive reliance on them may negatively affect the development of essential skills, particularly breathing and independent movement in water (Kjendlie, 2009; Kjendlie & Mendritzki, 2012; Misimi, et al., 2022, Misimi, et al., 2023b; van Duijn, et al., 2021). Therefore, their use should be considered as a temporary and controlled strategy in the early stages of learning. Taken together, these findings indicate that non-swimmer education should be conceptualized as a progressive pedagogical process rather than as a short-term technical intervention. The reviewed studies suggest that effective programs need to combine age-appropriate methodological progression, psychological support, play-based learning, individualized instruction, and objective assessment of aquatic competence. This is particularly important because fear of water and anxiety have been shown to negatively affect swimming performance and learning outcomes (Badruzaman, et al., 2022; Ostrowski, et al., 2022; Rastovski, et al., 2023), while play-based and individualized approaches can enhance motivation, engagement,

and skill acquisition (Bitang, et al., 2021; Bovi, et al., 2008; Grigoniene & Skyriene, 2006; Leite, et al., 2007). Therefore, future programs should move beyond the narrow evaluation of swimming distance or stroke performance and should include multidimensional assessment of aquatic competence, including motor, cognitive, and affective components (Jidovtseff, et al., 2024; Langendorfer, 2015; Stallman, et al., 2008, 2017). Additional evidence from the studies summarized in Table 1 further supports this broader interpretation. Community-based water safety programs have been shown to improve children's water safety knowledge and to be well accepted by parents, instructors, and local communities (Calverley, et al., 2021), while studies on perceived water competence emphasize the importance of valid and age-appropriate assessment tools for children (Morgado, et al., 2023). Earlier and more recent studies also indicate that learning outcomes are shaped by individual learning rates, curricular structure, didactic strategies, access to facilities, and learner support. Scott (1954) highlighted variability in the learning rate of beginning swimmers, whereas later studies emphasized the role of parental and caregiver awareness, didactic approaches, national or school-based swimming programs, and structured assessment frameworks in the development of aquatic competence (Mekkaoui, et al., 2025; Ondrušová & Koláriková, 2016; Pečaver, et al., 2014; Ryan, Irwin, Drayer, & Irwin, 2011; Sundan, Haga, & Lorås, 2025; Usra, 2018; Vranešić-Hadžimehmedović, Mahmutović, Bajramović, & Jelešković, 2012). In addition, studies comparing the use of buoyancy aids, goggles, snorkels, or other support tools suggest that such aids may facilitate selected aspects of early adaptation, confidence, and body position, but they should not replace the development of independent breathing, floating, and unsupported movement in water (Misimi, et al., 2023a, 2023b; Parker, et al., 1999;). However, the analysis also revealed several structural limitations within the research field. First, the predominance of English-language publications and contributions from high-income countries indicates an uneven global distribution of scientific output (Swelieh, 2018; Zane, Lawrence, Cosart, & Johnson, 2024). This concentration may limit the visibility of research from low- and middle-income countries, even though these regions are disproportionately affected by drowning (Bartlett, 2002; WHO, 2014). In addition, the analysis of co-authorship networks reveals a fragmented research community with limited international collaboration, which may hinder the development and practical application of scientific knowledge (Arhesa, Ma'mun, Lumba, Blegur, & Calunsag, 2025). Compared to more established scientific fields, non-swimmer education still exhibits characteristics of an emerging research area, particularly in terms of interdisciplinary integration. The findings of this study have important practical implications for the development of educational programs. Effective non-swimmer education should be based on an integrated approach that includes the development of motor skills, reduction of fear of water, implementation of play-based and individualized teaching methods, and controlled use of swimming aids. Furthermore, the results indicate the need for systematic and long-term programs that support the continuous development of aquatic competence, as short-term interventions often fail to produce lasting effects (Pilgaard, et al., 2020; Willcox-Pidgeon, et al., 2025). From an educational policy perspective, these findings support the implementation of standardized and accessible non-swimmer education programs within formal education systems, with particular emphasis on socially disadvantaged groups. Socioeconomic disparities in access to swimming programs represent a significant barrier to the development of aquatic competence and water safety (Pilgaard, et al., 2020; Stanley & Moran, 2017). Despite its contributions, this study has several limitations. The heterogeneity of the included studies, differences in methodological approaches, and variability in instruments limit direct comparability of findings.

In addition, the bibliometric analysis relied on indexed sources, which may have led to the underrepresentation of research from certain regions. In conclusion, non-swimmer education represents an important public health and pedagogical priority with significant benefits for safety, health, and psychosocial development. Despite the growing scientific interest in the field, important limitations remain, including unequal access to programs, limited international collaboration, and the lack of standardized assessment methods. Future research should prioritize longitudinal and multicentered studies, standardized measures of aquatic competence, and the inclusion of diverse populations and sociocultural contexts.

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