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ORIGINAL ARTICLE

International consensus on the non-pharmacological and non-surgical management of osteoporotic vertebral fractures

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Abstract

Summary/Rationale We identified a knowledge gap in the non-pharmacological and non-surgical management of osteoporotic vertebral fractures.

Main results This international consensus process established multidisciplinary biopsychosocial recommendations on pain, nutrition, safe movement, and exercise for individuals with acute and chronic vertebral fractures.

Significance These recommendations will guide clinical practice and inform interventions for future research.

Purpose To establish international consensus on recommendations for the non-pharmacological and non-surgical management of osteoporotic vertebral fractures.

Methods We adopted a five-step modified Delphi consensus process: (1) literature search and content analysis, (2) creation of the survey, (3) selection of the expert panel, (4) first round of the rating process, and (5) second round of the rating process. The first round included 49 statements and eight open-ended questions; the second round included 30 statements. Panelists were asked to rate their agreement with each of the statements using a 9-point scale, with the option to provide further comments. Consensus for each statement was determined by counting the number of panelists whose rating was outside the 3-point region containing the median.

Results We invited 76 people with degree in medicine, physiotherapy, kinesiology, and experience in the management of osteoporotic vertebral; 31 (41%) and 27 (36%) experts agreed to participate to the first and the second round, respectively. The mean percentage agreement after the first and second rounds was 76.6% ± 16.0% and 90.7% ± 6.5%, respectively. We established consensus on recommendations on pain, early satiety, weight loss, bracing, safe movement, and exercise for individuals with acute and chronic vertebral fractures.

Conclusion Our international consensus provides multidisciplinary biopsychosocial recommendations to guide the management of osteoporotic vertebral fractures and inform interventions for future research.

Keywords Education · Fragility fractures · Osteoporosis · Rehabilitation · Spine

Introduction

Vertebral fractures are the most common type of fracture in people with osteoporosis [1–3] and are associated with several morbidities and increased mortality [4, 5]. One in five women with an incident osteoporotic vertebral fracture (VF) will experience another one within one year, [6] and the risk of death is nine times higher following a VF [7]. VFs may cause pain, loss of height, and progressive thoracic kyphosis, which may lead to difficulties in performing daily activities. [1, 8–10]

Non-pharmacological interventions such as exercise, taping, bracing, and spine-sparing strategies are sometimes used to improve posture and reduce pain, disability, and fracture risk [11–13], but the evidence is limited, and no best practice guidance exists. A 2019 Cochrane review [14] on the effects of exercise in people with vertebral fractures showed that the number of studies was inadequate to determine the effects on falls, fractures, adverse events, pain, and health-related quality of life, while there were small improvements in physical function (e.g., performance on the Timed Up and Go Test). Randomized controlled trials

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(RCTs) and systematic reviews of interventions in people with osteoporosis or hyperkyphosis showed that exercise, alone or combined with other interventions, may improve posture, physical functioning, fear of falling, and quality of life in people with VFS, but the evidence is often heterogeneous or conflicting [15–20]. Furthermore, guidelines for the management of non-specific back pain recommend staying active and practicing general physical activity,[21–24] but the evidence does not allow us to draw recommendations on specific types of exercise or other non-pharmacological techniques to reduce pain after VFs.

Resistance, balance, and aerobic exercise training are recommended for people with osteoporosis, with or without VFs, and it is ideal that individuals with VFs are educated on these forms of training as part of a consultation with a physiotherapist to ensure the adoption of spine sparing strategies [12, 25]. However, the absence of specific guidelines for the management of people with vertebral fractures [12] represents a barrier for healthcare providers. A survey among over 100 physiotherapists, kinesiologists, and exercise instructors that was circulated to inform the upcoming Canadian Clinical Practice Guidelines for the Prevention and Management of Osteoporosis revealed that 46% of the participants were not comfortable guiding exercise in people at high risk of fractures, and 92% wanted more guidance to support safe exercise in this group [26]. Therefore, we performed a modified Delphi consensus process to generate multidisciplinary biopsychosocial recommendations for the non-pharmacological and non-surgical management of VFs.

