

Positive predictive values for self-reported fractures in an adult Japanese population

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Received: 29 April 2010 / Accepted: 10 July 2010 / Published online: 10 August 2010
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Abstract

Objectives Self-reporting provides useful information for assessing the risk factors of osteoporotic fractures in large cohort studies. However, to date, no studies in Japan have confirmed the accuracy of this approach in this context. The aim of the study reported here was to determine the positive predictive value (PPV) for the self-reporting of fractures.

Methods A total of 133 participants of the Oguni cohort in the Japan Public Health Center-based Prospective Study who reported a vertebral, upper limb, or hip fracture on the 15-year follow-up questionnaire survey were evaluated. The accuracy of fractures was confirmed by cross-referencing medical records.

Results The average age of the participants was 72.4 (standard deviation 7.9) years. The PPV for vertebral

fracture in the last 15 years was 17/20 (85.0%) for women and 2/9 (22.2%) for men, for a total of 19/29 (65.5%). PPVs for upper limb and hip fractures were as low as 30/68 (44.1%) and 12/22 (54.5%), respectively.

Conclusion Female self-reporting provided PPVs suitable for symptomatic vertebral fracture over 15 years and can be used as an outcome measure in large cohort studies in Japan.

Keywords Cohort studies · Fractures · Osteoporosis · Predictive value of tests

Introduction

Fractures due to osteoporosis are a growing public health concern in Japan. Osteoporotic fractures, the number of which have increased over the last two decades [1], have an adverse effect not only on patients' quality of life but also on medical care costs. Consequently, the prevention of osteoporotic fracture is of high priority. Epidemiologic studies on osteoporosis using incident fracture as an outcome are highly important in this context; however, few studies have explored the risk factors for osteoporotic fractures in Japan.

The Japan Public Health Center-based Prospective Study (JPHC Study) [2] is one of the largest population-based cohort studies in Japan, examining multiple outcomes of lifestyle-related diseases. One outcome evaluated in the JPHC Study is self-reported data on fractures. Such data may be used to analyze fracture risk factors if accurate and if they provide an appropriate positive predictive value (PPV). The aim of this study was, therefore, to determine PPVs for self-reported fractures of vertebra, upper limbs, and hip in a cohort of the JPHC Study.

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Subjects and methods

The study cohort consisted of all individuals in the Oguni cohort of the JPHC Study who reported any fracture in the 15-year follow-up questionnaire survey. Of the 2,248 respondents, 165 reported a fracture. Of these, 133 (80.6%) participated in our study after providing written informed consent. The study protocol was approved by the Institutional Review Board of the National Cancer Center, Tokyo, Japan. A detailed description of the study design, methodology, and participant profiles of the JPHC Study has been published previously [2].

In the 15-year follow-up questionnaire, subjects were to self-report any occurrence of fractures in the lumbar region (herein defined as a vertebral fracture), upper limbs, or hip. The question was posed as: “Has your doctor(s) told you that you have a fracture in the lumbar region, upper limbs, or hip? If so, was the fracture first diagnosed in the past 5 years, 5–15 years, or earlier?” Subjects were asked not to report fractures due to high-energy trauma, including traffic or occupational accidents. We tabulated all individuals who reported any incident fracture of the vertebra, upper limbs, or hip during the 15-year follow-up period and mailed them a second questionnaire to confirm the reported fractures. The second questionnaire asked subjects to provide data on the fracture site, date of occurrence, and medical facility for treatment of the reported fracture. The accuracy of information on incident fractures was confirmed by cross-referencing medical records at the designated medical facilities. When a subject’s medical record was considered discarded, the reported fracture was classified as unconfirmed. In this study, vertebral fractures included compression fractures at the lumbar and thoracic regions, which

were diagnosed using criteria from the Japanese Society of Bone and Mineral Research [3], fractures of upper limbs, which included fractures of the radius, ulna, and humerus, and hip fractures, which included fractures at the femoral neck and trochanteric region. Using the above information, we calculated a PPV, i.e., the probability that a person who self-reports a fracture has a true fracture, for fractures of the vertebra, upper limbs, and hip, respectively, stratified by gender and fracture date according to the following formula: (true positives)/(true positives + false positives), where true positives are those who self-reported a fracture and had a fracture, and false positives are those who self-reported a fracture but did not have a fracture.

Results

The average age of the 133 subjects (87 women and 46 men) was 72.4 (standard deviation 7.9) years. Cumulatively, they reported 34 vertebral fractures, 88 upper limb fractures, and 23 hip fractures in the 15-year follow-up survey. Of these, five vertebral fractures (14.7%), 20 upper limb fractures (22.7%), and one hip fracture (4.3%) could not be confirmed due to the unavailability of medical records. PPVs for self-reported fractures stratified by gender and fracture date are shown in Table 1. High PPVs were found for vertebral fracture in women, namely, >80% in any follow-up period, whereas PPVs in men were unsatisfactorily low. PPVs for upper limb fracture were generally low, except for those occurring in women over the last 5 years. PPVs for hip fractures occurring in the most recent 5 years were higher than those occurring earlier.

