

図2 温泉を核とした健康づくりモデル

(文献26を作図：国民健康保険中央会の報告書に基づいて飯島裕一氏が作図)

規模自治体（総務省類型：町村I-1）における地域診断と医療費関連指標の検討を行った。医療費と介護費が、相互補完型やともに低値、あるいはともに高値である自治体があり、自治体レベルの保健・介護予防事業の評価には、少なくとも医療費と介護費をともに投入して検討しなければならないことを明らかにしている。

#### 4. 温泉の有効利用とレジャーへの展開に関する展望

各種のレジャーの中でも、前述のように日帰り温泉や宿泊を伴う温泉利用は多く、健康を意識してのレジャー活動と位置づけられる。日本ヘルスツーリズム振興機構<sup>29)</sup>は、その趣旨において「(前略) 経済産業省は、健康サービス創造研究会報告書において、健康サービスのあり方について具体的なモデルを提示しており、その一例をみると、地域資源を活用した健康プログラムとして地域資源を活用した観光を取り上げられるなど、地域活

性化、産業活性化の起爆剤としても“健康产业”が注目されつつあります。(中略) 科学的根拠に基づく健康増進を理念に、健康増進・維持・回復・疾病予防に寄与するヘルスツーリズム概念を確立し広報・啓発活動を行う。(後略)」と述べ、レジャーという観点から健康づくりを推進しようとしている。

阿岸<sup>30)</sup>は、ヘルスツーリズムの概念を肯定したうえで、温泉、森林、高原、山岳、海洋などに恵まれた健康保養地には、この概念に沿う形で地域特性を生かした多彩なプログラムの提供を推奨している。また、観光・旅行に際して、温泉に限らず、生気象学を基盤とした気候療法（転地療法）、森林浴が中心となる森林療法、あるいは海の自然療法（タラソテラピー）などを上手に組み合わせること（食事療法や運動療法も同様）の意義を指摘している。

一方、温泉活用を健康増進（基礎疾患の治療）として考えた場合に、現実的ではない（実際には

表5 温泉をめぐる各立場での基本姿勢

対象	基本姿勢
国	エビデンスに基づく情報提供・啓発*, 状況によっては法整備
自治体（温泉を保有する）	地域診断、施策作成、評価
企業（観光・レジャー）	過大や虚偽ではない広報
温泉の提供者	法律に基づく事務的・衛生的管理と適切な公示
国民（利用者）	正しい知識の獲得と、事実を理解したうえでの自由な利用
学術団体（学会等）	エビデンス構築のための研究の推進と公式見解の公示
研究者	研究の推進と有害事象も含めた透明性の高い報告

\*ただし、温泉をめぐる地域経済への現実的な影響は莫大であるため、温泉の効能については、慎重な変更・公示の仕方が求められる。

転地効果があるため)が、温泉だけの効果を求めるならば、運動器疾患の疼痛の軽減は確実であることから、頻繁に利用することが有効である。こうした基礎疾患を有する中高年者はとくに多いことから、一般論として国民の温泉の利用は合理的だと考えられる。

現実的には、温泉そのものだけではなく、ほとんどの場合が自宅から離れて自然豊かな地（山・森林・海・川・湖沼など）へ移動しての温泉利用であり、そのことによる複合的な効果が得られる可能性は高く、それはまさに総合的な生体（精神心理面、QOLを含む）への影響である。加えて運動・身体活動や良好な食事を含めるならば、一層の健康増進効果が得られるものと考えられる。

ところで、一般的に、温泉による治療効果（効く）となると、「ある疾患が温泉入浴によって治癒する、あるいは著効性がある」という誤解を招きやすい点に問題があった。具体的な一例は、各種温泉に掲げられている効能（適応症）の記載である。これまでのところ、温泉が特定の疾患の完全な治癒、あるいは根治的な治療方法として有効だとするエビデンスはない。

医療は、西洋医学が主であるが、代替・補完医療、最近では、統合医療の考え方方が出現し、温泉（療法）の意義が高まっている。温泉は、古来から先人たちの経験に基づく知見や温泉医学の古い研究の歴史と蓄積もあるが、実はまだまだ新規的

でもあり、再検証（エビデンス・グレーディングの高い研究デザインや質の高い研究手法）をすべき課題が多いと考えられる。

表5は、温泉をめぐる国、各組織・利用者などに求められる姿勢としての概念モデルである。国としては、近く温泉の効能に関する見直しをする段階であり、エビデンスに基づくことは大前提であるが、公表には注意を要する。しかし、具体例を挙げれば、「これまで、ある疾患に有効だと人気のあった温泉（泉質）が、効果がないと発表された。」場合には、当該温泉をビジネスにしている地域・個人や、地域振興の施策としている地方自治体や地区などにとっては死活問題になりうる社会的な問題を含んでいることは言及するまでもない。一方、観光業においては、利用者の誤解を招くような広告や情報提供に頼るのでなく、温泉の提供側として、法令を遵守し、保健所などの指導を守った管理と正しい情報開示（塩素使用の有無やろ過循環の実施など）が不可欠である。地方自治体は、まずは地域住民の特性を診断し、温泉を活用した保健・介護予防事業の効果などをきちんと評価し、さらなる施策づくりに役立てるべきである。利用者側となる国民においては、過大であったり、誤った情報に惑わされず、正しい知識を得たうえでの自由な消費行動が望まれる。学術団体（学会）は、エビデンスを積み上げることは当然であるが、それは有害事象などのネガティブ

な情報も明確にする必要がある。なお、日本温泉気候物理医学会は、日本法医学会と共同で入浴に伴う事故報告と予防をまとめた共同声明<sup>3)</sup>を出している。

## 5. 結論

健康づくりを中心としたレジャー、その中でも温泉の愛好者は増えてきている。温泉による運動器疾患の疼痛軽減効果が明らかである。中高年者に有病者が多いことを考慮すると、温泉だけでなく転地を伴う様々な複合的な要素を含めての健康増進の効果の実証が期待される。一方、温泉を利用する者は正しい知識を得たうえで、レジャーとしての温泉の自由な利用が望まれる。

## ●附記

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# A systematic review of nonrandomized controlled trials on the curative effects of aquatic exercise

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**Background:** The objectives of this review were to integrate the evidence of curative effects through aquatic exercise and assess the quality of studies based on a review of nonrandomized controlled trials (nRCTs).

**Methods:** Study design was a systematic review of nonrandomized controlled trials. Trials were eligible if they were nonrandomized clinical trials. Studies included one treatment group in which aquatic exercise was applied. We searched the following databases from 2000 up to July 20, 2009: MEDLINE via PubMed, CINAHL, and Ichushi-Web.

**Results:** Twenty-one trials met all inclusion criteria. Languages included were English (N = 9), Japanese (N = 11), and Korean (N = 1). Target diseases were knee and/or hip osteoarthritis, poliomyelitis, chronic kidney disease, discomforts of pregnancy, cardiovascular diseases, and rotator cuff tears. Many studies on nonspecific disease (healthy participants) were included. All studies reported significant effectiveness in at least one or more outcomes. However results of evaluations with the TREND and CLEAR-NPT checklists generally showed a remarkable lack of description in the studies. Furthermore, there was the problem of heterogeneity, and we were therefore not able to perform a meta-analysis.