Methods

We established a steering committee that included physicians and other healthcare practitioners (HCPs) in geriatrics, internal medicine, physiotherapy, and dietetics; researchers with expertise in rehabilitation, pain, nutrition, malnutrition, osteoporosis, post-fracture care, and knowledge translation (KT); and individuals living with VFs and stakeholders. The steering committee decided to focus on the following strategies for the non-pharmacological management of VFs: pain management, bracing, exercise, safe movement education and training, and nutrition. We adopted a five-step modified RAND/UCLA Delphi consensus process [27] consisting of literature search and content analysis (phase I), creation of the survey by our team (phase II), expert panel selection and recruitment (phase III), first round of the rating process (phase IV), and second round of the rating process (phase V) (Fig. 1).

Phase I—Literature search and content analysis

We performed literature searches to collect direct or indirect evidence or recommendations that could be applied in the management of people with vertebral fractures to inform the statements of the survey. We performed three literature searches in PubMed to retrieve (a) existing guidelines for the management of low bone mass or osteoporosis, (b) existing guidelines for the management of back pain, and (c) existing guidelines on nutrition management in older adults, and only guidelines pertaining to the non-pharmacological management of low bone mass, back pain, and nutrition in older adults were included. We also included two systematic reviews led by our team on the effects of exercise interventions [14] and bracing [28] in people with osteoporotic vertebral fracture and five clinical trials of exercise interventions in people with VFs [29–33], to extract the exercises prescribed, organize them by therapeutic goal, and present them to the panelists of our modified Delphi for input on their appropriateness. The eligible papers were then uploaded in the NVivo 12 software (version 12.6.0; QRS International, Burlington, MA, USA), and we performed a conceptual content analysis [34] of each included paper to identify any information on pain management, bracing, exercise, safe movement education and training, and nutrition that may be relevant in the non-pharmacological management of VFs.

Phase II—Creation of the survey by our team

Two authors (MP and LMG) generated draft statements based upon the content analysis and information gathered during phase I. These statements were finalized after interviews with 10 people with VFs and 10 healthcare practitioners working with people with VFs [35, 36]. The statements were then converted into a survey (supplementary material),

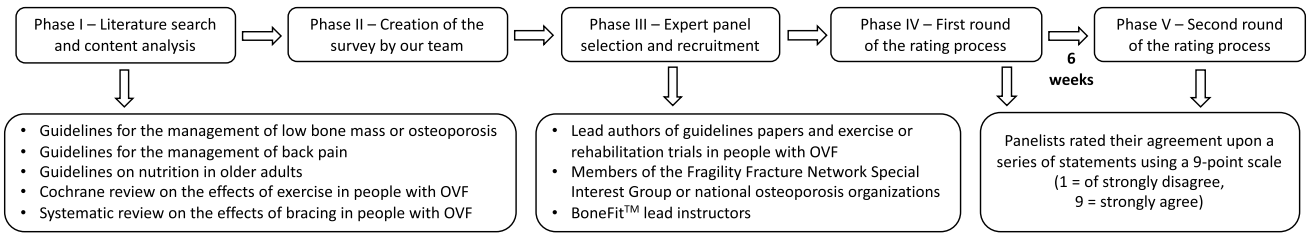

Fig. 1 The modified RAND/UCLA Delphi consensus process

which was finalized after two videoconferences and two rounds of revisions by the team members.

Phase III—Expert panel selection

We invited potential panelists who met the following inclusion criteria: degree in physiotherapy, medicine (with specialization in physiatry, geriatrics, rehabilitation medicine, or similar fields), and other physiotherapy- or kinesiology-related degrees; self-reported clinical or research experience in management of osteoporotic vertebral fractures; and ability to understand, read, and write in English. We used purposeful and convenience sampling techniques to recruit eligible participants among first and last authors of guidelines papers and exercise or rehabilitation trials in people with vertebral fractures; members of the Fragility Fracture Network Special Interest Group; representatives from the National Osteoporosis Foundation, the Royal Osteoporosis Society, and other national osteoporosis organizations; and BoneFit™ lead instructors. No exclusion criteria based on country, race, ethnicity, or gender was applied. Potential contributors were contacted via email. We aimed to recruit 20 participants to complete each round; therefore, considering the absence of a formal method to determine sample size in Delphi studies and the potential challenges in recruitment, we contacted 76 potential participants. The steering committee performed recruitment and selection of the panelists but was impartial to the rating process. The study received ethics approval from the University of Waterloo Research Ethics Board (ORE #43,154).

