ORIGINAL ARTICLE

Philippine Clinical Practice Guidelines for Periodic Health Examination: Screening for Musculoskeletal Disorders

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ABSTRACT

Background and Objective. Musculoskeletal diseases (MSDs) are acutely or chronically painful conditions that cause limitations in mobility, dexterity, and participation in society. They are a major contributor to years lived with disability worldwide and their burden is higher in countries with a lower sociodemographic index, like the Philippines. The goal of this clinical practice guideline (CPG) is to provide recommendations to primary care providers on screening for MSDs among asymptomatic, apparently healthy children and adults.

Methods. Following the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach to CPG development recommended in the Department of Health Manual, the evidence of net benefit or harm of screening for nine musculoskeletal conditions and risk factors was obtained through systematic literature search. Information on cost-effectiveness, patient values and preferences, acceptability, feasibility of screening, and its impact on equity were also obtained. The final recommendations were formulated through consensus by a panel of representatives from multiple stakeholder groups.

Results. There were 15 recommendations formulated. Strong recommendations were given to screen for physical inactivity among adults, fall risks and sarcopenia for adults aged ≥60 years old, and osteoporosis among women aged ≥65 years old. However, strong recommendations were made against screening for low vitamin

Full copy of the Philippine Clinical Practice Guidelines for Periodic Health Examination: Screening for Musculoskeletal Disorders can be found on this link – https://drive.google.com/file/d/1gD9YT6u0Iq6zwHYkd8ToGRSm9g7LHCu5/view

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D among infants, children, and adults, and against screening for osteoporosis among men and among women aged <65 years old.

Conclusion. Through a comprehensive evaluation of the best available evidence using the GRADE approach, the Task Force developed 15 recommendations on screening and risk factor assessment for nine MSDs. These recommendations will serve as guidance on screening for MSDs at the primary care level.

Keywords: periodic health examination, musculoskeletal, screening, executive check-up

INTRODUCTION

The Philippine Guidelines on Periodic Health Examination (PHEX) 2004 was a comprehensive guide on screening interventions committed to providing early preventive services for apparently healthy Filipinos.[1] This guideline is being updated to support the Universal Health Care Act, which aims to provide all Filipinos access to quality and affordable medical services starting with primary care benefits.[2] This manuscript is dedicated for the update of recommendations on screening for musculoskeletal disorders (MSDs).

MSDs refer to disorders of muscles (e.g., sarcopenia), bones (e.g., osteoporosis, fragility fractures, traumatic fractures), joints (e.g., osteoarthritis, rheumatoid arthritis, gout), and adjacent connective tissues (e.g., systemic lupus erythematosus).[3] There are more than 150 different MSDs that lead to temporary or lifelong limitations in function. MSDs are estimated to affect 1.71 billion people worldwide.[4] They are the largest contributor to the need for rehabilitation services in both adults and children.[5] On top of the direct complications of MSDs, these disorders frequently coexist with and increase the risk of developing other noncommunicable diseases such as cardiovascular diseases and mental health issues.[3,6] The need to screen for MSDs to enable early diagnosis and treatment is thus clear and urgent. Preventive measures against MSD-related risks and early identification of MSDs may reduce the burden of MSDs and improve the overall health of Filipinos.

This CPG aims to provide evidence-based recommendations on the screening of asymptomatic, apparently healthy children and adults for MSDs and their risk factors through a comprehensive evaluation of the benefits, harms, costs, acceptability, feasibility, people's values and preferences, and the impact of screening on equity. The following MSDs and risk factors were covered in this CPG: MSD in general, scoliosis, work-related MSD (WRMSD), physical inactivity, risk for musculoskeletal injury (MSKI), low vitamin D, risk of falls, sarcopenia, and osteoporosis. Although evidence on the effects of consequent management is cited, the guideline does not make any recommendations for the treatment of MSDs.

This CPG will provide guidance for primary care providers (general physicians and specialists, other health providers) in the examination of asymptomatic, apparently healthy individuals for select MSDs. Academic medical institutions may use this CPG as a reference to educate doctors-in-training on the best practices in screening for MSDs. The CPG may also guide labor force administrators and asymptomatic, apparently healthy individuals on the conditions that need to be included in the annual medical examinations of employees. Lastly, regulatory agencies and policy makers in the Philippines, government and private financial and health delivery institutions in the healthcare industry may use the CPG and its findings as basis for the development of screening programs or health benefit packages for MSDs and related conditions.

METHODS

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach to CPG development recommended in the Department of Health (DOH) Manual on Practice Guideline Development was utilized.[7] The detailed methodology can be viewed in the full guideline manuscript via http://phex.ph/.

Preparation

The Task Force Steering Committee determined the objectives, scope, target audience, and clinical questions of the guideline. It also convened the Technical Working Group involved in creating the evidence base and the Consensus Panel involved in finalizing the recommendations for each clinical question included. Nine clinical questions (Table 1) were prioritized based on burden of illness, availability of screening tests and early treatment, applicability to the general population from childhood to old age, and perceived controversies, uncertainty, and variation in screening practices.

COI Management

All task force members went through an evaluation of their potential conflicts of interest (COIs) in the last four years. The COI committee classified and gave recommendations on their management. Consensus Panel members with financial COI were not allowed to vote for questions related to the COI**.** Those with non-financial COIs (such as authorship related to the CPG topic) were allowed to participate, but their COIs were declared during the panel meeting and in the final manuscript. The declared COIs were valid during the period of guideline development, but the participants' actual COIs may have changed since then.

Evidence Synthesis

The evidence review questions were developed in the PICO (population, intervention, comparator, and outcome) format. International practice guidelines related to periodic health screening were appraised, including but not limited

Table 1. Key Clinical Questions during Guideline Development

No.	Clinical question
1	Should we screen for MSDs using Gait, Arms, Legs, and Spine (GALS) or pediatric GALS (pGALS) among asymptomatic, apparently healthy adults and children?
2	Should we screen for scoliosis among asymptomatic, apparently healthy children?
3	Should we screen for WRMSD among asymptomatic, apparently healthy working adults?
4	Should we screen for physical inactivity among asymptomatic, apparently healthy children and adults?
5	Should we screen for risk of MSKI among asymptomatic, apparently healthy children and adults?
6	Should we screen for low vitamin D among asymptomatic, apparently healthy children and adults?
7	Should we screen for predisposition to fall among asymptomatic, apparently healthy adults?
8	Should we screen for sarcopenia among asymptomatic, apparently healthy adults?
9	Should we screen for osteoporosis among asymptomatic, apparently healthy adults?

to the Canadian Task Force on Preventive Health Care, U.S. Preventive Services Task Force, and the National Institute for Health and Care Excellence. The evidence summaries of relevant good quality CPGs done within five years were adapted using the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) Adolopment approach and updated.