**Conclusion:** Because there was insufficient evidence on aquatic exercise due to poor methodological and reporting quality and heterogeneity of nRCTs, we were unable to offer any conclusions about the effects of this intervention. However, we were able to identify problems with current nRCTs of aquatic exercise, and propose a strategy of strengthening study quality, stressing the importance of study feasibility as a future research agenda objective.

**Keywords:** aquatic exercise, systematic review, nonrandomized controlled trials

## Introduction

Over the years, aquatic exercise has been known as pool therapy, hydrotherapy, and sometimes in earlier literature, as balneotherapy.<sup>1</sup> Exercise in warm water, usually termed hydrotherapy or aquatic therapy, is a popular treatment with a pain relief effect for many patients with painful neurologic or musculoskeletal conditions.<sup>2</sup> The warmth and buoyancy of water may block nociception by acting on thermal receptors and mechanoreceptors, thus influencing spinal segmental mechanisms.<sup>3,4</sup> In addition, the warmth may enhance blood flow, which is thought to help in dissipating algogenic chemicals, and it may facilitate muscle relaxation. The hydrostatic effect may also relieve pain by reducing peripheral edema<sup>5</sup> and by dampening sympathetic nervous system activity.<sup>6</sup>

Recent reports have demonstrated the effectiveness of comprehensive health education, including lifestyle education and exercise in combination with spa bathing,

for male white-collar workers,<sup>7</sup> and middle-aged and elderly people.<sup>8,9</sup>

It is well known in research design that evidence grading is highest for a systematic review (SR) with meta-analysis of randomized controlled trials (RCTs). In “the recent review (summary)<sup>10</sup> of the SRs of RCTs”, it was reported that there were three SRs<sup>1,2,11</sup> that included meta-analyses of RCTs on aquatic exercise. Bartels et al<sup>1</sup> reported that aquatic exercise had some beneficial short-term effects for patients with hip and/or knee osteoarthritis. Hall et al<sup>2</sup> reported that aquatic exercise had a small post-treatment effect in relieving pain compared with no treatment for patients with neurologic and musculoskeletal diseases, but there were no differences in pain relieving effects between aquatic and land exercise. Pittler et al<sup>11</sup> suggested that spa exercise may be effective for treating patients with chronic low back pain. However, we did not find any SRs of RCTs in which physical (eg, cardiovascular fitness) or psychological (eg, depression) effects were the primary outcome measurements.

An RCT is initially very difficult to execute and contains etiological issues, while the design of a non-RCT (nRCT) is easy to implement compared with an RCT. Although many studies have reported the curative effects of locomotrium diseases through aquatic exercise, there have been no systematic reviews of the evidence based on nRCTs. The objective of this study was to integrate the evidence from nRCTs on the curative effects through aquatic exercise for various diseases, and to assess the quality of those trials.

## Methods

### Criteria for considering studies included in this study

Studies were eligible if they were nRCTs and included one treatment group in which curative aquatic exercise was applied. Any type of aquatic exercise for cure and not for sports (eg, swimming) was permitted. The use of medication, alternative therapies, or lifestyle changes was described, and had to have been comparable in the group studies. There was no restriction on language.

### Search methods for identification of studies

We searched the following databases from 2000 up to July 20, 2009: MEDLINE via PubMed, CINAHL, Web of Science, and Ichushi-Web (in Japanese). The International Committee of Medical Journal Editors (ICMJE) recommended uniform requirements for manuscripts submitted to biomedical

journals in 1993. We selected articles published on and after 2000 because it appeared that the ICMJE recommendation had been adopted by the relevant researchers and had strengthened the quality of reports.

All searches were performed by two specific searchers (hospital librarians) who were qualified in medical information handling, and who were sophisticated in clinical trial research.

### Search strategies

The search strategies contained the following elements and terms for all databases:

- I: Search “aquatic exercise” or “water exercise”
- II: Search “water gymnastic” or “water aerobics” or “pool exercise” or “pool therapy” or “aerobic aquatics” or aquatics
- III: Search “exercise therapy”[MeSH] and “water”[MeSH]
- IV: Search “water-based exercise”[All Fields] or “water-based training”[All Fields] or “aquatic therapy”[All Fields] or “aquatic physical therapy”[All Fields] or “water training”[All Fields] or “water-gymnastics”[All Fields]
- V: Search I or II or III or IV Limits: Publication Date from January 1, 2000 to 2009
- VI: Search I or II or III or IV Limits: Publication Date from January 1, 2000 to 2009, Randomized Controlled Trial
- VII: Search V not VI.

Only keywords about intervention were used for the searches. First, titles and abstracts of identified published articles were reviewed to determine the relevance of the articles. Next, references in relevant studies and identified nRCTs were screened.

2000 is the year the CONSORT Statement became available on the Internet. The CONSORT Statement was created in the mid-1990s for improving the quality of RCTs. Because of the impact of the Internet, the quality of RCTs has improved since 2000.

### Reference checking, hand-searching and others

We did not check the references of included studies, perform any hand-searching, or contact any institutions, societies, or specialists known to have expertise in aquatic exercise, or authors of included studies to identify any additional published or unpublished data.

### Selection of trials

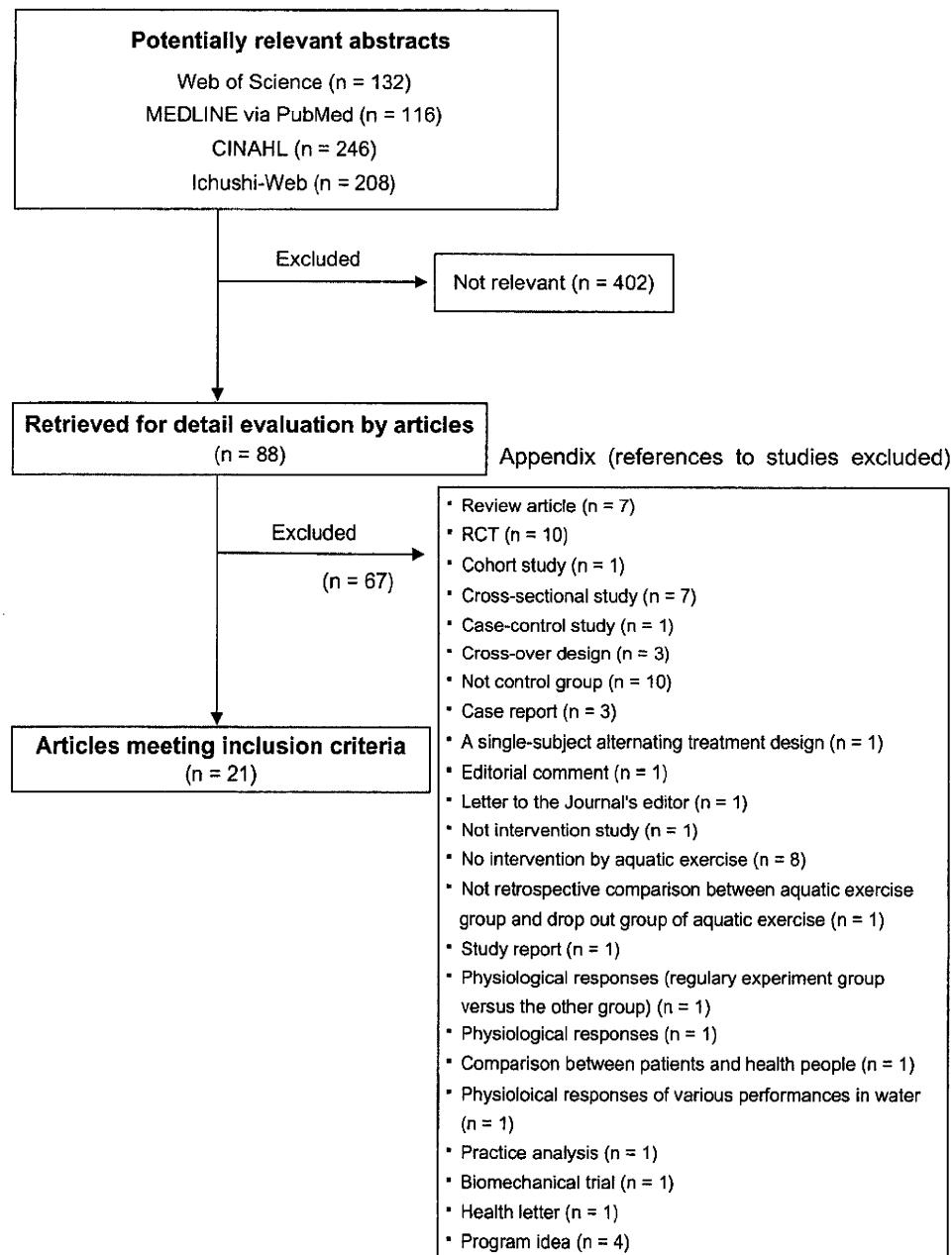
To make the final selection of studies for the review, all criteria were applied independently by two authors (JK and NS) to