Phase IV and V—First and second round of the rating process

The experts who agreed to participate were emailed a link to the online survey, generated using Qualtrics (Qualtrics^{XM}, Seattle, US, https://www.qualtrics.com/); both rounds of rating were anonymous. Participants were asked to agree or disagree upon 49 statements by using a 9-point scale (supplementary material, Figure S1); a space for optional open-ended comments was provided for every statement. The survey ended with a few open-ended questions, that arose in prior surveys, interviews, or input from of healthcare providers who manage people with vertebral fractures [36] and that are not addressed by the extant literature (supplementary material, Table S1). Consensus for each statement was determined by counting the number of panelists whose rating was outside the 3-point region containing the median. The minimum consensus threshold for each statement was established a priori, based upon the resultant number of respondents, in accordance with the RAND/UCLA approach (supplementary material) [27]. Participants were asked to complete the first round within four weeks; two weeks after the end of the first round, we invited to participate to a second round all the potential contributors that were contacted to participate in the first round. Participation to the first round was not a requirement to participate to the second round. Two authors (MP and LMG) reviewed the answers from the first round. For statements where consensus was not reached, and for the answers to the open-ended questions, the two authors generated a new set of statements based on feedback received (supplementary material, Table S2). Statements where a consensus was reached during the first round were enriched with the feedback provided by the panelists. The experts who agreed to participate to the second round were emailed a summary of the distribution of the ratings for every statement from the first round, a list of the final statements where consensus was reached in the first round, and a link to the survey for the second round, where they were asked to rate the revised statements where consensus was not reached. Participants were asked to complete the survey within four weeks. Reminders were sent via email after two weeks during both rounds. We decided a priori to not invite dietitians to the modified Delphi consensus process, due to the limited exposure to individuals with VFs in community practice [37]. A registered dietitian is part of our team (HK), and we invited four external dietitians with expertise on vitamin D, calcium, and bone health to review the statements on nutrition after the survey was closed to finalize recommendations. We calculated the percentage of consensus for each statement, as well as the mean percentage of consensus across statements for each round. A third round was not performed because the predefined level of consensus for each statement was reached after the second round. Demographic information (i.e., age, gender, race, main occupation, years of experience at current occupation) were collected at the beginning of the survey and presented as descriptive statistics (mean ± standard deviation [SD] or counts (n) and percentages [%]).

Results

Thirty-one (response rate: 41%) and 27 (response rate: 36%) experts from Asia, Europe, North America, and Oceania participated in the first and the second round, respectively. The mean age was 55 ± 11 years for the first round and 54 ± 12 years for the second round. The panelists included physiotherapists, rheumatologists, and geriatricians who have been practicing their occupation for over 20 years on average (supplementary material, Table S3). In the first round, the mean percentage agreement was 76.6% ± 16.0% (the minimum percentage agreement required upon each statement based on panel size was 71%), and there was lack of consensus on 20 out of 49 statements ($n = 15$ on exercise, $n = 3$ on nutrition, $n = 1$ on bracing, $n = 1$ on pain management; supplementary material, Table S1). The second round included 30 statements; the mean percentage agreement was 90.7% ± 6.5% (the minimum percentage agreement required upon each statement based on

panel size was 70%), and consensus was reached upon all the statements (supplementary material, Table S2). We established general recommendation after a VF (Box 1), and specific recommendations on pain management (Box 2), how to perform activities of daily living safely (Box 3), exercise and physical activity (Box 4), physical assessment (Box 5), and nutrition (Box 6). Three of the four dietitians we contacted agreed to provide feedback on the recommendations on nutrition. The mean percentage agreement is reported after each statement.