If updated, relevant, and trustworthy CPG was not found, a systematic search of local and international databases, including MEDLINE (via PubMed), The Cochrane Library, and HERDIN was performed. The end dates of the search ranged from August 2022 to March 2023 across the nine questions. Systematic reviews that met the inclusion criteria to answer the clinical questions were used directly to identify relevant articles and to present the summary of findings. If no related systematic reviews were found, *de novo* systematic reviews were conducted. Direct evidence on the benefits and harms of screening versus no screening for MSDs among asymptomatic, apparently healthy children and adults were sought. In its absence, indirect evidence on net benefit or harm of early treatment and the accuracy of diagnostic tests were appraised and summarized.

Appraisal of methodological quality was done using the Cochrane Risk of Bias tool for randomized controlled trials (RCTs), Painless EBM appraisal criteria, the Quality Assessment of Diagnostic Accuracy Studies-2 for diagnostic accuracy studies, the Newcastle–Ottawa Scale for observational studies, and the AGREE-II tool for guidelines.[8-12] The GRADE approach was used to rate the certainty of evidence and the strength of recommendations (Table 2).[13] The certainty of evidence assessment took into consideration risk of bias, indirectness, imprecision, and inconsistency of the available summarized data.

We also searched the literature for disease burden, cost-effectiveness of screening and early treatment, recommendations of international organizations, and availability and acceptability of screening tests and treatment. Search for the values and preferences of the general population, feasibility implementing the interventions including the facilitators and barriers of screening, and its impact on health equity was also done.

Formulation of the Recommendations

The multisectoral consensus panel identified the critical and important outcomes for each clinical question (Appendix A) and reviewed the evidence summaries. During the *en banc* meeting, they discussed and formulated the recommendation statements and the strength of recommendation (Table 2) through formal consensus (>75% agreement).[13] Up to three rounds of voting and a modified Delphi methodology were done if consensus was not reached.

Using the GRADE evidence to decision framework, the panel considered the balance of benefit and harm of screening, its cost-effectiveness, whether individuals value or prefer it,

Table 2. Grading of Certainty of Evidence and Strength of Recommendations

Certainty of Evidence	Description
High	We are very confident that the true effect lies close to the estimate of the effect
Moderate	We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different
Low	Our confidence in the effect estimate is limited: The true effect maybe substantially different from the estimate of the effect
Very low	We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect
Strength of Recommendation	**Description**
Strong	Advantages of the intervention significantly outweigh disadvantages or vice versa
Weak	Advantages of the intervention may outweigh disadvantages, or vice versa, or the relationship between advantages and disadvantages is not clear

Adapted from GRADE Working Group

its applicability, feasibility, appropriateness, and its impact on equity.[14] A strong recommendation for screening was made when the panel was confident that the desirable effects of screening outweigh its harms and costs, and that it is valued by patients, feasible, applicable, and has a positive impact on health equity.[15] A weak recommendation for screening meant that the desirable effects probably outweighed the undesirable effects. Strong or weak recommendations against screening were made when the undesirable effects of screening intervention either definitely or probably outweighed its desirable effects.

External Review

Three independent stakeholders specializing in orthopedics, rheumatology, and rehabilitation medicine reviewed the manuscript for completeness and relevance of the evidence, the processes, clarity of the output (the recommendations and the manuscript), and the planned methods of dissemination of the CPG. Their feedback was considered by the Task Force Steering Committee in finalizing the CPG manuscript.

Dissemination, Implementation, Monitoring, and Updating

The guideline will be disseminated by posting the evidence summaries and recommendations in the web-based application https://phex.ph. It will also be accessible online via the websites of the Philippine DOH and the participating organizations. This journal publication and discussion in medical education forums attended by doctors, other health professionals, and the public are other ways to ensure good dissemination. The public may also be informed through radio, television, social media, and posters and other written educational materials.

The CPG manuscript was approved by the Evidence Generation and Management Division of the Disease Prevention and Control Bureau of the DOH for endorsement to the DOH Secretary as a DOH-approved CPG. Implementation of strong recommendations may be done by incorporating these into screening algorithms and medical facility standards of care (or quality of care indicators), subject to reimbursement under the Universal Health Care Act implementing rules and regulations. Users of the guideline can use an online application to obtain a list of appropriate screening tests for individuals after encoding their age, sex, height, weight, smoking and sexual history, and pregnancy status.

Monitoring of uptake of the guideline can be done yearly through the Philippine Health Insurance Corporation reimbursement process. User access to the CPG through the websites can also be monitored annually. The guideline and its recommendations will be updated as new evidence on screening, diagnosing, or managing various risk factors and MSDs emerges, or in three years after publication of the guideline.

RESULTS

The guideline has 15 recommendations, which are summarized in Table 3. A list of the recommended screening tools can be found in Appendix B.

Musculoskeletal Disease

Recommendation 1. Among asymptomatic, apparently healthy adults, we suggest screening for musculoskeletal disease using the GALS locomotor screen once a year. *(Very low certainty of evidence, weak recommendation)*

Recommendation 2. Among asymptomatic, apparently healthy children, we suggest screening for musculoskeletal disease using the pGALS locomotor screen once a year. *(Very low certainty of evidence, weak recommendation)*

Key findings: There was no direct evidence on the impact of GALS or pGALS screening on clinical outcomes, and no CPGs were found that evaluated these tests in the screening for MSDs. Indirect evidence from nine observational studies (n=3,347) showed likely beneficial effects of screening.[16–24] Early treatment due to early disease detection was associated with less radiographic progression of rheumatoid arthritis in adults compared to delayed treatment (Sharp score: MD 1 point vs. MD 7 points, p=0.03).[16–18] Most children (72–95%) experienced no or minimal discomfort with the pGALS examination.[19–21] Both GALS and pGALS were highly sensitive (GALS Sn 97.9%, 95% CI 88.5, 99.6%; pGALS Sn 96.6%, 95% CI 90.3, 99.3%) but not specific (GALS Sp 37.7%, 95% CI 19.1, 76.5%; pGALS Sp 6.8%, 95% CI 2.5, 14.3%) in detecting MSD.[22–24]

No cost-effectiveness studies were found on screening with GALS or pGALS but performing these assessments do not entail additional direct cost to patients and to health professionals. The tests can be completed in an average of 2.49–4.26 minutes, and this was acceptable to most parents (94–98.1%) and children (88.7–98%).[19–21,23–25] However, one study reports low rate of practice (21%) of the GALS screen by medical interns in their clinical encounters.[26]

Justification: The consensus panel recognized that screening would enable the detection of the more common MSDs, and that early detection and treatment may result in improved outcomes. GALS and pGALS are easy to perform (<5 minutes) when regularly practiced but most primary care providers will need training since these tests are not routinely used in the current primary care setting.