the full text of articles that had passed the first eligibility screening (Figure 1). Disagreements and uncertainties were resolved by discussion between the review authors.

Studies were selected when 1) the design was an nRCT and 2) one of the interventions was a form of aquatic exercise. Curative effects were used as a primary outcome measure. Trials that were excluded are presented with reasons for exclusion (Appendix 1).

## Quality assessment and summary of studies

To ensure that variation was not caused by systematic errors in the study design or execution, two review authors (MK and HK) independently assessed the quality of articles. A full quality appraisal of these papers was made using the TREND statement checklist<sup>12</sup> and CLEAR-NPT checklist,<sup>13</sup> developed to assess the methodological quality of nRCTs



**Figure 1** Flowchart of trial process.

**Abbreviation:** RCT, randomized controlled trial.

and nonpharmacological trials, respectively. Disagreements and uncertainties were resolved by discussion between the review authors.

For meta-analysis preparation, the target objects and main outcomes in each study were examined. We found that there were various kinds of target diseases in the studies reviewed: healthy young students, middle-aged or elderly people, or people with a certain disease. In addition, the studies were heterogeneous, and the main outcomes varied. Moreover, the quality of most studies was low according to the checklist results, and such low-quality studies were excluded from the analysis based on the Cochrane Review.<sup>1</sup> We could not perform a meta-analysis since no variable was eligible.

One review author (HK) selected the summary from each of the structured abstracts.

### **Benefit, harm, and withdrawals**

The GRADE Working Group<sup>14</sup> reported that the balance between benefit and harm, quality of evidence, applicability, and the certainty of the baseline risk were all considered in judgments about the strength of recommendations. Adverse events, withdrawals, and the cost for intervention were especially important information for researchers and users of clinical practice guidelines, and we presented this information with the description of each article.

## **Results**

### **Study characteristics**

The literature searches included 402 potentially relevant articles (Figure 1). Abstracts from those articles were assessed and 88 papers were retrieved for further evaluation (checks for relevant literature). Sixty-seven publications were excluded because they did not meet the eligibility criteria (see Appendix 1). Twenty-one trials<sup>15–35</sup> met all inclusion criteria (Table 1). The languages of the eligible publications were English (N = 9), Japanese (N = 11), and Korean (N = 1). Target diseases were knee and/or hip osteoarthritis,<sup>19,24,28</sup> poliomyelitis,<sup>15</sup> chronic kidney disease,<sup>21</sup> discomforts of pregnancy,<sup>30</sup> cardiovascular diseases,<sup>33</sup> and rotator cuff tears.<sup>35</sup> Many studies<sup>16–18,20–23,25–27,29,31,32,34</sup> on nonspecific disease (healthy participants) were included (Table 2). All studies reported significant effectiveness in one or more outcomes. In particular, many studies reported that aquatic exercise had a significant effect on pain relief and outcome measurements for locomotor diseases.<sup>15,19,24,28,35</sup> These intervention periods ranged from 2 weeks to 12 months. These reflected the difficulty of maintaining long-term participation

in each intervention trial. Whatever the case, the long-term effects are not clear.

### **Withdrawals and adverse events**

Withdrawals (dropouts) were reported in five studies,<sup>24,28,29,32,34</sup> and adverse events were reported in four studies (Table 2). There were three studies<sup>15,19,35</sup> that reported ‘nothing’ on adverse events, and one study<sup>28</sup> reported a slipping accident on the poolside (details of the injury were unclear). Other studies did not provide information on withdrawals or adverse events.

### **Intervention costs**

A description of intervention costs was included in only one trial,<sup>30</sup> but the summary of that trial did not describe the costs (Table 2).

### **Quality assessment**

We evaluated 21 items from the TREND checklist in more detail (Table 3). This assessment evaluated the quality of how the main findings of the study were summarized in the written report. A lack of description was noteworthy for the studies in general. The items for which the description rate was less than 30% were as follows: “information on how units were allocated to interventions (23.8%)”; “how sample size was determined and, when applicable, explanation of any interim analyses and stopping rules (23.8%)”; “method used to assign units to study conditions, including details of any restriction (19.0%)”; “inclusion of aspects employed to help minimize potential bias induced due to non-randomization (4.8%)”; “whether or not participants, those administering the interventions, and those assessing the outcomes were blinded to study condition assignment; if so, statement regarding how the blinding was accomplished and how it was assessed (14.3%)”; “if the unit of analysis differs from the unit of assignment, the analytical method used to account for this (9.5%)”; “statistical methods used for additional analyses, such as subgroup analyses and adjusted analysis (9.5%)”; “methods for imputing missing data, if used (14.3%)”; “flow of participants through each stage of the study: enrollment, assignment, allocation and intervention exposure, follow-up, analysis (19.0%)”; “dates defining the periods of recruitment and follow-up (14.3%)”; “baseline comparisons of those lost to follow-up and those retained, overall and by study condition (9.5%)”; “comparison between study population at baseline and target population of interest (4.8%)”; “indication of whether the analysis strategy was ‘intention to treat’ or, if not, description of how noncompliers were treated in the