Box 1 General recommendations

1. Individuals with vertebral fracture should:

a. Avoid prolonged or continuous bed rest

A few days of bed rest might be indicated in presence of severe pain immediately after the fracture, but prolonged or continuous bed rest should be limited as much as possible. (77.42%)

b. Avoid heavy physical exertion, lifting, or activities that exacerbate pain during the 12-week period following fracture (e.g., carrying groceries, lifting pets or children, yard work)

When to resume these activities will depend on the severity of fracture(s) and symptoms. Resume activities involving heavy physical exertion gradually. (90.32%)

c. Receive education on pain expectation

For example: that, for most people, pain and activity tolerance will get better over time, but it may take 3 months or longer, and that they can gradually start or resume exercise and physical activities of daily life, leisure, or work as pain diminishes. (93.55%)

d. Receive education that having a spine fracture increases the risk of having another fracture. Individuals with vertebral fractures must be referred to their physician to learn about treatment strategies (including medications and fall prevention) to prevent further fractures. (100%)

2. In general, bracing (i.e., taping, rigid, dynamic, or soft orthoses) is not recommended for individuals with vertebral fractures

Some people believe that selected persons, immediately after fracture, can benefit from using braces intermittently in the acute stage, if it means reducing fear or giving the person confidence to mobilize or resume activities. Evidence from clinical trials is heterogeneous and of very low certainty, and there is high risk of bias. Bracing should not be used routinely and should not be used at all in subacute or chronic stages post-fracture. (80%)

3. When the therapeutic goal is to improve respiratory function, individuals with acute or chronic vertebral fractures can be taught diaphragmatic breathing exercises

For example: in the supine position with knees bent and feet flat on lying surface, cueing focus on lower rib expansion and diaphragm contraction, inhaling through nose, and exhaling through pursed lips, with focus on lower ribs moving in, pelvic-floor and deep abdominal muscle contraction. Progression involves practicing breathing exercises during sitting or standing. (93.33%)

4. In the acute and chronic stages after a vertebral fracture, healthcare professionals are encouraged to use "how to" language rather than only suggesting activity restrictions and to be mindful of choosing words carefully, to promote optimism rather than create fear and activity avoidance

Healthcare professionals can provide examples of activities that should be modified or avoided (e.g., bend at your hips instead of rounding your back; get someone to lift heavy objects for you instead of doing it yourself). (96.67%)

5. For individuals with fear-related beliefs (e.g., fear of pain, fractures, falling, and movement), consider education on coping techniques, body awareness, spine safe movement strategies, and movements to modify or avoid, being mindful of choosing words carefully to avoid creating fear and activity avoidance. (96.67%)

6. Refer to a physiotherapist or occupational therapist to perform an assessment of fall risk and physical functioning, or a home hazard assessment, where appropriate. (96.30%)

7. When body image is a concern at any stage post-vertebral fracture, health professionals could consider using education or approaches informed by cognitive behavioral therapy to enhance self-esteem and improve the perception of body image. (83.33%)

Box 2 Recommendations on pain management

Strategies to manage back pain and discomfort (in acute or chronic stages) associated with vertebral fracture include:

1. Assessment by a healthcare professional for pain-related psychological risk factors (e.g., pain catastrophizing, pain-related fear, anxiety, social isolation, low mood) that could increase the risk of persistent pain and disability

If present, consider referral to a health professional (e.g., physiotherapist, occupational therapist, psychologist) who has expertise in pain and psychological factors. (93.33%)

2. Avoiding prolonged sitting and, when sitting, do so with attention to posture, as well as when getting in and out of the seated position

If prolonged sitting is necessary, for example, at work, get up and move around every 30 min and consider consulting an ergonomist about alternative strategies, such as perched sitting or standing desks. (76.67%)

3. Education on movements to avoid or modify (e.g., rapid, repetitive, weighted, sustained or end-range flexion or twisting of the spine) and on strategies to reduce loads on the spine (e.g., hip hinge, step-to-turn, getting up and moving around every 30 min) during physical activities of daily life, leisure, and work

Where possible, refer to a physiotherapist for assessment and education, or suggest free resources for education, to get detail on the types of movements to modify or avoid. (96.67%)

4. Pacing or "graded activity" to help facilitate increased activity tolerance or to avoid doing too much too soon. (100%)

5. Self-application of cold or heat for sore or painful areas can be performed if it helps to manage pain, with education on when and how to safely apply it. (100%)

6. In presence of chronic pain after the fracture has healed (> 12 weeks post fracture), consider whether the person would benefit from a referral to an interdisciplinary pain management clinic or psychologist that specializes in the biopsychosocial management of pain, or, to a physician for the medical management of pain. (90%)

Box 3 Recommendations on performing daily activities safely

Individuals with vertebral fractures are often given advice to not lift things, bend, or twist the spine. However, lifting things, forward bending, and twisting the spine are often impossible to completely avoid in the daily life