Scoliosis

Recommendation 3. Among asymptomatic, apparently healthy children, we suggest AGAINST screening for scoliosis. *(Very low certainty of evidence, weak recommendation)*

Key findings: Evidence was indirect from diagnostic accuracy studies (n=306,082), and trials and observational

Table 3. Summary of Recommendations on Screening for Musculoskeletal Disorders and Risk Factors

Recommendations	Strength of Recommendations	Overall Certainty of Evidence
Musculoskeletal disease		
Among asymptomatic, apparently healthy ADULTS, we **suggest screening** for musculoskeletal disease using the GALS locomotor screen once a year.	Weak	Very low
Among asymptomatic, apparently healthy CHILDREN, we **suggest screening** for musculoskeletal disease using the pGALS locomotor screen once a year.	Weak	Very low
Scoliosis		
Among asymptomatic, apparently healthy CHILDREN, we **suggest AGAINST screening** for scoliosis.	Weak	Very low
Work-related musculoskeletal disorder		
Among asymptomatic, apparently healthy WORKING ADULTS, we **suggest screening** for the risk of work-related musculoskeletal disorder.	Weak	Low
Physical inactivity*		
Among asymptomatic, apparently healthy ADULTS, we **recommend screening** for inadequate physical activity using the PAVS at least annually.	Strong	Very low
Among asymptomatic, apparently healthy ADOLESCENTS, we **suggest screening** for inadequate physical activity using either the GSHS or the PAQ-C at least annually.	Weak	Very low
Among asymptomatic, apparently healthy CHILDREN, we **suggest AGAINST screening** for inadequate physical activity.	Weak	None
Risk of musculoskeletal injuries		
Among asymptomatic, apparently healthy children and adults, we **suggest AGAINST screening** for risk of musculoskeletal injuries.	Weak	Very low
Low vitamin D		
Among asymptomatic, apparently healthy infants, children, and adults, we **recommend AGAINST screening** for low vitamin D.	Strong	Very low
Risk of falls		
Among asymptomatic, apparently healthy older adults ≥60 years old, we **recommend screening** for fall risks.	Strong	Low
Among asymptomatic, apparently healthy adults <60 years old, we **suggest AGAINST screening** for fall risks.	Weak	Low
Sarcopenia		
Among asymptomatic apparently healthy adults ≥60 years old, we **recommend screening** for sarcopenia using a combination of tools (SARC-Calf with or without grip strength assessment) annually or after the occurrence of a major health event (fall, fracture, hospital admission).	Strong	Very low
Among asymptomatic, apparently healthy adults <60 years old, we **suggest AGAINST screening** for sarcopenia.	Weak	None
Osteoporosis		
Among asymptomatic, apparently healthy men at any age and women <65 years old, we **recommend AGAINST screening** for osteoporosis.	Strong	Very low
Among asymptomatic, apparently healthy women ≥65 years old, we **recommend screening** for osteoporosis using FRAX with or without BMD or OSTA.	Strong	Low

**For the recommendation on screening for physical activity, the pediatric age group was further divided into adolescents and children (referring to those below the adolescent age group) because of different screening tools used for these groups.*

FRAX – Fracture Risk Assessment Tool, BMD – bone mineral density, OSTA – Osteoporosis Self-Assessment Tool for Asians

studies (n=835) on the effectiveness of linked treatment (exercise and bracing) for scoliosis.

The most sensitive tests when used alone were the scoliometer (Sn 100%, 95% CI 84.2, 100%) and Moire topography (Sn 93.8%, 95% CI 79.2, 99.2%), but diagnostic accuracy increased with the use of multiple tests (i.e., forward bend test and scoliometer, followed by Moire topography) (Sn 93.8%, 95% CI 93.3, 94.3%).[27–29] Two trials on physiotherapeutic scoliosis-specific exercise showed reduction in curve progression with the prescribed exercise compared to usual physiotherapy or traditional spinal exercises; however, results could not be pooled due to inadequate data (MD -7.0˚, 95% CI -8.31, -5.69 in 1 RCT; -0.33˚ in the intervention group vs. +1.12˚ in the control group in the other RCT). There was also inconclusive effect on serious adverse events (RR 0.79, 95% CI 0.39, 1.58).[30,31] No significant difference in adverse events was observed with bracing for curve progressions >50˚ and >5˚ compared to observation or watchful waiting (p=0.32).[32–36] Quality of life was not significantly improved with bracing (MD 0.10 points, 95% CI -3.76, 3.96).[37]

Cost-effectiveness studies on single-step screening programs from Singapore and Turkey reported minimal costs, while a two-step screening program (i.e., forward bend test with the school physician, followed by a consult from an orthopedic surgeon) in Italy was more cost-effective than a referral to an orthopedic surgeon alone.[38-40] There was acceptance of scoliosis screening at schools by 94.8% of families in a European study.[41]

Justification: The consensus panel considered that early detection of scoliosis during childhood is important to prevent or control its consequences throughout life such as back pain, psychological distress, and respiratory compromise. However, the panel deemed that the evidence of the net benefit of screening for scoliosis in asymptomatic, apparently healthy children is inconclusive to recommend screening on a nationwide scale.

Work-related Musculoskeletal Disorders

Recommendation 4. Among asymptomatic, apparently healthy working adults, we suggest screening for the risk of work-related musculoskeletal disorders. *(Low certainty of evidence, weak recommendation)*