**Table I** Summary of articles based on structured abstracts

Article	Year	Title	Aim/objective	Setting/place	Participants	Detail and period of intervention	Main and secondary outcomes	Main results	Conclusion
Wilén et al <sup>15</sup>	2001	Dynamic water exercise in individuals with late poliomyelitis	To evaluate the specific effects of general dynamic water exercise on individuals with late effects of poliomyelitis	A university hospital department	Twenty-eight individuals with late effects of polio, 15 (7 men, 8 women) assigned to the TG and 13 (9 men, 6 women) to the CG. The mean age was 51 years (range, 22–65 years) for the TG and 49 years (range, 28–59 years) for the CG	A 40-minute general fitness training session in warm ( $33^{\circ}\text{C}$ ) water twice a week. The average training period was 5 months	Peak load, peak work load, peak oxygen uptake, peak HR, muscle function in knee extensors and flexors, and pain dimension of the NHP	The exercise did not influence the peak work load, peak oxygen uptake, or muscle function in knee extensors compared with the controls. However, a decreased HR at the same individual work load was seen, as well as significantly lower distress in the dimension pain of the NHP	A program of nonswimming dynamic exercises in heated water has a positive impact on individuals with late effects of polio, with a decreased HR at exercise, less pain, and a subjective positive experience. The program was well tolerated (no adverse effects were reported) and can be recommended for this group of individuals
Ebisu et al <sup>16</sup>	2001	Effectiveness of serum lipids on spa-walking	To examine the effect of spa walking on serum lipids	A spa pool	Spa walking group consisted of five healthy female students who did not have an exercise regime ( $21.3 \pm 0.7$ years). Nonwalking group consisted of five females who did not have an exercise regime ( $22.1 \pm 0.2$ years)	Walking in a spa pool three times a week (30 minutes at a time) for 10 weeks	Serum lipids (TC, HDL-C, LDL-C, triglycerides) and energy intake	In the exercise group, a significant increase of HDL-C was seen. A group comparison was not conducted	Spa walking can improve HDL-C value, though the detailed mechanism for HDL-C increase is unclear
Aoba et al <sup>17</sup>	2001	The effects of enforcement water exercise class on hypotensive elderly subjects	To examine the effect of 8 weeks of water exercise on blood pressure in 133 elderly subjects	A heated pool	One hundred elderly people (29 males and 71 females, aged $59.1 \pm 10.0$ years) who participated in the water exercise program and 30 elderly people (17 men and 13 women, aged $57.0 \pm 12.5$ years) who didn't have fitness regimes	The exercise group trained for 8 weeks with two 90-minute programs per week. Each program consisted of stretches and cool down on land, and walking, stretching, resistance training, and aerobic exercise in water	Blood pressure	In elderly subjects, significant improvements of SBP or DBP and blood pressure were shown among the subjects in the elderly group. However, obese subjects showed no significant change	The present study suggested that blood pressure value would improve with water exercise and recognition of health for elderly subjects who participated in the water exercise program

(Continued)

Table 1 (Continued)

Article	Year	Title	Aim/objective	Setting/place	Participants	Detail and period of intervention	Main and secondary outcomes	Main results	Conclusion
Yamada et al <sup>18</sup>	2002	Effects of water-based well-rounded exercise on vital age and physical fitness in older adults	To determine the effects of water-based exercise training on the VA of older adults	No description	Thirty-nine volunteers were randomly divided into an exercise group (8 males and 13 females aged 69 ± 4 years) and control group (5 males and 11 females aged 68 ± 4 years)	The exercise group participated in a 12-week water-based exercise program, 70 minutes/day, and 3 days/week; the control group continued their normal lives	VA based on age and various physical fitness tests	Significant lowering in VA was noted in the exercise group, and no significant changes were observed in the control group	Water-based exercise is an effective measure to lowering VA, thus improving the overall physical fitness in the elderly
Murai et al <sup>19</sup>	2002	Exercise therapy for osteoarthritis of the knee – preliminary study of water exercise	To compare the effects of aquatic exercise training and land exercise on patients with slight knee OA	No description	Aquatic exercise group consisted of 16 females aged 49.7 years on average. Land exercise group consisted of 6 females aged 53.5 years on average	Once per week for 10 weeks on average. Voluntary exercise was permitted. Aquatic exercise included walking in the water, balancing exercises and cool down. Land exercise included stretching, resistance training, balancing exercises, ergometer exercise and icing	Body fat, VAS, JOA knee score, and isometric knee extension force	There was no significant difference in weight and body fat. VAS, JOA score and COP sway were significantly decreased or improved by aquatic exercise. They improved by land exercise, although not significantly. Knee extension force was improved in both groups. Significance level was higher in aquatic exercise	Knee pain, JOA, muscle force and COP were significantly improved in the aquatic exercise group. Only muscle force was improved in land exercise group. Aquatic exercise was more effective than land exercise in patients with slight OA
Igarashi et al <sup>20</sup>	2002	Health effect of aquatic exercise therapy using a hot spring	To examine the health effect of aquatic exercise therapy with a hot spring for people who are not athletes	A city hot spring pool	The aquatic exercise group consisted of an aquatic exercise class for 13 females for 2 years (56–70 years).	Stretching and balance training was included. 45 minutes a week for 4 months	Physical characteristics (height, weight, body fat, blood pressure), muscle volume, VO <sub>2</sub> max, physical flexibility were examined at the beginning and end of the intervention.	In the exercise group, significant reduction of weight and minimum blood pressure were seen. A group comparison was not conducted	The intervention period (4 months) and frequency (once a week) might not be enough to improve health

Pechter et al. <sup>11</sup>	2003	<b>Beneficial effects of water-based exercise in patients with chronic kidney disease</b>	To ascertain whether water-based, 12-week regular, low-intensity aerobic exercise conditioning provides beneficial effects for individuals with moderate CRF and to compare the outcome with data from a sedentary control group	No description	Twenty-six patients with moderate CRF: an exercise group (7 male and 10 females aged 31–72 years) and a control group (6 men and 3 women aged 35–65 years)	The exercise group did low-intensity aerobic exercise in the pool over a period of 12 weeks, twice a week, with sessions lasting for 30 minutes; the control group remained sedentary	Cardiorespiratory parameters (VO <sub>2</sub> max and peak ventilation), renal functional parameters (serum creatinine, Cys-C, GFR, and U-prot), SBP and DBP, and oxidative stress indices (products of lipid peroxidation and reduced GSH)	Only in the exercise group, all cardiorespiratory functional parameters, SBP, and DBP were lowered significantly. U-prot and U-prot were diminished significantly and GFR was enhanced. LPO was reduced significantly, and GSH showed significant improvement	Regular water-based exercise has beneficial effects on the cardiorespiratory, renal functional parameters, and oxidative stress status in patients with moderate renal failure, and can be used in the complex rehabilitation of chronic renal failure patients, together with blood pressure control, dietary consultation, encouragement and education to prevent physical worsening and to postpone cardiovascular and renal atherosclerotic complications.
Douris et al. <sup>12</sup>	2003	<b>The effect of land and aquatic exercise on balance scores in older adults</b>	To determine if aquatic exercise was more effective than land-based exercise when training balance	Aquatic: Inground Custom Therapy Pool (Longmont, CO, USA). Land; assisted living recreation area	Subjects were healthy elderly aged 65 years and older who were independent walkers with or without an assistive device and independent in activities of daily living. Land group: 83.2 ± 8.14 (73–91) years (5 subjects). Aquatic group: 75.0 ± 3.63 (68–78) years (6 subjects)	Exercise was comparable for both land and water and was administered twice a week for 6 weeks. Walking activities (3 times each): 1) walking forward 11 feet, 2) marching forward without crossing legs 11 feet, and 4) tandem walking 11 feet. Exercise activities (one set of 15 repetitions): 1) marching in place, 2) hip flexion/extension, 3) hip abduction/adduction, 4) toe raises/heel raises, 5) shallow	BBS score	There was a significant main effect of time ( $P < 0.001$ ) but not group on BBS scores. There was no significant interaction between group and time	The utilization of lower body exercise, whether in water or on land, was accompanied by improved balance

(Continued)

Table 1 (Continued)