Recommendations on safe movement education for individuals with vertebral fractures include: (96%)

1. Consult a physiotherapist or occupational therapist on safe movement during activities of leisure or daily life
2. Bend at the hips, knees, and ankles rather than rounding the back
3. Rather than twisting the torso, use a step-to turn, so that the trunk, knees, and toes face the same direction
4. When holding objects out front, hold them close to the body, and when holding something in hands at sides of body, split and distribute the weight evenly across both hands (e.g., carrying shopping bags)
5. Use slow and controlled movements rather than sudden movements
6. Look for print or online resources from a national osteoporosis society

Box 4 Recommendation on exercise and physical activity

1. Ideally in consultation with a physiotherapist or exercise physiologist, individuals with a vertebral fracture should initiate an individualized exercise program focusing on goals such as improving back extensor endurance, spinal mobility, physical functioning, and balance

The exercise program can be introduced within 4–12 weeks after vertebral fracture, as tolerated, or when acute fracture-related pain has diminished, or after 12 weeks, based on individual preferences and clinician judgment. Exercises to consider are provided in the supplementary material (Table S4)

Individuals with a vertebral fracture should be referred to a physiotherapist or exercise physiologist, so that exercises can be phased in and tailored according to individual needs, health conditions, abilities, fracture type and symptoms, and time post-fracture (e.g., start with focus on teaching body mechanics, individualized selection and phasing in of exercises)

When access to physiotherapy or exercise physiologist is not possible, persons with vertebral fractures should be referred to print or online resources from a national osteoporosis society. (93.33%)

2. When pain has diminished and the fracture has healed (usually around 12 weeks post fracture), individuals with vertebral fracture should initiate an exercise program, ideally in consultation with a physiotherapist or exercise physiologist, and informed by a baseline assessment, so that the exercise prescription is individually tailored

The exercise program should include balance and functional training and progressive resistance training, focusing on form first and then progressing to moderate intensity (i.e., 70–80% of estimated 1 repetition maximum (RM), or 8–12 RM, determined during baseline assessment—an estimated 1 RM is suggested as the safety of 1 RM testing has not been established)

There is evidence that progressive resistance training may address activity limitations and improve physical functioning in individuals with vertebral fracture. There are very little data on the effects of exercise on BMD in this population. Functional or muscle strength training should target muscles of upper and lower extremities, back extensor muscles, and stabilizers of pectoral girdle

When selecting exercises, consider fall risk and the loads on the spine (e.g., modify or avoid rapid, repetitive, weighted, sustained or end-range flexion or twisting of the spine). Clinical judgment is required regarding the selection of exercises, especially ones that involve overhead movements, or hip and lower back extension (e.g., bridging) in the presence of lumbar spine fractures. Exercises to consider are provided in the supplementary material (Table S5). (96%)

3. Certain exercises or physical activities are sometimes considered risky for people with one or more vertebral fractures, including deadlift, overhead press, sit-ups, clean and jerk, deep squats, spinal flexion movements in yoga, Pilates, golf, ball sports, or anything involving sudden, end-range, or resisted spinal flexion and sudden or end-range spinal twisting. Some exercises, like yoga, Pilates, squats, overhead presses, and modified deadlifts may be acceptable if can be performed them with good alignment or if they could be modified to be safer, ideally supervised by an exercise professional. (95.83%)

4. Individuals with vertebral fractures often have questions about whether they can participate in certain physical activities of leisure or daily life (e.g., lifting, yoga, golf, running, Pilates). If the person has a history or a strong preference to perform an activity, the activity should be encouraged if it can be performed safely, or modified; however, individuals with vertebral fractures are encouraged to discuss their options with a healthcare provider

Factors that may affect decision-making include the person's physical health, functional status, and history of the activity, as well as time since fracture and time on therapy. (96.67%)

Box 5 Recommendations on physical assessment

1. Sudden onset or acute exacerbation of pre-existing back or radicular pain, decreased mobility due to pain, increase or sudden worsening of thoracic kyphosis, loss of height, or shortness of breath might indicate a new fracture or progression of an existing fracture and the need for cessation of exercise/therapy and referral back to physician. (96%)
2. The assessment of spinal range of motion should be avoided in people with an acute vertebral fracture or multiple fractures