Key findings: One RCT (n=741) demonstrated that the use of a questionnaire to screen for symptoms and ergonomic or work-related risk factors followed by interventions resulted in similar or fewer neck, upper back, and shoulder symptoms (RR 0.85, 95% CI 0.65, 1.07), and sick leaves (RR 0.89, 95% CI 0.78, 1.02 for at least one day of sick leave and RR 0.84, 95% CI 0.64, 1.10 for at least seven days of sick leave) among office workers who received full feedback on their questionnaire results compared to those who were given limited advice.[42] On the other hand, eight studies (seven RCTs, one non-randomized trial) (n=5,530) showed that ergonomic risk assessment coupled with corresponding workstation adjustments resulted in fewer reports of arm pain (RR 0.48, 95% CI 0.30, 0.75), and similar or fewer reports of neck (RR 0.97, 95% CI 0.86, 1.10), wrist/hand (RR 0.94, 95% CI 0.80, 1.10), and upper back pain (RR 0.62, 95% CI 0.38, 1.00) compared to no ergonomic risk assessment or intervention.[43–50] There was no significant difference in the effect of ergonomic risk assessment or intervention compared to no ergonomic risk assessment or intervention on symptoms in the shoulders (RR 0.98, 95% CI 0.83, 1.16) and forearm (RR 0.99, 95% CI 0.83, 1.17), while there was inconclusive effect on symptoms in the lower back (RR 0.90, 95% CI 0.69, 1.17), hip/thigh (RR 1.02, 95% CI 0.80, 1.30), knee (RR 1.08, 95% CI 0.87, 1.35), and ankle/feet (RR 1.04, 95% CI 0.82, 1.32). There were similar to more sick leaves among those who had ergonomic risk assessment or intervention compared to no risk assessment or intervention (RR 1.51, 95% CI 0.99, 2.31). Subgroup analysis by job type showed significant benefit in reducing arm (RR 0.33, 95% CI 0.17, 0.64) and low back pain (RR 0.53, 95% CI 0.36, 0.78) among hospital orderlies, but no significant benefit was observed for office workers and kitchen workers.[49] None of the included studies reported any instance of harm because of screening and the subsequent intervention.

No local economic evaluations on screening or risk assessment for WRMSD were found. An RCT conducted in the Netherlands showed higher healthcare costs and productivity losses with a participatory ergonomics program compared to no intervention.[51] In the Philippines, employers can reach out to the Occupational Safety and Health Center under the Department of Labor and Employment for "safety and health audits" at no cost to the employer.

A few studies have successfully performed musculoskeletal risk assessment in various occupations in the Philippines with good compliance among participants, but their impact on WRMSD were unreported.[52–54] In the Integrated Survey on Labor and Employment conducted from 2015–2016 by the Philippine Statistics Authority, 30.8% of respondents reported having an ergonomics intervention in the workplace.[55] There was no information on the quality and oversight of these interventions.

Justification: The consensus panel considered that screening for WRMSD will promote prevention of these diseases and result in overall better health for workers. However, a weak recommendation was given because studies were limited to office workers, kitchen workers, and hospital orderlies, and the panel perceived that there would be limitations in enforcing nationwide screening. There is a lack of occupational medicine practitioners and specialists in ergonomic risk assessment in the country. There is also a need for many screening tools (such as the RSI QuickScan Questionnaire) since these tools are usually specific per job type.[42,56,57] The Rapid Upper Limb Assessment and Rapid Entire Body Assessment are tools commonly used by occupational medicine physicians in the Philippines and are found to correlate with WRMSD, but these were not

the screening tools used in the studies reviewed.[58,59] There were no studies on the frequency of screening, but the panel opined that this will depend on the type and duration of work done, the hazards associated with an occupation, and the level of risk identified.

Inadequate physical activity

Recommendation 5. Among asymptomatic, apparently healthy ADULTS, we recommend screening for inadequate physical activity using the PAVS at least annually. *(Very low certainty of evidence, strong recommendation)*

Recommendation 6. Among asymptomatic, apparently healthy ADOLESCENTS, we suggest screening for inadequate physical activity using either the GSHS or the PAQ-C at least annually. *(Very low certainty of evidence, weak recommendation)*

Recommendation 7. Among asymptomatic, apparently healthy CHILDREN, we suggest AGAINST screening for inadequate physical activity. *(No certainty of evidence, weak recommendation)*

Key findings: There were no studies on the effects of screening for physical inactivity among asymptomatic, apparently healthy children and adults. Among obese/overweight children and young adults, physical activity interventions compared to no intervention resulted in significant benefit in terms of weight loss (MD -1.18 kg/m^2, 95% CI -1.67, -0.69) and health-related quality of life (SMD 0.44, 95% CI 0.09, 0.79). There was inconclusive effect on cognitive function (MD 5.00 points, 95% CI 0.68, 9.32).[60–63] Physical activity interventions showed significant benefit in improving bone mineral density (BMD) among peri- and post-menopausal women (lumbar spine BMD: MD 0.54 kg/m^2, 95% CI 0.22, 0.87; femoral neck BMD: MD 0.22 kg/m^2, 95% CI 0.07, 0.38; total hip BMD: MD 0.48 kg/m^2, 95% CI 0.22, 0.75); reducing incidence of falls among community-dwelling adults aged ≥65 years old (RR 0.83, 95% CI 0.76, 0.92); and reducing incidence of CVDs (RR 0.83, 95% CI 0.77, 0.89), mortality due to CVDs (RR 0.77, 95% CI 0.71, 0.84), and incidence of diabetes mellitus (RR 0.74, 95% CI 0.72, 0.77) among healthy, asymptomatic adults.[64-68]

Several screening tools for detection of physical inactivity were considered in this review. For children, accelerometry would yield the most accurate measurement of physical activity, but it is time- and cost-intensive and thus difficult to administer in a large-scale population.[69] Self-report measures are also difficult to use due to the need for habitual monitoring, understanding of questions, and accurate recall. Only the Physical Activity Questionnaire for Older Children or Adolescents (PAQ-C/PAQ-A) and the Global School-based Student Health Survey (GSHS) questionnaires had available data on their reliability, and these were found to be weakly correlated with accelerometry (r=0.34 for PAQ-C; r=0.18 for males and r=0.27 for females for GSHS).[70-73] Among adults, the Physical Activity Vital Sign questionnaire (PAVS) (r=0.52) and the Modifiable Activity Questionnaire (r=0.71) demonstrated moderate agreement with accelerometry, while the International Physical Activity Questionnaire (r=0.19), Global Physical Activity Questionnaire (r=0.19) and Previous Week Modifiable Activity Questionnaire (r=0.37) were weakly correlated.[74-81] Pedometers and accelerometers may also be used among adults, but pedometers run the risk of underestimating step counts at slow activity speeds, which would inaccurately measure physical activity for sedentary adults or the elderly.[82–84]

Of the screening tools described, accelerometers and pedometers are the costliest (>PhP 3,000/unit).[85,86] A study on the cost-effectiveness of physical activity interventions found that point-of-decision prompts and school-based physical activity interventions for children and adolescents were the most cost-effective strategies.[87]

Justification: The consensus panel considered that there is a global initiative to promote adequate physical activity among persons of all ages to prevent and resolve the adverse consequences of inactivity. Despite the very low certainty of evidence, the recommendation for screening among adults is strong because of the tremendous disease burden of obesity and the simplicity, availability, and ease of use of the PAVS questionnaire. However, PAVS has not been translated into Filipino and thus cannot be administered to non-English speaking Filipinos.

