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## Original Research

# Screening for musculoskeletal problems in Japanese schoolchildren: a cross-sectional study nested in a cohort



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## ABSTRACT

**Objectives:** To clarify the frequency of musculoskeletal problems in public elementary and junior high school children and to determine the advantages and problems of musculoskeletal examinations.

**Study design:** School-based cross-sectional study nested in a cohort.

**Methods:** We examined 41,376 public elementary and junior high school children (aged 6–15 years) in Miyazaki, Japan, from 2008 to 2014. Participation was voluntary. Participants received an in-school primary musculoskeletal examination (clinical examination with check items and a questionnaire) and a secondary examination at an orthopaedic outpatient clinic as indicated. Estimated prevalence rates for musculoskeletal problems were calculated from the results of both examinations.

**Results:** The total estimated prevalence of musculoskeletal problems was 8.6%. Prevalence by school grade ranged from 3.2% to 13.7%. Estimated prevalence rates increased as grade increased and were higher in junior high school students than in elementary school students. The secondary examination identified musculoskeletal problems on the back (65.4%), knee (8.1%), ankle or feet (7.3%) and elbow (5.4%). Of those referred for a secondary examination, 44.4% had not reported musculoskeletal complaints on the initial questionnaire. Overall, 69.8% of problems diagnosed in the secondary examination were previously undiagnosed.

**Conclusions:** School-based musculoskeletal examination enables early detection of abnormal growth and disorders of the locomotive organs and is expected to support children's musculoskeletal growth and development. We recommend musculoskeletal examinations as part of school check-ups in Japan. Our findings suggest musculoskeletal examinations should be conducted for students in higher elementary school grades and for all junior high school students. Evaluation should include both direct clinical examination and questionnaires.

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## Introduction

In Japan, problems in preventive medicine include declining birth rates and an ageing society. The World Health Organization's 2016 World Health Statistics ranked Japan first in the world, with the life expectancy of Japanese people as 83.7 years and the healthy life expectancy as 74.9 years.<sup>1</sup> The most important contributor associated with reduced healthy life expectancy in Japan was musculoskeletal disorders (25%).<sup>2</sup>

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) reported a decrease in the physical strength and athletic abilities of children in Japan over the past 30 years,<sup>3</sup> attributed to failure of healthy growth of the locomotive organs. Increasing rates of obesity and lifestyle-related diseases associated with lack of exercise have been highlighted in children. Moreover, sports-related injuries of the extremities and spinal injuries associated with excessive exercise have increased in Japan. These very different problems affecting the locomotive organs may lead to metabolic syndrome or locomotive syndrome in older age.<sup>4–9</sup>

Physical check-ups for children in Japan (including internal medicine, dental health, eyesight/eye disease, audiometry, urinalysis for kidney disease, parasite burdens, electrocardiograms, tuberculosis, spine/thorax problems, skin disease and otorhinolaryngologic disease) have been implemented by law since the 1951 School Health and Safety Act.

School medical check-ups are usually carried out in schools and have demonstrated efficacy in the early detection and prevention of diseases. In 1994, the former Ministry of Education, Science, Sports and Culture of Japan (now the MEXT) stipulated in a notice that 'abnormalities of the bones or joints, and conditions of the extremities, must be given special attention during examination of the spine and thorax'. However, although examinations for scoliosis have been part of school medical check-ups for a long time, very few schools examine the extremities in Japan.<sup>10</sup> In addition, there has been no medical check system for extremities.

The Bone and Joint Decade Japan, part of an international collaboration to address musculoskeletal conditions as a public health issue, worked to establish school medical examinations of the locomotive organs. The project started in 2005 in four areas (Hokkaido, Kyoto, Tokushima, and Shimane). Ten areas are currently participating in the project. As part of this project, the Miyazaki Prefecture group, organized by orthopaedic surgeons in our institution, began performing musculoskeletal examinations in 2007 to screen for musculoskeletal problems in elementary and junior high school children.

Previous studies have reported on sports medical check-ups or sport-related injuries in child and adolescent athletes.<sup>11–14</sup> However, most check-ups concerned sport-specific injuries (e.g., tennis,<sup>15</sup> soccer,<sup>16,17</sup> basketball,<sup>18</sup> long-distance running<sup>19</sup> and ice skating<sup>20</sup>) or body part-specific injuries (e.g., anterior cruciate ligament injuries,<sup>21,22</sup> knee injuries,<sup>23</sup> throwing-related injuries<sup>24,25</sup> and low back pain<sup>26</sup>). Studies have investigated musculoskeletal pain<sup>27–32</sup> and the relationship between musculoskeletal pain and hypermobility<sup>33–35</sup> in school children, but few reports describe the results of musculoskeletal problems in school-based

screening.<sup>36–38</sup> The results of musculoskeletal examinations in three other project areas in Japan (Shimane,<sup>39</sup> Niigata<sup>40</sup> and Kyoto<sup>41</sup>) have been reported (in Japanese).

This study aimed to clarify the frequency of musculoskeletal problems in public elementary and junior high school children and determine the advantages and problems of musculoskeletal examinations as part of school medical check-ups.

## Methods

We (Miyazaki Prefecture group) used data for 2008–2014. Although we have conducted musculoskeletal examinations in schools since 2007, the examination system changed during the first year. In 2007, primary in-school musculoskeletal examinations were conducted by school doctors (internists or paediatricians). Since 2008, examinations have been conducted by orthopaedic surgeons. The clinical examination protocol and medical questionnaire were modified based on issues identified during the first year. Therefore, data for 2007 were excluded from the present study.

During the first three years, students in Miyazaki City (where our institution is located) voluntarily participated in the study. Three municipalities participated from 2011 and an additional municipality participated in 2014. We explained the purpose and methods of our study to the Prefectural Board of Education of Miyazaki and a principal of the Educational Committee of Miyazaki City to obtain permission to conduct the study. Then, we explained the study to public school nurses and principals in Miyazaki City and the additional municipalities. After participating schools were identified, we held a briefing session for school doctors and nurses and provided a DVD about how the musculoskeletal examination would be reviewed. Participating schools were voluntary participants.

Workshops involving multiple examinations were conducted with the examiners (senior orthopaedic surgeons) to provide training to reduce the time taken for examinations and ensure assessments were performed in a uniform and consistent way. Sessions (approximately 2 h) were conducted at the beginning and end of each year by the same trainer. Inter-rater reliability for workshop participants was not performed due to time restrictions for in-school examinations.

## Participants

We used data for 41,376 children (20,219 girls, 21,157 boys) who received in-school musculoskeletal examinations in Miyazaki, Japan, from 2008 to 2014. Of these, 21,429 were in elementary school (grades 1–6) and 19,947 were in junior high school (grades 7–9) (Tables 1 and 2). Musculoskeletal examinations were performed at 407 schools over the 7-year period. The number of participating schools and students increased each year (Table 1). Some schools participated in multiple years; however, most selected the same grades each time (e.g., we examined 6th grade students every year for one school). All students in two small-scale schools (322 students in total, 0.8%) participated in examinations annually for whole years

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