

# A Comparison of Foot Forms Among the Non-Shoe and Shoe-Wearing Chinese Population\*

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This investigation was stimulated by statements that foot deformities are hereditary and develop in people who have never worn shoes<sup>2</sup>. However, we believe that foot deformities are of recent origin in the history of man, dating back only to the introduction of footwear. The only deformity of the feet that we can find occurring prior to the wearing of shoes is atrophy of the fifth toe portrayed in Grecian and Roman sculptures. This condition appears to have been caused by the constricting strap of the sandals worn in those times. We felt that an investigation comparing foot forms of the local population should be undertaken; since the population was gradually taking to shoes, such a comparison might not be possible in the future.

TABLE I  
DISTRIBUTION BY AGE AND SEX OF SUBJECTS EXAMINED

	Shod		Unshod	
	Male	Female	Male	Female
Youngest subject (Years)	4	9	3	1½
Oldest subject (Years)	70	53	50	70
Total subjects examined	79	39	17	90

A perusal of the literature showed that there is considerable information about the condition of feet in both the non-shoe-wearing and shoe-wearing peoples; however, no comparison between the unshod and the shod portions of the same population has been reported.

Hoffmann concluded that until the individual starts to wear shoes, the shape of the foot and its range of voluntary and passive motion are practically the same in barefooted and shoe-wearing peoples. The wearing of shoes, usually begun at the end of the first year, compresses and splints the foot; following this, there is progressive narrowing of the anterior portion of the foot and diminution in the range of motion of the phalangeal, tarsal, and ankle joints. Engle and Morton, in a survey of foot disorders among natives of the Belgian Congo, concluded that foot problems were not urgent among the natives from an orthopaedic standpoint. Their foot trouble was chiefly surgical, caused by trauma in some, and by infection in the vast majority. Emslie, reporting on the feet of 281 children between the ages of two and four years old seen at the Woolwich Toddler's Clinic, found that 80 per cent of the children had deflection of the terminal phalanx of the great toe and 30 per cent had incurvation of the fourth and fifth toes. These deformities were not found in children of walking age who had not worn shoes. She concluded that wearing shoes should be avoided during childhood whenever possible to preserve the natural functions of the feet. James described the feet of barefooted natives of the Solomon Islands and stated that he found no deformities of the feet. Wilkins, in his paper, gave figures for the prevalence of foot

\*This investigation was financed by a research grant from the University of Hong Kong, Hong Kong.

Fig. 1: Dorsal view of unshod feet showing atrophied, jagged toenails and marked skin creases.

Fig. 2: Photograph of unshod feet showing multiple minor lacerations, thick keratinized layer, and prominent skin creases.

disorders among school children in Birmingham, England. In defining the normal foot, he used an unshod foot as a typical example. Brooke thinks that unsatisfactory shoes, and perhaps stockings, are the cause of the great majority of foot troubles. Jelliffe and Humphreys, in a survey of Nigerian troops, described unshod native feet as having deep fissures of the sole, pitting of the plantar surface, fissures of the rim of the heel, erosion of plantar skin, and posterolateral thickening of the heel. They attributed these features to repeated traumata.

This paper is a report of a survey made on a portion of the Chinese population to compare foot forms and foot ailments between two groups. The group in which shoes were not worn was chosen from the fishing population who live aboard their boats. To represent the shoe-wearing category, we decided to examine the feet of all patients admitted to the University Surgical Wards of the Queen Mary Hospital during the month of April 1956 (Table I). This group was chosen because: they represented the shoe-wearing population of the Chinese

in Hong Kong; their primary complaint for admission was not related to their feet; and they had been using some type of footwear all their lives. It was extremely difficult to examine the men who did not wear shoes since they were out working or fishing most of the time.

#### UNSHOD FEET

The feet of the non-shoe-wearing population showed thick soles with prominent skin creases apart from many minor lacerations due to traumata. The pachydermatous skin on the sole of the foot had an extraordinarily thick keratinized layer about 0.5 to one centimeter thick which permitted the individual to walk about without any discomfort. Although thick and tough, the skin was pliable and was marked by deep transverse folds which were similar to the lines of joint flexion found on the palm of the hand (Figs. 1 and 2). The skin on the dorsum of the foot presented minute though well marked folds, similar to those seen on the back of the hand. The depth and distinctness of these folds were probably due to the constant movements of the phalangeal and tarsal joints with concomitant intermittent folding of the skin. The toenails were thick, cornified, and short with uneven and jagged edges. This was due to contact with hard stones and other objects on the ground. Most of the subjects examined had well developed