If the fracture has healed, consider weighing the need for assessment with the potential risk and whether their functional mobility can be assessed via *observation during functional tasks (e.g., getting out of bed or chair). If it is necessary to assess spinal range of motion, consider a modified version, or cue the movement so it is slow and controlled. Do not continue if the movement is painful. (95.83%)*

3. Some experts feel that assessment of self-limited forward reach (i.e., to assess balance) should be avoided in all people with vertebral fractures or only in people with acute or painful fractures. Others think that it may be safe in some scenarios. Factors that might influence whether it is safe or necessary include whether shoulder flexion to 90 degrees is pain free, if you can ensure they are not reaching forward and rotating trunk at same time, if you have a spotter, if standing balance is not impaired, if there is no fracture-related pain, if it is relevant for activities of daily living, or if the patient identified it as a task they are having difficulty with. (95.83%)

Box 6 Recommendations on nutrition

All individuals with osteoporosis should follow national guidelines or their healthcare provider's recommendations related to protein, calcium, and vitamin D intake. Inadequate intake of nutrients and calories can result in weight loss and specifically loss of bone and muscle. When weight management or early satiety are a concern for individuals at any stage postvertebral fracture, consider the strategies below to ensure adequate intake:

1. Referral to a dietitian. (93.33%)
2. Weight monitoring at the discretion of the dietitian and client. (91.67%)
3. Dietitian to assess and educate on the recommended daily intake of protein, calcium, and vitamin D

Where diet is inadequate, recommend nutrient enhancement through nutrient dense foods and where required, supplementation based on guidelines and best practice. (96.67%)

4. Consider how functional impairments may impact food-related activities (e.g., bending over in the kitchen, standing in the kitchen, and grocery shopping) and develop a plan to address this or refer to an occupational therapist. (90%)
5. In presence of poor appetite and weight loss, suggest energy and protein dense foods to support weight maintenance or gain

Recommend meal programs and food access-related supports (e.g., grocery shopping delivery, meals delivered to home) where required. (90.48%)

6. If dysphagia is suspected, refer to a dietitian, speech language pathologist, or occupational therapist for assessment, education on the safest foods, and use of texture-modified foods. (94.24%)
7. Create an eating environment that supports food intake (e.g., preparation of appealing food). (80%)
8. Where required, increase variety in diet, considering individual food preferences and food matrices of different foods (e.g., yogurt vs milk vs cheese) to support bone health. (76.67%)

Discussion

Our international consensus process provides multidisciplinary biopsychosocial recommendations that target different HCPs (e.g., physiotherapists, physicians, exercise professionals, dietitians) to guide clinical practice and future research among people with VF. Pharmacotherapy is recommended to prevent fractures in people with osteoporosis [38], and given the high risk of having a subsequent fracture after the first VF, we provide guidance on how to safely perform those activities of daily living that might increase the risk of fracture, such as bending forward, turning, and holding or carrying objects. HCPs are often asked to advise on the weight that should be avoided when lifting objects. As there is no published data that would substantiate such recommendation, the panelists recommended guidance on safe movement and spine sparing strategies be provided, as how the weight is lifted influences fracture risk. While we advocate for the referral to physiotherapists and exercise professionals, we convey the message that they should also provide advice on safe movement techniques and pain management strategies that people can perform to improve independence in their daily lives. We emphasize the "how to" rather than providing restrictions and limitations, as it is paramount that individuals with VF receive guidance on how to modify activities that might be risky, rather than avoiding them, thus preventing or limiting negative effects on their mental health (e.g., anxiety, social isolation, and depression). Furthermore, we encourage the referral to a physiotherapist or occupational therapist to perform an assessment of fall risk and physical functioning (e.g., gait speed, Timed Up and Go Test, in accordance with the World Guidelines for Falls Prevention and Management for Older Adults) [39] or a home hazard assessment. Our recommendations are in line with a 2017 network meta-analysis of interventions for preventing falls in older adults, that demonstrated that exercise, alone or combined vision assessment and treatment, or with environmental assessment and modification, is associated with a reduced risk of injurious fall compared to usual care. [40]