Among adolescents, the value of screening is well recognized. When used in the school setting, the WHO-endorsed GSHS questionnaire may require consent of their parents or legal guardians due to the sensitive nature of select items in this questionnaire (e.g., items on substance use, unintentional injuries, violence, risky sexual behaviors). Both the GSHS and the PAQ-C need to be translated and validated in the local setting, but the English version can be used in schools.

At least annual screening was the panel's recommended frequency for adolescents and adults. The presence of a screening program may serve to remind and encourage individuals to become more physically active.

Among asymptomatic, apparently healthy children <9 years old, the panel considered that there was no evidence of significant net benefit of screening for physical inactivity and there was no validated tool for large-scale screening. By suggesting against screening, the panel gives leeway for practitioners working in high-resource settings to discuss screening for select children (e.g., those who are overweight or obese) with their concerned families and/or schools.

Risk for musculoskeletal injuries

Recommendation 8. Among asymptomatic, apparently healthy children and adults, we suggest AGAINST screening for risk of musculoskeletal injuries. *(Very low certainty of evidence, weak recommendation)*

Key findings: There were no studies that assessed the impact of screening versus no screening for MSKI risk on occurrence of injuries and MSDs. Studies that assessed tests of physical performance (PPTs) showed high reliability but low sensitivity in differentiating individuals that were high-risk for MSKI. The following PPTs were reviewed: Functional Movement Screen (FMS), Star Excursion Balance Test (SEBT), Y-Balance Test (YBT), Landing Error Scoring System, various lower extremity tests, and Closed Kinetic Chain Upper Extremity Stability Test.[88–110] Only the FMS and the SEBT were shown to be associated with a risk for MSKI—low FMS scores were associated with higher risk for MSKI among male students (RR 1.51, 95% CI 1.34, 1.69), while low SEBT scores were associated with a higher risk for MKSI among military and basketball players (OR 3.0, 95% CI 1.50, 6.10).[89–97] Integrating PPT scores (e.g., FMS and YBT) and certain personal characteristics (e.g., injury history, age) can moderately to strongly predict MSKI risk among athletes (OR 3.4, 95% CI 2.0, 6.0).[111]

One observational study (n=38) that evaluated the effect of integrated neuromuscular training for badminton players screened for MSKI risk using FMS reported no injuries for both high- and low-risk groups.[112] Data from trials on preventive injury programs (e.g., multicomponent exercise-based programs, balance training, plyometrics) show benefit for reducing incidence of MSKIs; however, none of these interventions were specifically applied to individuals who underwent MSKI screening.[113–122]

Most PPTs require minimal to no equipment. The FMS and the YBT test kits come at a substantial cost (>PhP 10,000).[123]

Justification: With the call to increase physical activity for most of the population, there must be awareness of the need for MSKI prevention. MSKI can lead to permanent disability and are a huge burden to the individual and to society. Screening for risk of MSKI, which is currently practiced for organized sports (especially during competitions), will facilitate interventions for at-risk individuals. However, the panel considered that there was scarce data on the benefits and harm of screening for MSKI both for athletes and for the general population. The suggestion AGAINST routine screening leaves room for those involved in organized sports activities to continue their screening activities while we await more robust evidence to justify screening for the general population.

Vitamin D deficiency

Recommendation 9. Among asymptomatic, apparently healthy infants, children, and adults, we recommend AGAINST screening for low vitamin D. *(Very low certainty of evidence, strong recommendation)*

Key findings: There were no studies on the effects of screening versus no screening of asymptomatic individuals of all ages for vitamin D deficiency on clinical outcomes. Vitamin D supplementation for vitamin D-deficient infants aged 0–11 months did not have a significant effect on height (MD -0.50 cm, 95% CI -1.80, 0.80), weight (MD -0.18 kg, 95% CI -0.77, 0.41), and the risk for pneumonia (RR 1.06, 95% CI 0.90, 1.24) compared to placebo. There was inconclusive effect on all-cause mortality (RR 1.43, 95% CI 0.54, 3.74).[124–126] For children aged 2–16 years, vitamin D supplementation did not have a significant effect on height (MD 1.24 cm, 95% CI -0.80, 3.29), weight (MD -0.01 kg, 95% CI -2.97, 2.95), and body mass index (BMI) (MD -0.18 kg/m2, 95% CI -1.04, 0.69) compared to placebo or low-dose vitamin D. There was inconclusive effect on the risk for hypercalciuria (RR 2.59, 95% CI 0.12, 53.88).[127,128] For adults aged ≥18 years who received vitamin D supplementation compared to placebo, there was inconclusive effect on the risks for all-cause mortality (RR. 0.14, 95% CI 0.02, 1.22), fractures (RR 1.09, 95% CI 0.19, 6.17 after 3–12 months; RR 0.96, 95% CI 0.61, 1.51 after 3 years), falls (RR 1.17, 95% CI 0.76, 1.79 after 1 year; RR 1.06, 95% CI 0.94, 1.18 after 3 years), and serious adverse events (RR 1.36, 95% CI 0.87, 2.14). No significant difference was observed for adverse events (RR 0.68, 95% CI 0.46, 1.00).[129] Among older adults aged ≥50 years, vitamin D supplementation significantly reduced the risk of falls after a 2-year follow-up compared with placebo or no treatment (RR 0.33, 95% CI 0.19, 0.58), but there was no significant difference in effect when high-dose vitamin D was compared with low-dose vitamin D after a 2-year follow-up (RR 1.00, 95% CI 0.89, 1.13).[130-132] The effects on all-cause mortality (RR 0.87, 95% CI 0.36, 2.12) and hypercalcemia (RR 2.91, 95% CI 0.12, 71.29) were inconclusive.

Clinical prediction models can identify adults at risk for vitamin D deficiency with moderate sensitivity and high specificity (Sn 61%, Sp 82–84%). These models include predictors such as age, sex, BMI, lifestyle, and physical activity.[133] However, these models have not been validated among Filipinos.

Cost-effectiveness studies among Americans and Europeans observed that screening and supplementation for vitamin D were cost-effective strategies for preventing falls and reducing mortality among older adults.[134–136] In the Philippines, the estimated annual cost of vitamin D screening and supplementation range from PhP 1,600.00–3,460.00.[137,138]

Justification: The panel considered that there was absence of clear benefit for vitamin D supplementation. Given the potential harms of vitamin D supplementation and the

cost of screening and intervention, the panel made a strong recommendation AGAINST screening. The availability, accessibility, and quality standards of the screening test are unknown. Programs that improve nutrition and education, directed to individuals with low socioeconomic status who are at higher risk of vitamin D deficiency, may be more worthwhile than doing screening.

