number of hospital bed users, any deaths or injuries associated with a device intended for patient protection are significant. The number of adverse events due to side-rail entrapment can be decreased if user facilities take the following precautions[6]:

1. Inspect hospital bed frames, side-rails, and mattresses regularly for potential locations for entrapment.
2. Use compatible side-rails and mattresses to prevent gaps in which a patient could become entrapped. Check with manufacturers to verify compatibility of components purchased separately.
3. Verify that side-rails have been installed according to the manufacturer's instructions.
4. Use additional safety measures (e.g., side-rail protective barriers) for high-risk patients.
5. Develop profiles of patients at increased risk of entrapment.

In addition, manufacturers and the user community should develop universal standards for side-rail design.

Adverse events can be reported to the FDA's MedWatch program (Medical Products Reporting Program, MedWatch, HF-2, Food and Drug Administration, 5600 Fisher Lane, Rockville, MD 20857; telephone [to report an adverse event or to request MedWatch information]: 1-800-FDA-1088). Reporting, although voluntary, is vital to ensure that medical devices continue to be safe. □

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Consequences of Foot Binding among Older Women in Beijing, China

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ABSTRACT

Objectives. This study examined the prevalence and consequences of foot binding in older Chinese women.

Methods. Women older than 70 years in Beijing, China, were assessed for bound feet, falls, functional status, and bone density.

Results. Thirty-eight percent of women aged 80 years and older and 18% of women aged 70 through 79 years had bound-foot deformities. Women with bound feet were more likely to fall, less able to squat, and less able to stand up from a chair without assistance than women with normal feet. They also had 14.3% less functional reach (a test of balance) and 5.1% lower hip bone density.

Conclusions. Foot binding has caused substantial disability that is still evident in many elderly Chinese women. (*Am J Public Health.* 1997; 87:1677–1679)

Introduction

The practice of foot binding began in the Sung dynasty (AD 960–1280) in China, reportedly to imitate an imperial concubine who was required to dance with her feet bound.[1] By the 12th century, the practice was widespread and more severe: feet were bound so tightly and so early in life that women were unable to dance and had difficulty walking.[1,2] When a girl was about 3 years old, all but the first toe on each foot were broken and the feet bound with cloth strips that were tightened over the course of 2 years to keep the feet shorter than 10 cm and to bend the sole into extreme concavity (Figure 1). Foot binding ceased in the 20th century with the end of imperial dynasties and the increasing influence of Western fashion. As the practice waned, some girls' feet were released after initial binding, leaving less severe deformities.

The prevalence and consequences of foot-binding deformity have never been studied. We studied foot-binding deformities as part of a study of osteoporosis in older women in Beijing.

Methods

We randomly selected one health section from each of Beijing's central districts, then randomly selected neighborhoods from each section and randomly ordered streets within the selected neighborhoods. We interviewed all women aged 50 or older on each street until we reached a quota proportional to the population of women aged 50 or older in that district, according to the 1990 China census.

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Source. Adapted from Chinese texts with the permission of Xu Ling, MD, MPH, professor of obstetrics and gynecology, Peking Union Medical College, Beijing.

FIGURE 1—The foot-binding process: foot bones were fractured and the foot was bound tightly for several years, foreshortening the foot and exaggerating its arch.

We invited random samples of interviewees (with a goal of 100 in each decade) to a clinic-based examination for osteoporosis. (Only 1 of 206 examinees under age 70 had bound feet, so we limited this analysis to women aged 70 or older). We interviewed 676 (93%) of the 724 residents aged 70 or older. Of 326 women invited, 193 (59.2%) attended the examinations. Those who attended the examination were significantly ($P < .05$) younger (78.7 years vs 80.3 years) and reported more difficulty in walking 1 km (17.1% vs 32.2%), climbing 10 steps (20.2% vs 40.8%), and preparing meals (10.5% vs 29.8%) than interviewees who did not attend.

TABLE 1—Characteristics of Women Who Completed the Examinations for the Effects of Bound Feet: Beijing, China, 1993 (n = 193)

Characteristic	
Age, %	
70–79 y	51.8
80–92 y	48.2
Education, %	
None	66.3
1–6 y	21.2
>6 y	12.4
History of any previous fracture, %	15.0
History of fall during past year, %	22.8
Bound-foot history, %	
Bound	28.5
Bound and released	17.1
Mean femoral neck bone density, g/cm^2 (SD)	0.50 (0.09)
Mean lumbar spine bone density, g/cm^2 (SD)	0.74 (0.15)

Using standardized, translated, and back-translated interviews,[3] we asked the women if they had fallen to the floor or ground during the past 12 months; had ever suffered a fracture; or had difficulty walking 1 km on level ground, walking up 10 steps, or preparing meals. Chinese physician-examiners inspected the women's feet and classified them as bound, bound and released, or never bound; all classifications agreed with participants' reports. Examiners assessed grip strength, timed usual and fastest gait speeds over a 6-m course, and assessed functional reach (a test of balance).[4] Examiners asked the participants to stand from a chair while keeping their arms crossed over their chests and then timed them as they sat and stood as rapidly as possible five times.[5] Participants were also asked to squat until their thighs were horizontal and stand again. Spine and hip bone mass were measured on a Lunar DPX-L (Madison, Wis).