Furthermore, we reached consensus on controversial topics, such as bracing and prolonged bed rest. Bracing remains an area where further research is needed. In general, it is not recommended, although there were a few respondents that thought that selected persons may find a brace helpful. Bed rest can be used in the acute phase, in presence of severe pain, but should not be used routinely and should not be used in the subacute and chronic phases. We reached consensus upon the need of early mobilization, as early as tolerated, and provide guidance on therapeutic goals, as well as examples of exercises based on the stage after the fracture, with tailored exercise programs to improve back extensor endurance and spinal mobility in the acute and subacute phase, to gradually introduce exercises to improve balance, physical functioning, and muscle strength in the chronic phase after a VF. Our recommendations in favor of back extensor and balance training are supported by existing literature. Sensitivity analyses from a systematic review in people with age-related hyperkyphosis recently published by members of our team showed that exercise may improve back extensor strength and endurance, pain, and physical functioning in people with low bone mass or VFs [19]. Back extensor endurance was moderately associated with better balance performance in 31 women with VFs,[41] and poor balance is a risk factor for falls in older women with and without osteoporosis [42, 43]. A 2019 Cochrane review on the effects of exercise for preventing falls in the community showed that balance and functional training, alone or combined with progressive resistance training, reduce the number of falls [44]. Furthermore, while there is no data in people with VFs, a recent meta-analysis demonstrated that supervision of exercise programs may reduce the risk of fracture in adults with and without musculoskeletal or neurological conditions. [46] Therefore, we recommend starting a tailored exercise program to improve balance and back extensor strength and endurance as early as tolerated, and we established consensus on the most appropriate exercises for different therapeutic goals in people with VFs.

Finally, we provide some nutritional recommendations to address common consequences of VFs. The importance of protein, calcium, and vitamin D for maintaining bone health is well known, [46–48] and HCPs should provide

guidance on how to meet the recommended protein, calcium, and vitamin D intakes and refer individuals with VFs to the numerous resources accessible to the public on the websites of national and international osteoporosis organizations. However, maintaining the recommended nutritional intake can be challenging after a VF. Some people with vertebral fracture reported a reduction in their caloric intake during the first few weeks after fracture, as pain and immobility made preparing and consuming food challenging [35]. Unintentional loss of body weight is a concern, as it can cause further disability and increase the risk of death [49–51]. We provide guidance on how to ensure an adequate nutritional intake, and we recommend the referral to a dietitian, in case of suspected malnutrition, or to an occupational therapist, in presence of functional impairments or environmental factors that impact food-related activities (e.g., preparing food and grocery shopping).

We acknowledge some limitations to our work. While we invited people from 16 countries in Asia, Europe, North America, and Oceania, none of the experts identified themselves as BIPOC (Black, Indigenous, and People of Color). While we did not apply any exclusion criteria based on country, race, ethnicity, or gender, our recruitment protocol lead to the identification of panelists of mainly white race. The acceptability and applicability of these recommendations among people of non-white race warrant further analysis. Further, we did not specifically formulate recommendations on behavioral change techniques to change practice or habits, as it was beyond the scope of the project. Researchers leading studies in people with VFs are encouraged to partner with experts in behavior change, to test the efficacy of behavior change techniques in people with VFs and inform their incorporation in future interventions. The consensus process did not consider the use of patient support groups, and there is some evidence that they may influence outcomes. Thus, future guideline developers may consider reviewing that body of evidence. Our consensus process bridges some gaps in the non-pharmacological and non-surgical management of VFs. However, a consumer engagement/patient-public involvement process [52, 53] is recommended before guidelines and recommendations are disseminated on a larger scale. A logical next step might be to engage target users of the recommendations (i.e., individuals with VFs, clinicians working with people with VFs, other stakeholders, and policy makers) to determine how to deliver the recommendations in a user-friendly way (e.g., recommendations to prioritize, user-friendly language, and supporting resources).

To conclude, we recommend a multidisciplinary biopsychosocial management of VFs to improve pain and promote safe movement strategies, exercise, and adequate nutrition. Future studies should test the efficacy of these recommendations for improving outcomes relevant to people with vertebral fracture and the effectiveness of their implementation in routine clinical practice.

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Data availability The data being reported are accurate and are coming from the official source.

Code availability Not applicable.

Declarations

Ethics approval This study received ethics approval from the University of Waterloo Research Ethics Board (ORE #43154).

Conflict of interest None.

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