Risk of falls

Recommendation 10. Among asymptomatic, apparently healthy older adults ≥60 years old, we recommend screening for fall risks. *(Low certainty of evidence, strong recommendation)*

Recommendation 11. Among asymptomatic, apparently healthy adults <60 years old, we suggest AGAINST screening for fall risks. *(Low certainty of evidence, weak recommendation)*

Key findings: Screening for fall risk resulted in reduced recurrent falls among community-dwelling healthy older adults aged ≥60 years compared to usual care (RR 0.87, 95% CI 0.76, 0.99).[139–155] Fear of falling was also lower among older adults in the fall risk evaluation group (RR 0.47, 95% CI 0.39, 0.56).[149,156] There was no significant difference between screening for falls and usual care in terms of risk of fall-related fractures (RR 1.04, 95% CI 0.83, 1.30), hospitalization (RR 0.90, 95% CI 0.80, 1.01), mortality (RR 0.95, 95% CI 0.81, 1.11), and disability (MD ranging from 0.20 to 1.30 points; outcome not pooled due to inadequate data) among the older adult population. No significant benefit was observed for quality of life (MD 11.84 points, 95% CI -0.12, 30.8).[139,140,143–147,149,150,152,153,155–172]

In 2017, an analysis of treatment costs for surgical intervention for fall-related concerns such as fractures at a tertiary government hospital in the Philippines ranged from PhP 126,349.02–147,749.44.[172] Almost half (46.1%) were hospital sector costs (i.e., diagnostic and laboratory fees, use of facilities, cost of surgery, physicians' fees, and other sector costs). An RCT (n=233) conducted in the Netherlands found that a comprehensive fall assessment by a multidisciplinary team which takes an average of 150 minutes per participant was not cost-effective when compared to usual care.[144]

Justification: A screening program to detect risk of falls may serve as a preventive strategy for falls. Although the certainty of evidence is low, the panel decided on a strong recommendation for screening among adults ≥60 years because of direct evidence showing significant benefits and minimal harms with screening. When implemented in the Philippines, the screening tests are simple and relatively easy to do and will not entail additional costs. Interventions for individuals with high risk of falling (exercises, activity modification) are feasible, already part of the usual health interventions for the elderly, and are not harmful. On the other hand, the downstream effects of falls (including fragility fractures) in older adults are disabling and life-threatening, and their treatment involves high cost. The Timed Up and Go, Get Up and Go, and the Berg Balance Scale may be used for screening.[173,174] These tests are commonly used in geriatrics practice but are not routinely done by all healthcare practitioners.

For adults <60 years old, the suggestion was NOT to routinely screen for risk of falls due to scarcity of data in this age group. This leaves room for discussion between the primary care physician and individual patients to consider screening on a case-to-case basis.

Sarcopenia

Recommendation 12. Among asymptomatic apparently healthy adults ≥60 years old, we recommend screening for sarcopenia using a combination of tools (SARC-Calf with or without grip strength assessment) annually or after the occurrence of a major health event (fall, fracture, hospital admission). *(Very low certainty of evidence, strong recommendation)*

Recommendation 13. Among asymptomatic, apparently healthy adults <60 years old, we suggest AGAINST screening for sarcopenia. *(No certainty of evidence, weak recommendation)*

Key findings: There were no studies on the effect of screening versus no screening for sarcopenia among asymptomatic, apparently healthy adults on clinical outcomes. Among the screening tests for sarcopenia, the Ishii score had the best pooled sensitivity (Sn 81%, 95% CI 69, 89%) and pooled specificity (Sp 83%, 95% CI 75, 89%).[175–179] SARC-F and SARC-F with calf circumference (SARC-Calf) were highly specific (SARC-F Sp 87%, 95% CI 83, 91%; SARC-Calf Sp 88%, 95% CI 79, 96%) but were also the least sensitive (SARC-F Sn 29%, 95% CI 20, 38%; SARC-Calf Sn 54%, 95% CI 39, 69%).[180–185] A positive SARC-F screening result was associated with all-cause, CVD-specific, and cancer-specific mortality, with hospitalization, lower quality of life ratings, and high depression scores.[186–190] The Ishii score was associated with higher mortality at three years.[189] Among patients screened positive and confirmed with sarcopenia, a multi-component intervention (moderate physical activity, nutritional interventions, and technological support) led to lower mobility disability rates compared to health or lifestyle education programs (HR 0.78, 95% CI 0.67, 0.92) without increasing the risk of serious adverse events (RR 1.09, 95% CI 0.94, 1.26).[191]

Most of the existing screening tools can be performed at minimal to no cost, and different screening strategies (e.g., EWGSOP strategy, SARSA-Mod) were shown to be cost-effective in Iran.[192] Several studies have demonstrated that sarcopenia screening is feasible, particularly when using self-completed questionnaires, a mobile application of SARC-F, phone interviews, and online surveys.[193–198] Low awareness and limited knowledge on sarcopenia among health

professionals are barriers to screening implementation.[199] However, screening for sarcopenia may be facilitated nationwide with the proposed creation of geriatric specialty centers among DOH-retained regional hospitals.[200]

Justification: Despite the very low certainty of evidence, a strong recommendation for sarcopenia screening among individuals ≥60 years old was made due to the high burden of sarcopenia.[201] Sarcopenia usually coexists with other geriatric syndromes, such as osteoporosis and risk for falls, that portend poor health outcomes. Identifying individuals with sarcopenia and those at risk among older adults may maintain their mobility and increase their chances of maintaining job productivity.

Screening tools that are simple and with adequate accuracy are available. However, the tool that the panel recommended, the SARC-Calf, requires (a) translation in Filipino and other dialects and (b) training for primary healthcare providers since it is not routinely used in practice. Grip strength may be used as a screening tool, subject to availability of the hand dynamometer and training on its use.

The suggestion AGAINST screening for sarcopenia among individuals <60 years old keeps the option to screen open for primary care providers and patients who agree on this plan of action after discussion of its advantages and disadvantages.