Article	Year	Title	Aim/objective	Setting/ place	Participants	Detail and period of intervention	Main and secondary outcomes	Main results	Conclusion
Liquori et al <sup>23</sup>	2003	Effects of a 6-week prenatal water exercise program on physiological parameters and wellbeing in women with pregnancies in the 2nd–3rd trimesters: a pilot study	To evaluate an established prenatal water aerobics program for its impact on the physiological function and wellbeing of females with low risk pregnancy in the 2nd and early 3rd trimesters	A pool in a rehabilitation center	Seven healthy females with uncomplicated singleton pregnancies participated in the exercise group (mean age 32.8 years). Six women having the same characteristics participated in the control group (mean age 30.5 years)	Participating in the 1-hour water aerobic exercise class using a shelf in aquatic group	Cooper 6-minute walk test, muscle force in the quadriceps, shoulder abductors, biceps, and triceps, and the health pronoting lifestyle profile II questionnaire	Post-test measures of strength in the quadriceps and biceps, as well as the subscale of physical activity within the HPIP II questionnaire were greater in the exercise group	This study outcome supported the effect of prenatal water aerobic exercise but further research with greater number of subjects is necessary to establish the most effective protocols
Lin et al <sup>24</sup>	2004	Community rehabilitation for older adults with osteoarthritis of the lower limb: a controlled clinical trial	To examine the effectiveness of a 12-month community-based water exercise program on measures of self-reported health and physical function in people aged over 60 years with knee-hip OA	Public community swimming pool in Sheffield, UK	One hundred and six community-dwelling sedentary older people (aged ≥60 years), with conformed knee-hip OA, enrolled in an experimental controlled trial for 12 months. Sixty-six subjects in the exercise group were offered a water-exercise program. Forty age-matched, nonexercising, 'control' subjects received monthly education material and quarterly telephone calls	Participants in the exercise group were asked to attend two exercise sessions a week of 1 hour for 12 months led by specially trained swimming instructors	The disease-specific Western Ontario, McMaster University Osteoarthritis Index (WOMAC), a battery of performance-based physical function tests	After 1 year, participants in the exercise group experienced a significant improvement in physical function ( $4.0 \pm 2.1$ versus $-0.4 \pm 7.3$ units; 95% CI 0.96–7.96, $P < 0.05$ ) and reduction in the perception of pain ( $1.3 \pm 3.7$ versus $0.2 \pm 2.5$ units; 95% CI $-0.19$ –2.52, $P < 0.05$ ) compared with the control group, as measured by the WOMAC Osteoarthritis Index. In addition, the exercise group performed significantly better in the ascending and descending stairs tests ( $P < 0.05$ ), had significantly greater improvements in knee range of movement ( $P < 0.01$ )	Older people with knee/hip OA gained modest improvements in measures of physical function, pain, general mobility, and flexibility after participating in 12 months of community-based water exercise

Akamine et al <sup>5</sup>	2005	Effects of underwater exercise with hot spring bathing on middle aged people	To investigate the effects of underwater exercise with hot spring bathing on middle aged people	No description	Three males and 22 females ( $59.6 \pm 8.9$ years) without serious systemic complication	Group A: (1-day intervention): underwater exercise (70 minutes) and hot spring bathing (20 minutes). Group B: (1-day intervention): underwater exercise (70 minutes) and fresh water bathing (20 minutes)	Blood pressure, total cholesterol, CD4, red blood cells, hematocrit, total protein, and POMS	Exercise with bathing significantly lowered values of DBP, TC, CD4, red blood cells, hematocrit, and total protein when compared with the before exercise with bathing group ( $P < 0.05$ ). After exercise with bathing, significantly lower levels of depression-dejection, anger-hostility and confusion in POMS test were observed when compared with control group	Underwater exercise with hot spring bathing has good effects on the health of middle aged people
Takumi et al <sup>6</sup>	2005	Participation in an aquatic exercise class twice a week for 12 weeks improved physical fitness for good walking, walking self-efficacy on winter roads, mental health and QOL	This study investigated whether the level of good walking, walking SE on winter roads, mental health and QOL improved through participation in an aquatic exercise class (twice a week, for 12 weeks) in elderly women	A pool with water temperature $34^{\circ}\text{C}$	The subjects were 15 females who took part in the aquatic exercise class and 16 females in the control group (over 60 years)	The duration of each class was 60 minutes (twice a week, for 12 weeks) and was conducted under the guidance of a skilled instructor	Good walking tests (standing on one leg with eyes open, Bosu balance score), walking SE, MHP, and QOL	Good walking tests of the final class were improved compared with the first class ( $P < 0.05$ ). Walking SE on winter roads did not change in either group, but the SE scores for general falling were significantly increased at the last class compared with the first class in the exercise group ( $P = 0.032$ ). The stress scores of MHP did not increase in the exercise group, which indicates that participating in the aquatic exercise class was not stressful. In QOL measures, the scores of physical symptoms ( $P < 0.001$ ) and	Participation in an aquatic exercise class is suggested to be effective for promoting good walking, QOL, and an active lifestyle

(Continued)

Table I (Continued)

Article	Year	Title	Aim/objective	Setting/place	Participants	Detail and period of intervention	Main and secondary outcomes	Main results	Conclusion
Takumi and Moriya <sup>27</sup>	2005	Participation in an aquatic exercise class for 12 weeks improved physical fitness for good walking, walking self-efficacy on winter roads, mental health and QOL in elderly women	This study investigated whether participation in an aquatic walking class (once a week, for 12 weeks) had an effect on middle-aged and elderly women, compared with no participation	A pool with water temperature 29°C	The subjects were 35 women ( $58.5 \pm 8.3$ years) who took part in the aquatic exercise class and 24 women ( $61.0 \pm 7.4$ years) in the control group	The duration of the exercise class was 50 minutes (once a week, for 12 weeks) under the guidance of a skilled instructor. Averages of % HRR during exercise were 24%–34%, so that the intensity of exercise was lower middle level	Mood Check List-Short Form I, good walking tests (maximal one step distance, one leg squat, Bosu balance test, 10 m walk time), walking SE	Mood Check List-Short Form I, good walking tests (maximal one step distance, one leg squat, Bosu balance test, 10 m walk time) (P < 0.001). Good walking tests in the 12th week improved compared with those from the first week. The scores of walking SE in strong wind and on an icy surface in the 12th week were increased compared with the scores from the first week.	No changes were observed in the control group. The mean of QOL (P = 0.028) was significantly improved at the last class compared with the first class in the exercise group
Lee <sup>28</sup>	2006	Comparison of effects among Tai Chi exercise, aquatic exercise, and a self-help program for patients with knee osteoarthritis	To compare the effects between Tai Chi exercise, aquatic exercise, and a self-help program for knee OA patients on symptoms of arthritis, muscle strength, balance, and difficulty of programming activities	Tai Chi exercise and self-help center. Aquatic exercise: a pool	Tai Chi exercise group (N = 18; $61.3 \pm 9.5$ years), aquatic exercise group (N = 16; $66.4 \pm 6.7$ years) and self-help program group (N = 16; $61.6 \pm 7.6$ years)	Tai Chi exercise and aquatic exercise group exercised twice a week (1 hour) for 2 months. In the self-help program group, they exercised once a week (2 hours) for 2 months	Muscle strength, balance and difficulty of performing activities (K-WOMAC Index)	The Tai Chi group was significantly different from the self-help group for knee extensor peak torque, knee flexor, and stiffness. In addition, the Tai Chi group or aquatic group were significantly different from the self-help group for difficulty of performing activities	The Tai Chi group or aquatic group were significantly different from the self-help group for knee extensor peak torque, knee flexor, and stiffness. However, it seems that Tai Chi exercise may be more suitable than aquatic exercise in an OA exercise program