Table 1 Positive predictive values (PPVs) for self-reported fractures of the vertebra, upper limbs, and hip by gender and fracture date

Fracture location	PPV (%)		
	15–5 years ago (1993–2002)	Last 5 years (2003–2008)	Total (Last 15 years) (1993–2008)
Vertebral fracture			
Women	81.8 [9/11]	88.9 [8/9]	85.0 [17/20]
Men	0 [0/5]	50.0 [2/4]	22.2 [2/9]
Total	56.3 [9/16]	76.9 [10/13]	65.5 [19/29]
Upper limb fracture			
Women	39.1 [9/23]	70.8 [17/24]	55.3 [26/47]
Men	11.8 [2/17]	50.0 [2/4]	19.0 [4/21]
Total	27.5 [11/40]	67.9 [19/28]	44.1 [30/68]
Hip fracture			
Women	50.0 [3/6]	66.7 [6/9]	60.0 [9/15]
Men	20.0 [1/5]	100 [2/2]	42.9 [3/7]
Total	36.4 [4/11]	72.7 [8/11]	54.5 [12/22]

Values are given as a percentage, with the no. of subjects with true fracture/no. of subjects with self-reported fracture given in square parenthesis

Discussion

This is the first study to confirm the adequacy of PPV for self-reported vertebral fracture in Japanese women. Several validation studies have confirmed self-reported non-vertebral fractures in Caucasian populations [4–7]; however, very few studies have addressed the accuracy of self-reported vertebral fractures. One reason may be that vertebral fractures are not common in such populations. In contrast, vertebral fractures have been reported to be more common in Japan than in Western countries [8]. We believed that both patients and orthopedists in Japan are more likely to be attentive to this type of fracture, especially among women. It should be noted that self-reported vertebral fractures are likely to be symptomatic; thus, the results of our study cannot be applied to asymptomatic vertebral fractures.

Although a number of studies have shown the self-reporting of limb fractures to be accurate [4–7], we were unable to demonstrate accurate reporting of upper limb or hip fractures, even for those occurring in the last 5 years. We further investigated nine false positive cases of upper limb fracture reported in the last 5 years and found that five were due to high-energy trauma, one was a fracture at a different anatomical site (the clavicle), one involved fractures predating the study period, and two cases did not involve fractures. Fracture secondary to high-energy trauma primarily skewed the PPV for recent upper limb fractures. As such, data on self-reported fractures, especially for those of limbs, should be used with care when conducting a questionnaire survey, and a strategy to exclude fractures arising from high-energy trauma should be considered. An insufficient number of self-reported hip fracture cases were obtained, which should be further investigated in future studies.

A limitation of this study was that the sensitivity could not be evaluated; that is, an unknown number of cases with a fracture may not have been reported in our cohort. If the sensitivity is insufficiently high, self-reported fractures may not represent the total number of fractures occurring in a study, and a positive association may be underestimated due to a reduction of effect size. However, the sensitivity of self-reported fractures is relatively high because, unlike cancer, fractures can be readily recognized by the individual. In fact, previous studies have demonstrated sensitivities of self-reporting as high as 78 [5] and 86% [7] for all types of fragility fracture. The sensitivity of self-reported vertebral fractures has not yet been reported. Notably, self-reported vertebral fractures are very likely to be symptomatic. Indeed, in our study, all vertebral fractures confirmed in medical records

were symptomatic. Thus, the accuracy of self-reported vertebral fractures should be discussed with respect to symptomatic vertebral fractures. The sensitivity of self-reporting symptomatic vertebral fractures is considered to be acceptably high, similar to that of other fragility fractures. However, the prevalence of asymptomatic vertebral fractures is estimated to be tenfold higher than that of symptomatic fractures [9]. Thus, the sensitivity of self-reporting all vertebral fractures, including symptomatic and asymptomatic fractures, must be low. Although the detection of false negative cases of self-reported fractures occurring in the distant past is difficult, the sensitivity of self-reported fractures should be explored in a future study.

In conclusion, female self-reporting provided PPVs suitable for symptomatic vertebral fracture over the 15-year follow-up period and can be used as an outcome measure in large cohort studies. PPVs for other fracture types, such as hip fractures, should be further investigated with a larger sample size.

Acknowledgments We thank the following institutions for providing us with relevant medical information: Imura Orthopedic Clinic, Kobayashi Orthopedic Clinic, Nagaoka Chuo General Hospital, Nagaoka Red Cross Hospital, Nemoto Orthopedic Clinic, Oguni Clinic, Ojiya General Hospital, Tachikawa General Hospital, Tokamachi Hospital, Uonuma Hospital, and Yoshida Hospital. This study was supported by a Grant-in-Aid for Cancer Research and for the Third Term Comprehensive Control Research for Cancer from the Ministry of Health, Labour and Welfare of Japan. The authors have no conflicts of interest to report.

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