Osteoporosis

Recommendation 14. Among asymptomatic, apparently healthy women ≥65 years old, we recommend screening for osteoporosis using FRAX with or without BMD or OSTA. *(Low certainty of evidence, strong recommendation)*

Recommendation 15. Among asymptomatic, apparently healthy men at any age and women <65 years old, we recommend AGAINST screening for osteoporosis. *(Very low certainty of evidence, strong recommendation)*

Key findings: Five RCTs assessed the effect of osteoporosis screening versus no screening in asymptomatic women aged ≥65 years and aged 45–54 years. Among screened asymptomatic women aged >65 years compared to those who were not screened, there was no significant difference in the risk of major osteoporosis fractures (RR 0.98, 95% CI 0.92, 1.04), osteoporosis-related fractures (RR 0.94, 95% CU 0.88, 1.01), hip fractures (RR 0.93, 95% CI 0.85, 1.02), any type of fracture (RR 0.98, 95% CI 0.94, 1.02), mortality (RR 1.04, 95% CI 0.95, 1.13), and quality of life scores (EuroQOL-5D: MD 0 points, 95% CI -0.01, 0.01; SF-12: MD 0.10 points, 95% CI -0.59, 0.79).[202–205] Among asymptomatic women 45-54 years, the effect of screening on the risk of fractures was inconclusive (RR 0.94, 95% CI 0.73, 1.21).[206] There was no significant reduction in anxiety levels in the screening compared to the no screening group (high-risk group: MD -0.10 points, 95% CI -0.47, 0.27; low-risk group: MD 0.20 points, 95% CI 0, 0.40, respectively).[202] There were adverse events associated with treatment for osteoporosis as follows: esophagitis (RR 1.67, 95% CI 1.09, 2.56) with the use of alendronate; any musculoskeletal pain (RR 4.56, 95% CI 2.14, 9.68) and influenza-like illness or acute phase reactions (RR 4.41, 95% CI 3.63, 5.37) among zoledronic acid users; stroke (RR 1.46, 95% CI 1.02, 2.09; RR 1.33, 95% CI 1.06, 1.67) and gallbladder disease (RR 1.64, 95% CI 1.30, 2.06; RR 1.78, 95% CI 1.42, 2.24) with combined continuous hormone therapy (CHT) or estrogen alone; coronary events (RR 1.89, 95% CI 1.15, 3.10), venous thromboembolism (RR 4.28, 95% CI 2.49, 7.34), and breast cancer (RR 1.27, 95% CI 1.03, 1.56) with CHT; and hot flashes (RR 1.42, 95% CI 1.22, 1.66) with raloxifene.[207,208]

The Fracture Risk Assessment Tool (FRAX) and the Osteoporosis Self-Assessment Tool for Asians (OSTA) are screening tests that have been validated as highly sensitive (74–94%) among Filipinos, and can be used at no cost.[209,210] The dual-energy X-ray absorptiometry (DXA) scan, which measures BMD, costs PhP 3,000.00–7,000.00 per test but is not widely available across health facilities in the country.

A study in Canada found that a BMD-based strategy was more cost-effective for women who lived <40 miles from the nearest health facility, while a risk factor-based strategy was more cost-effective for women who would travel >40 miles.[211] The SCOOP trial also reported that screening reduced the incidence of fractures over the course of the patients' remaining lifetimes, leading to a gain of 0.015 quality-adjusted life-years and savings of £286.00 (~PhP 19,000.00).[212] Depending on the medication, osteoporosis treatment can cost between PhP 7,000.00–25,000.00 per year while a conservative estimate of the average treatment cost including hospitalization for an osteoporotic fracture in a tertiary government hospital is PhP 150,000.[172,213]

Screening for osteoporosis was viewed by some women as both a moral obligation and a chance to halt osteoporosis progression.[214] However, due to the lack of symptoms and lack of interference with daily activities, patients may not perceive osteoporosis to be worrisome or threatening to health.

Justification: Osteoporosis is a silent disease, and its downstream effects are disabling and potentially fatal. Despite low certainty of evidence, a strong recommendation was given for screening high-risk women aged ≥65 years since this is already standard of care for this group and the screening tools were easy to use. Screen-negative individuals will need to be screened again, but the decision on appropriate timing of a rescreen is left to the discretion of the healthcare provider. For women <65 years and men, the recommendation AGAINST screening is strong because of the potential harm and cost of early intervention and the lack of evidence of its benefit.

DISCUSSION

The PHEX Musculoskeletal Task Force formulated 15 recommendations for or against screening for nine MSK

conditions and risk factors. This is a wider scope than the 2004 PHEX guidelines where only 5 MSK conditions (scoliosis, congenital MSK abnormalities, hyperuricemia, osteoporosis, and predisposition to fall) were included. This CPG serves to update the recommendations on scoliosis, osteoporosis, and predisposition to fall, and introduces other conditions that need attention such as musculoskeletal disease in general and those that are work-related, physical inactivity, low vitamin D, musculoskeletal injuries, and sarcopenia. We focused on some MSK risk factors (risk of falls, sarcopenia, osteoporosis, MSK injuries, physical inactivity) because they predispose to more worrisome and disabling conditions like fractures, osteoarthritis, and obesity. We emphasize the need to prevent them and their cascade of far-reaching complications. Because most MSK diseases are not fatal, these are often less prioritized by individuals and society when placed side by side with infectious diseases, cancer, and cardiovascular diseases that are directly and acutely life-threatening. However, the creation of this CPG acknowledges the burden that MSK diseases impose on society and the importance of diagnosing and managing them early among asymptomatic and apparently healthy Filipinos.

Most of the recommendations are aligned with those made by other groups or organizations such as those AGAINST screening for scoliosis in children, vitamin D in all ages, and osteoporosis in women <65 years and men; and those that support screening for physical inactivity among adults, fall risk and sarcopenia among older adults aged ≥60 years, and osteoporosis among women aged ≥65 years. The WHO and other organizations are pushing for adequate and appropriate levels of physical activity for people of different age groups. However, these organizations had no screening recommendations for physical inactivity. Screening for MSDs using GALS or pGALS was another topic that was also not included among the reviewed international guidelines. The GALS and pGALS are recognized by rheumatologists as sensitive screening tests and easy to perform by healthcare practitioners after sufficient practice. The opportunity to incorporate this 2-3 minute screening maneuver, involving three simple questions and a few physical examination maneuvers, into the assessment process of primary care physicians will make both physicians and patients aware of MSK conditions that need attention.

Musculoskeletal injury from trauma is one of the known risk factors for osteoarthritis, a progressive end-stage disease of the joint.[215] However, there were no guidelines found on screening for this risk factor in the general population. We found that most of the data on the benefits and risks of screening for MSKI were from performance tests used for athletes. This resulted in indirectness and very low certainty of evidence. This was a recurring limitation in this CPG, the lack of direct evidence on the effectiveness of screening among asymptomatic, apparently healthy individuals. Another limitation was the scarcity of data on cost-effectiveness, patient values and preferences, feasibility, acceptability, and impact of screening on equity. Most of the information on the latter were obtained from the experiences of the multisectoral panel.

For successful implementation of the CPG, primary care providers need to be trained on the screening tests that are recommended. Most of these tests were chosen for their simplicity, yet the value of training and validation for its proper use and interpretation should not be overlooked. Feedback from guideline users will be crucial to determine and address problem areas in implementation.