Lord et al. <sup>9</sup>	2006	The effects of water exercise on physical functioning in older people	All participants	To determine whether a 22-week water exercise program can improve physical functioning in older people	Eighty-five persons (18 males and 67 females, mean age 71.8 years) participated in a water-exercise program, and 44 control subjects (7 males and 37 females, mean age 76.5 years) participated in exercise program specifically designed for older people	The exercisers participated in approximately 1-hour exercise sessions once a week for two 10-week periods (with 2-week inter-term break). The intervention comprised the 'WAVES' water exercise program specifically designed for older people	Leaning balance, quadriceps strength, reaction time and shoulder range of motion	The 48 exercise subjects who were available for retest showed significantly improved leaning balance (as measured by tests of maximal balance range and coordinated stability) and shoulder range of motion compared with the controls. The groups did not differ in tests of quadriceps strength and reaction time. However, 37 people dropped out from the program because of dislike of the pool environment (N = 7), move/vacation (N = 6), hospitalization (N = 5), illness (N = 11), caring for sick spouse (N = 2), requested no second interview (N = 2), deceased (N = 1), changed to another program (N = 1), and no reason (N = 2)	These findings show that water exercise can produce benefits with regard to improving balance and flexibility in older people
Smith and Michie <sup>10</sup>	2006	A pilot study on the effects of aquatic exercises on discomforts of pregnancy	No description	To estimate the impact of an aquatic exercise program on the perception of body image, participation in health-promoting behaviors, barriers to health-promoting participation, level of physical discomfort, and mobility	Forty nonexercising pregnant women with more than 19 weeks gestation. Based on self-selection, participants were assigned to either aquatic exercise group (N = 20; $25.1 \pm 4.9$ years) or control group (N = 20; $24.8 \pm 5.6$ years)	The aquatic exercise group participated in a 60-minute, 6-week aquatic exercise program (three sessions per week). The control group was instructed to continue their normal activities of daily living	The Pregnancy Body Shape Questionnaire, the Health Promotion Lifestyle Profile, the Timed Get Up and Go Test, and the Discomfort Intensity Index	Women in the aquatic exercise group reported significantly less physical discomfort, improved mobility, and improved body image and health-promoting behaviors as compared with control subjects	Aquatic exercise during pregnancy may enhance physical functioning, decreasing maternal discomfort, improving maternal body image, and improving health-promoting behaviors

(Continued)

**Table 1 (Continued)**

Article	Year	Title	Aim/objective	Setting/place	Participants	Detail and period of intervention	Main and secondary outcomes	Main results	Conclusion
Chishiki et al <sup>31</sup>	2006	Comparison of usefulness between water exercise and gymnastic exercise, jijojutsu, in maintaining physical ability for the elderly	To compare physical ability and physical characteristics of elderly women between water exercise and gymnastic exercise	No description	The aquatic group consisted of 21 healthy females ( $60 \pm 5.2$ years). The land group consisted of 10 healthy females ( $60 \pm 3.2$ years)	Aquatic group: aquatic walking, swimming (twice or more [60 minutes at a time] a week for 1 year). Land group: gymnastic (shoulder raise/lower, arm raise/lower, push-up, lower back twist, straddle stretching, head shake, tumble, etc) (every day [20 minutes in the morning and the afternoon] of the week for 1 year)	Physical characteristics (body mass index, waist size, hip size, % fat), and physical fitness (10 m walking, 10 m maximal walking, 10 m obstacle walking, single-leg standing with eyes open, grip strength, sit up, side steps, sitting-toe-touch test, VO <sub>2</sub> max)	The mean percentage of fat mass was reduced in the gymnastic exercise group without change of weight. The average estimated maximal oxygen uptake increased in the gymnastic exercise more than in the water exercise. Sitting trunk flexion was decreased in both groups after 1 year	The results of this study suggested that water exercise could be more beneficial by adding flexibility exercise in the gymnastic exercise, and could maintain and promote physical fitness in elderly people
Kawasaki et al <sup>32</sup>	2007	The effect of aquatic exercise on preventing falls and lifestyle related disease among middle-aged and elderly people	To evaluate the effects of water exercise on blood pressure, carbohydrate and lipid metabolism, arterial sclerosis, and stability of center of mass in middle- and old-age	A swimming club in Kyushu Sangyou University	Eleven healthy males and 24 healthy females were assigned to the training group ( $N = 35$ , $61.5 \pm 0.8$ years) and control group ( $N = 22$ , $62.6 \pm 0.9$ years)	A 2-hour program consisted of stretching, bicycling, walking in warm water (30.5°C) water stream, and swimming twice weekly. The training period was 6 months	Anthropometric variables; blood pressure, HR, work load, blood biochemical values, urine testing, blood pressure pulse wave, and stability of center of mass	Weight, body mass index, amount of body fat, blood pressure, and pulse wave velocity decreased and lipid and carbohydrate metabolism and index of arterial sclerosis significantly improved in the training group	Water exercise may be useful for controlling metabolic syndrome and preventing falls in the middle-aged and elderly
Nishikawa et al <sup>33</sup>	2008	Effect of aquatic walking on the cardiovascular patients in our hospital and health-related QOL – in comparison with indoor exercise therapy	To compare the effectiveness of a program of aquatic exercise therapy and land exercise therapy in patients with heart disease	Rehabilitation pool	The aquatic group consisted of 11 males and 3 females ( $66 \pm 7$ years. The land group consisted of 8 males and 2 females ( $63 \pm 9$ years. Patient characteristic (aquatic/land); angina pectoris (7/5), myocardial infarction (4/5), valve replacement	Aquatic exercise therapy: stretching, aquatic walking, resistance training. Land exercise therapy: stretching, resistance training, aerobic exercise (ergometer). Each therapy was conducted two times (60 minutes at a time)	ATVO <sub>2</sub> , VO <sub>2</sub> max, and health-related QOL	ATVO <sub>2</sub> , VO <sub>2</sub> max, and health-related QOL were significantly improved in both groups	The improvement of aerobic fitness was similar in both groups. The difference of improved effect in QOL was due to the fact that the content and the environment of each exercise were different