We used age-adjusted logistic regression models to analyze categorical variables and age-adjusted least squares means to analyze continuous variables.

The study was approved by human research committees at the Peking Union Medical College, the World Health Organization (Geneva), and the University of California, San Francisco.

Results

The participants are described in Table 1. Bound feet were found in 38% of women older than age 80 and in 18% of 70- through 79-year-olds; 33 women (17.1%) older than age 70 had had their feet bound but released early.

Women with bound feet were much more likely to have fallen during the previous year (Table 2): of women with bound feet, 38% of those aged 80 or older and 28% of the 70- through 79-year-olds had fallen, compared with 19% in each age group with normal feet. Compared with women who had normal feet, those with bound feet were less able to squat (54% vs 31% unable for women aged 80 or older, 11% vs 3% among 70- through 79-year-olds) or rise from a chair without assistance (43% vs 26% unable for those aged 80 and above, 6% vs 2% among 70- through 79-year-olds), were slower to rise from a chair five times, and had poorer functional reach (Table 2). Grip strength was unrelated to foot binding. Women with bound feet reported no greater difficulty than women with normal feet in preparing meals, walking 1 km, or walking up 10 steps.

Age-adjusted bone density was 5.1% lower in the hip ($P < .10$) and 4.7% lower in the spine ($P < .10$) for women with bound feet than for those with normal feet. Women with normal feet had more education (mean = 3.7 years) than those with bound (mean = 0.9 years) feet or bound and released (mean = 0.5 years; $P < .0001$) feet, but differences in neuromuscular function and functional status were not substantially altered by adjustment for years of education.

Women whose feet were bound and then released early did not differ significantly from women with normal feet on any outcome measure.

Discussion

Deformities due to foot binding are common among elderly women in Beijing. These deformities have left women more prone to fall and less able to rise from a chair. We found that many women with deformed feet were also unable to

TABLE 2—Age-Adjusted Comparisons of Women with Normal Feet and Women with Bound Feet: Beijing, China, 1993

	Normal Feet (n = 105)	Bound Feet (n = 55)
Odds ratio[a] (95% confidence interval)		
Fell in past year	1.0	2.2 (1.0, 4.6)**
History of fracture	1.0	1.2 (0.5, 3.0)
Unable to squat	1.0	2.9 (1.3, 6.6)**
Unable to stand from chair unassisted	1.0	2.3 (0.9, 5.6)*
Impaired ability or inability to		
Prepare meals	1.0	1.2 (0.4, 3.4)
Walk 1 km	1.0	0.7 (0.3, 1.7)
Climb 10 steps	1.0	1.4 (0.6, 3.3)
Adjusted mean value[b] (95% confidence interval)		
Time to complete 5 chair stands, s	12.5 (11.4, 13.7)	15.8 (14.2, 17.5)**
Functional reach, cm	24.1 (22.9, 25.3)	20.7 (19.0, 22.3)**
Usual gait speed, m/s	9.4 (7.9, 10.9)	11.2 (9.2, 13.2)
Grip strength, kg	15.0 (14.2, 15.9)	14.2 (13.0, 15.4)
Femoral neck bone density, g/cm^2	0.51 (0.49, 0.53)	0.49 (0.46, 0.51)*
Lumbar spine bone density, g/cm^2	0.75 (0.72, 0.78)	0.71 (0.67, 0.76)

[a]Age-adjusted odds ratio compared with women with normal feet.
[b]Least squares means computed from age-adjusted regression models.
*$P < .10$; **$P < .05$.

squat, an ability that is particularly important for toileting and other daily activities in China.

Women with bound feet also had somewhat lower femoral neck bone density, perhaps because of limited weight-bearing activity. The combination of lower hip bone density and greater risk of falling is likely to increase the risk of hip fractures. Our sample, however, was too small to test this possibility.

Despite the difficulties we observed, women with bound feet reported no greater difficulty than other women in preparing meals, walking, or climbing steps. Perhaps these women have accommodated to their impairments or are reluctant to complain.

This study has several limitations. Women who declined to attend the examination may have had more disability and, perhaps, an increased prevalence of bound feet. Thus, we may have underestimated the prevalence of bound feet and the amount of disability they cause. The prevalence of foot binding might be different in Beijing than in other regions of China; the consequences, however, should be similar.

The high prevalence of bound feet might surprise some foreigners who have visited China, since women with bound feet are infrequently seen on city streets. They tend to stay indoors and in residential alleys not commonly visited by tourists.

We conclude that, over the centuries, foot binding produced severe lifelong disability for many millions of women. The deformities of foot binding linger on as a common cause of disability in elderly Chinese women. □

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