For successful updating of the CPG, the medical community needs to take a close look and design studies to generate information on the knowledge gaps that had been identified.

Research Gaps

There was limited evidence on the benefits and harms of screening (compared to no screening) for the selected MSDs among the asymptomatic, apparently healthy Filipino population. One of the limitations of the evidence was its indirectness. For some questions, the available evidence on screening came from specific subgroups of the general population and may not be generalizable to the entire apparently healthy population. The available data on the effectiveness of linked management of some conditions, such as physical inactivity, were for high-risk groups only.

More studies are needed to substantiate evidence on the use of the recommended screening tools. There are currently no standardized tools for screening of WRMSD, physical inactivity, and risk of falls. Most of the available tools have also not been locally validated. In the case of screening for WRMSD, the screening tools included in this review could only be used for specific occupations and may not apply to the general population of working individuals. Screening for sarcopenia and risk of MSKI are also limited by the lack of locally validated cut-offs.

Future studies could also investigate the resources required and cost-effectiveness of screening, patient values and preferences, and the acceptability, feasibility, and equity of screening for the selected MSDs. Only a few of these studies were found to support screening for MSDs, and most of these studies were conducted in Western countries.

CONCLUSION

The PHEX Musculoskeletal Task Force developed 15 evidence-based recommendations on screening and risk factor assessment for nine MSDs. This followed a comprehensive evaluation of the best available evidence using the GRADE approach. These recommendations will serve as guidance on screening for MSDs among asymptomatic, apparently healthy children and adult Filipinos at the primary care level.

Disclaimer

This guideline is intended to be used by general practitioners, specialists, and health professionals who are primary care providers. Although adherence to this guideline is encouraged, it should not restrict primary care providers from using their sound clinical judgment in handling individual cases. Payors and policymakers, including hospital administrators and employers, can also utilize this CPG, but this document should not be the sole basis for evaluating insurance claims. Recommendations from the PHEX app and the guidelines therein should also not be treated as strict rules on which to base legal action.

Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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APPENDICES

Appendix A. Summary of Critical and Important Outcomes

	Outcome	Critical	Important
MSD	Detection of joint disease	×	
	Disability	×	
	Risk of injuries	×	
	Diagnostic accuracy	×	
	Misdiagnosis, overdiagnosis	×	
	Acceptability, AEs	×	
Scoliosis	Curve progression	×	
	Disability HRQOL	×	
	AEs of treatment: body pain		×
	AEs of treatment: psychosocial issues		×
	AEs of treatment: anxiety		×
	AEs of treatment: depression		×
	AEs of treatment: skin problems		×
	AEs of treatment: abnormal breast development		×
	Diagnostic accuracy		×
WRMSD	Region specific symptoms: neck pain, shoulder pain, arm pain, forearm pain, wrist-hand pain, lower back pain, upper back pain, hip-thigh pain, knee pain, ankle-feet pain	×	
	Severity of symptoms: pain intensity in each of the region-specific symptoms, pain frequency for neck, shoulder and wrist-hand symptoms	×	
	Prevent disability	×	
	Improve QOL	×	
	Improve work performance and productivity	×	
	Prevent or resolve pain	×	
	Sick leave: % with at least 1 day and at least 7 days sick leave	×	
	Self-reported productivity (in %)	×	
	CV disease, CV- and all cause-death	×	
	Reduction in CV and/or all-cause mortality	×	
Physical inactivity	Incidence of DM, Hypertension, or Obesity	×	
	QOL	×	
	Reduction in CV and/or all-cause mortality	×	
	Incidence of weight loss, injury or disability	×	
	Prevention of OA or progression of OA	×	
	Mislabeling	×	
	AEs		×
MSKI	Degree of association with MSKI	×	
	Reduction in MSKI incidence	×	
	Psychometric properties of screening tool (reliability, validity)	×	
	Disability	×	
	Deformity	×	
	Death from CVD, NCD, all-causes	×	
	Improved cardiovascular fitness	×	
	AEs of screening		×
Low vitamin D	Growth among children (height, weight, body mass index)	×	
	Incidence of fractures, falls	×	
	Hypercalcemia	×	
	Hypercalciuria	×	
	Infections (pneumonia)	×	
	SAEs	×	
	All-cause mortality		×
	AEs		×
Falls	Fractures	×	
	Improved outcomes (fragility fractures, disability, death, hospitalization, QOL)	×	
	Fall-related injuries	×	
	HRQOL	×	
	Incidence of injurious fall	×	
	Hospitalization	×	
	Increased anxiety or fear of falling	×	
	AE (Anxiety) of Screening State-Trait Anxiety Inventory (SF-12)	×	
	AEs of screening		×
Sarcopenia	Prevention of frailty	×	
	Disability	×	
	Diagnostic accuracy	×	
	Improvement of QOL	×	
	Mortality		×
	Anxiety		×
	Prevention of NCD		×
	Prevention of infection		×
Osteo-porosis	Reduction of osteoporosis-related fractures	×	
	Reduction of major osteoporosis fractures	×	
	Reduction of hip fractures	×	
	Reduction of all fractures	×	
	Mortality	×	
	QOL improvement (EUROQOL-5D)	×	
	QOL improvement (SF-12)	×	
	AE (Anxiety) of Screening State-Trait Anxiety Inventory (SF-12)	×	

Appendix B. Screening Tools

GALS: https://doi.org/10.1136/ard.51.10.1165
pGALS: https://doi.org/10.1002/art.22230
RSI QuickScan Questionnaire: https://doi.org/10.1080/00140130902915939
RULA: https://www.physio-pedia.com/Rapid_Upper_Limb_Assessment_(RULA)
REBA: https://ergo-plus.com/wp-content/uploads/REBA-Worksheet-v-2.0.pdf
GSHS: https://www.who.int/publications/m/item/gshs-core-questionnaire-modules-(2021)
PAQ-C/PAQ-A: https://www.prismsports.org/UserFiles/file/PAQ_manual_ScoringandPDF.pdf
PAVS: https://exerciseismedicine.org/wp-content/uploads/2021/04/EIM-Physical-Activity-Vital-Sign.pdf
BBS: https://www.ncbi.nlm.nih.gov/books/NBK574518/
http://www.chiropractic.on.ca/wp-content/uploads/fp-berg-balance-scale.pdf
TUG: https://www.cdc.gov/steadi/pdf/TUG_test-print.pdf
SARC-Calf: https://www.frontiersin.org/articles/10.3389/fnut.2022.803924/full#supplementary-material
FRAX calculator: https://frax.shef.ac.uk/FRAX/tool.aspx?country=1

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