Rotstein et al <sup>14</sup>	2008	The effect of a water exercise program on the bone density of postmenopausal women	To examine the effect of a 7-month program of water exercise on BMD in postmenopausal females	A heated pool	(2/0), dilatative cardiomyopathy (1/0)	Thirty-five postmenopausal females aged 50–65 (20 in the experimental group and 10 in the control)	The exercise group trained for 7 months with three 1-hour sessions per week. Each session was divided into four different segments: warm-up, aerobic set, strengthening muscles, and loading the bones, and cool down and stretches	Bone density by DEXA (lunar) for vertebrae L2–L4 and femoral neck of the legs	DEXA test findings for femoral neck density indicated no significant differences between the groups pre- and post-treatment. However, a significant interaction was found for BMC in the right leg indicating an increased trend in BMC in the experimental group and a trend towards decrease for the control group	It is possible to plan and execute a water exercise program that has a positive effect on bone status of postmenopausal women
Brady et al <sup>15</sup>	2008	The addition of aquatic therapy to rehabilitation following surgical rotator cuff repair: a feasibility study	To determine the feasibility of implementing and investigating the effect of a combined aquatic and land-based rehabilitation program in the post-operative rehabilitation of rotator cuff tears	University of Sydney and Delmer Private Hospital	Eighteen subjects undergoing rotator cuff repair. Aquatic and land group (N = 12, 56.3 ± 9.1 years) and land group (N = 53.5 ± 16.0 years)	Twice per week for 12 weeks. Combined aquatic- and land-based program: standard protocol (passive ROM, active-assisted ROM, resistive phase). Standard land-based program: standard protocol, adding 10 days postoperatively	Passive ROM (forward flexion, external rotation), WORC index, health-related QOL and 11-point VAS	Both subjects improved passive ROM and WORC. Participation in aquatic therapy significantly improved passive flexion range of motion measured at 3 and 6 weeks. No significant differences in the attendance rate and patients perceptions of the programs	The implementation of a combined aquatic- and land-based physiotherapy program following surgical repair of the rotator cuff is feasible and presents a potentially viable alternative to conventional land-based exercise with comparable outcomes	

Note: \*Description of study design was omitted.

Abbreviations: ATVO<sub>2</sub>, anaerobic threshold oxygen consumption; BBS, Berg Balance Scale; BMC, bone mineral content; BMD, bone mineral density; CG, control group; CI, confidence interval; COP, center of pressure; CRF, chronic kidney disease; Cys-C, cystatin-C; DBP, diastolic blood pressure; GSH, glutathione; HDL-C, high density lipoprotein cholesterol; HR, heart rate; HPLP II, Health Promotion Lifestyle Profile II; JOA, Japanese Orthopedic Association; LD-L-C, low density lipoprotein cholesterol; LPO, lactoperoxidase; MHP, mental health pattern; NHP, Nottingham Health Profile; OA, osteoarthritis; POMS, Profile of Mood States; QOL, quality of life; RQOM, range of motion; SBP, systolic blood pressure; SE, self-efficacy; TC, total cholesterol; TG, training group; U-prot, protein/creatinine ratio; VA, vital age; VAS, visual analog scale; VO<sub>2</sub> max, maximal oxygen consumption; WORC, Western Ontario Rotator Cuff.

**Table 2** Brief summary of 21 articles

Article	Year of publication	Object disease	Effects noted	Withdrawals	Adverse event	Cost of intervention
Willén et al <sup>15</sup>	2001	Poliomyelitis	Significant effect	No withdrawal	Nothing	No description
Ebisu et al <sup>16</sup>	2001	No specific disease	Significant effect*	No description	No description	No description
Aoba et al <sup>17</sup>	2001	No specific disease	Significant effect	No description	No description	No description
Yamada et al <sup>18</sup>	2002	No specific disease	Significant effect	No description	No description	No description
Murai et al <sup>19</sup>	2002	Knee OA	Significant effect	No description	Nothing	No description
Igarashi et al <sup>20</sup>	2002	No specific disease	Significant effect*	No description	No description	No description
Pechter et al <sup>21</sup>	2003	Moderate chronic kidney disease	Significant effect	No description	No description	Not description
Douris et al <sup>22</sup>	2003	No specific disease	Significant effect	No description	No description	Not description
Liquori et al <sup>23</sup>	2003	No specific disease	Significant effect	No description	No description	No description
Lin et al <sup>24</sup>	2004	Knee-hip OA	Significant effect	N = 9; Reason was not described.	No description	No description
Akamine et al <sup>25</sup>	2005	No specific disease	Significant effect	No description	No description	No description
Takumi et al <sup>26</sup>	2005	No specific disease	Significant effect	No description	No description	No description
Takumi and Moriya <sup>27</sup>	2005	No specific disease	Significant effect	No description	No description	No description
Lee <sup>28</sup>	2006	Knee OA	Significant effect	N = 3; Slipping on poolside, having a cold, low height.	N = 1 Slipping on poolside.	No description
Lord et al <sup>29</sup>	2006	No specific disease	Significant effect	N = 37; Reasons were shown in Table 1 in detail.	No description	No description
Smith and Michel <sup>30</sup>	2006	Discomforts of pregnancy	Significant effect	No description	No description	After pretests were completed, each participant received a \$10 grocery store gift certificate, and each one in the aquatic exercise group were given the bus tickets or parking passes to assist participants' attendance. Other cost was not described
Chishaki et al <sup>31</sup>	2006	No specific disease	Significant effect	No description	No description	No description
Kawasaki et al <sup>32</sup>	2007	No specific disease	Significant effect	N = 8; Low compliance.	No description	No description
Nishikawa et al <sup>33</sup>	2008	Cardiovascular disease	Significant effect	No withdrawal	No description	No description
Rotstein et al <sup>34</sup>	2008	No specific disease	Significant effect	N = 5; Reason was not described.	No description	No description
Brady et al <sup>35</sup>	2008	Rotator cuff tears	Significant effect	No description	Nothing	No description

Note: \*Group comparison was not conducted.

Abbreviation: OA, osteoarthritis.

analyses (9.5%)"; "for each primary and secondary outcome, a summary of results for each study condition, and the estimated effect (9.5%)"; "inclusion of results from testing prespecified causal pathways through which the intervention was intended to operate, if any (14.3%)"; "summary of other analyses performed, including subgroup or restricted analyses, indicating which are prespecified or exploratory (4.8%)"; and "summary of all important adverse events or unintended effects in each study condition (19.0%)".

Table 4 presents an assessment of the evaluation of study quality by use of the CLEAR-NPT checklist. This tool mainly evaluated the quality of the study conduct. The description rate for the details of the intervention was high (81%), but the rate was low in other primary items. The primary items for which the executive rate was less than 30% were as follows: "Were participants adequately blinded? (4.8%)"; "Were care providers or persons adequately blinded? (4.8%)"; "Were outcome assessors adequately blinded to assess the primary

**Table 3** Evaluation of the quality of nonrandomized controlled trials by using the TREND checklist

Paper section/topic	Item no.	Descriptor	N of yes	%
Introduction	1	<ul style="list-style-type: none"> <li>• Information on how units were allocated to interventions</li> <li>• Structured abstract recommended</li> <li>• Information on target population or study sample</li> </ul>	5/21	23.8
			8/21	38.1
			12/21	57.1
Background	2	<ul style="list-style-type: none"> <li>• Scientific background and explanation of rationale</li> <li>• Theories used in designing behavioral interventions</li> </ul>	18/21	85.7
Methods	3	<ul style="list-style-type: none"> <li>• Eligibility criteria for participants, including criteria at different levels in recruitment/sampling plan (eg, cities, clinics, subjects)</li> <li>• Method of recruitment (eg, referral, self-selection), including the sampling method if a systematic sampling plan was implemented</li> <li>• Recruitment setting (settings and locations where the data were collected)</li> </ul>	14/21	66.7
	4	<ul style="list-style-type: none"> <li>• Details of the interventions intended for each study condition and how and when they were actually administered, specifically including:</li> <li>• Content: what was given?</li> <li>• Delivery method: how was the content given?</li> <li>• Unit of delivery: how were subjects grouped during delivery?</li> <li>• Deliverer: who delivered the intervention?</li> <li>• Setting: where was the intervention delivered?</li> <li>• Exposure quantity and duration: how many sessions or episodes or events were intended to be delivered? How long were they intended to last?</li> <li>• Time span: how long was it intended to deliver the intervention to each unit?</li> <li>• Activities to increase compliance or adherence (eg, incentives)</li> </ul>	10/21	47.6
Interventions			7/21	33.3
Objectives	4	<ul style="list-style-type: none"> <li>• Details of the interventions intended for each study condition and how and when they were actually administered, specifically including:</li> <li>• Content: what was given?</li> <li>• Delivery method: how was the content given?</li> <li>• Unit of delivery: how were subjects grouped during delivery?</li> <li>• Deliverer: who delivered the intervention?</li> <li>• Setting: where was the intervention delivered?</li> <li>• Exposure quantity and duration: how many sessions or episodes or events were intended to be delivered? How long were they intended to last?</li> <li>• Time span: how long was it intended to deliver the intervention to each unit?</li> <li>• Activities to increase compliance or adherence (eg, incentives)</li> </ul>	11/21	52.4
	5	<ul style="list-style-type: none"> <li>• Specific objectives and hypotheses</li> </ul>	19/21	90.5
Outcomes	6	<ul style="list-style-type: none"> <li>• Clearly defined primary and secondary outcome measures</li> <li>• Methods used to collect data and any methods used to enhance the quality of measurements</li> <li>• Information validated instruments such as psychometric and biometric properties</li> <li>• How sample size was determined and, when applicable, explanation of any interim analyses and stopping rules</li> </ul>	17/21	33.3
Sample size	7	<ul style="list-style-type: none"> <li>• Specific objectives and hypotheses</li> <li>• Clearly defined primary and secondary outcome measures</li> <li>• Methods used to collect data and any methods used to enhance the quality of measurements</li> <li>• Information validated instruments such as psychometric and biometric properties</li> <li>• How sample size was determined and, when applicable, explanation of any interim analyses and stopping rules</li> </ul>	17/21	100.0
Assignment method	8	<ul style="list-style-type: none"> <li>• Unit of assignment (the unit being assigned to study condition, eg, individual, group, community)</li> <li>• Method used to assign units to study conditions, including details of any restriction (eg, blocking, stratification, minimization)</li> <li>• Inclusion of aspects employed to help minimize potential bias induced due to nonrandomization (eg, matching)</li> </ul>	16/21	47.6
Blinding (masking)	9	<ul style="list-style-type: none"> <li>• Whether or not participants, those administering the interventions, and those assessing the outcomes were blinded to study condition assignment; if so, statement regarding how the blinding was accomplished and how it was assessed</li> </ul>	1/21	4.8
Unit of analysis	10	<ul style="list-style-type: none"> <li>• Description of the smallest unit that is being analyzed to assess intervention effects (eg, individual, group, or community)</li> <li>• If the unit of analysis differs from the unit of assignment, the analytical method used to account for this (eg, adjusting the standard error estimates by the design effect or using multilevel analysis)</li> </ul>	3/21	14.3
Statistical methods	11	<ul style="list-style-type: none"> <li>• Statistical methods used to compare study groups for primary outcome(s), including complex methods for correlated data</li> <li>• Statistical methods used for additional analyses, such as subgroup analyses and adjusted analysis</li> <li>• Methods for imputing missing data, if used</li> <li>• Statistical software or programs used</li> </ul>	15/21	71.4
Results			2/21	9.5
	12	<ul style="list-style-type: none"> <li>• Flow of participants through each stage of the study: enrollment, assignment, allocation and intervention exposure, follow-up, analysis (a diagram is strongly recommended)</li> <li>• Enrollment: the numbers of participants screened for eligibility, found to be eligible or not eligible, declined to be enrolled, and enrolled in the study</li> </ul>	20/21	95.2
Participant flow			3/21	14.3
Discussion			10/21	47.6
			4/21	19.0
Conclusion			8/21	38.1

(Continued)

**Table 3 (Continued)**

Paper section/topic	Item no.	Descriptor	N of yes	%
		• Assignment: the numbers of participants assigned to a study condition	20/21	95.2
		• Allocation and intervention exposure: the number of participants assigned to each study condition and the number of participants who received each intervention	21/21	100.0
		• Follow-up: the number of participants who completed the follow-up or did not complete the follow-up (ie, lost to follow up), by study condition	10/21	47.6
		• Analysis: the number of participants included in or excluded from the analysis, by study condition	13/21	61.9
		• Description of protocol deviations from study as planned, along with reasons	9/21	42.9
Recruitment	13	• Dates defining the periods of recruitment and follow-up	3/21	14.3
Baseline data	14	• Baseline demographic and clinical characteristics of participants in each study condition	15/21	71.4
		• Baseline characteristics for each study condition relevant to specific disease prevention research	7/21	33.3
		• Baseline comparisons of those lost to follow-up and those retained, overall and by study condition	2/21	9.5
Baseline equivalence	15	• Comparison between study population at baseline and target population of interest	1/21	4.8
		• Data on study group equivalence at baseline and statistical methods used to control for baseline differences	10/21	47.6
Numbers analyzed	16	• Number of participants (denominator) included in each analysis for each study condition, particularly when the denominators change for different outcomes; statement of the results in absolute numbers when feasible	18/21	85.7
		• Indication of whether the analysis strategy was "intention to treat" or, if not, description of how noncompliers were treated in the analyses	2/21	9.5
Outcomes and estimation	17	• For each primary and secondary outcome, a summary of results for each study condition, and the estimated effect size and a confidence interval to indicate the precision	2/21	9.5
		• Inclusion of null and negative findings	9/21	42.9
		• Inclusion of results from testing prespecified causal pathways through which the intervention was intended to operate, if any	3/21	14.3
Ancillary analyses	18	• Summary of other analyses performed, including subgroup or restricted analyses, indicating which are prespecified or exploratory	1/21	4.8
Adverse events	19	• Summary of all important adverse events or unintended effects in each study condition (including summary measures, effect size estimates, and confidence intervals)	4/21	19.0
Discussion				
Interpretation	20	• Interpretation of the results, taking into account study hypotheses, sources of potential bias, imprecision of measures, multiplicative analyses, and other limitations or weaknesses of the study	10/21	47.6
		• Discussion of results taking into account the mechanism by which the intervention was intended to work (causal pathways) or alternative mechanisms or explanations	15/21	71.4
		• Discussion of the success of and barriers to implementing the intervention, fidelity if implementation	9/21	42.9
		• Discussion of research, programmatic, or policy implications	9/21	42.9
Generalizability	21	• Generalizability (external validity) of the trial findings, taking into account the study population, the characteristics of the intervention, length of follow-up, incentives, compliance rates, specific sites/settings involved in the study, and other contextual issues	7/21	33.3
Overall evidence	22	• General interpretation of the results in the context of evidence and current theory	12/21	57.1

outcomes? (9.5%); and "Were the main outcomes analyzed according to the intention-to-treat principle? (14.3%)".

## Discussion

### Overall evidence and quality assessment

There were only 21 nRCTs about aquatic exercise published from 2000 to July 20, 2009, possibly due to the increase in

studies with an RCT design. In previous SRs<sup>1–3</sup> of RCTs, the authors actually collected many articles that were published in 2000. Pooling of the data from nRCTs was not performed because of the heterogeneity of the studies, multiple outcome measurements, and overall poor presentation. We used the TREND and CLEAR-NPT checklists as quality assessments. There were serious problems with the