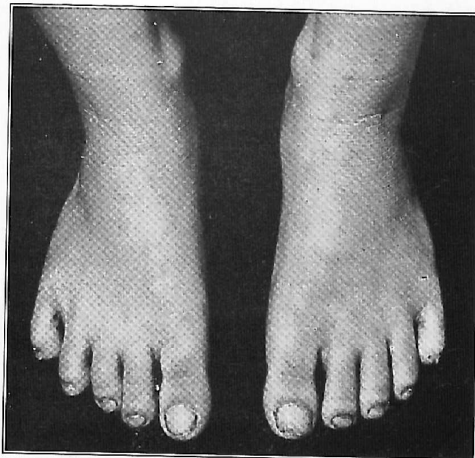


FIG. 1



FIG. 2

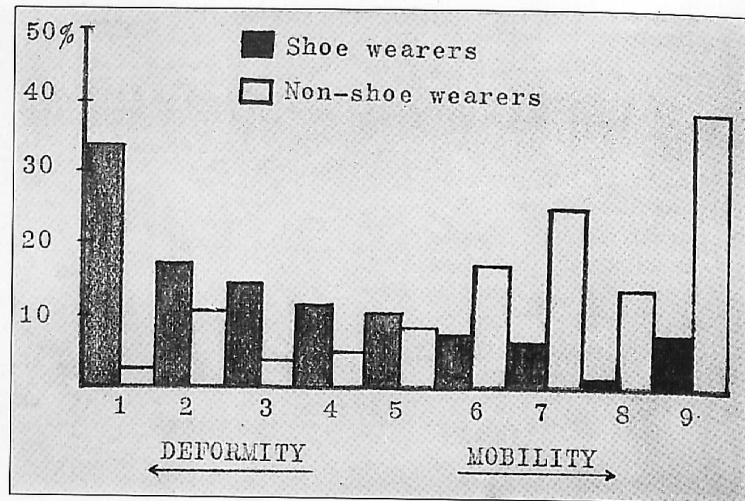


CHART I

This chart shows the frequency of deformity in relation to mobility. The numbered bars represent the following: 1, hallux valgus; 2, hallux rigidus; 3, varus fifth toe; 4, hammer-toe; 5, flat-foot; 6, metatarsus atavicus; 7, metatarsus primus varus; 8, hypermobility of the metatarsus; and 9, metatarsus latus.

arches. Even while walking, the arch was very evident, and those who had a degree of flat-foot did not have any complaints.

Because of the constant immersion of their feet in water, most of the subjects who do not wear shoes showed some degree of swelling; in many, it was not marked. This must cause considerable laxity of tissues and, with that, we expected a variety of foot complaints; however, that was not the case.

The fore part of the foot had a tendency to spread; this was most marked between the big and second toe. The big toe showed a remarkable degree of pre-

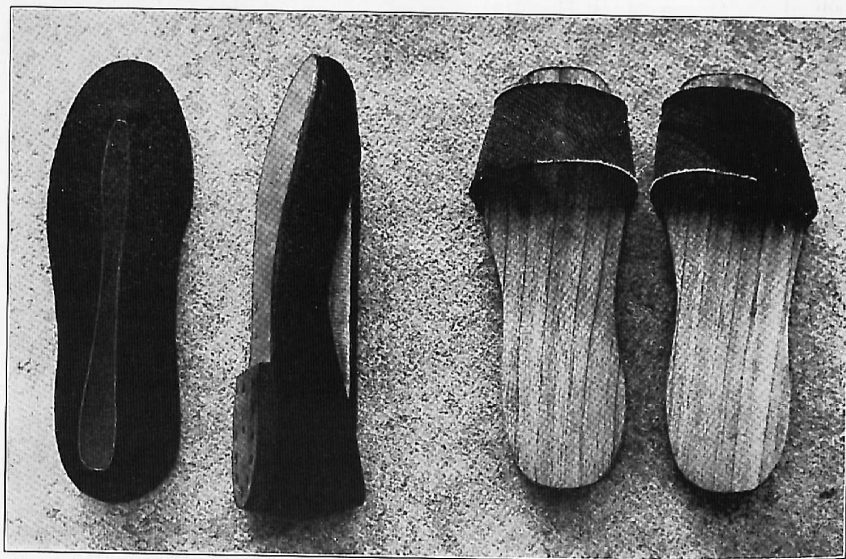


FIG. 3

Photograph showing the two forms of footwear commonly worn by the Chinese. On the right are wooden clogs, or kehk, and on the left are canvas shoes. Note the thin sole and absence of laces for adjustment.



TABLE II  
FREQUENCY OF DEFORMITIES AMONG SHOD AND UNSHOD

Deformity	Shod (Per cent)	Unshod (Per cent)
Hallux valgus	33	1.9
Hallux rigidus	17	10.3
Varus fifth toe	14.4	3.7
Hammer-toe	11	4.7
Flat-foot	10.1	7.5
Metatarsus atavicus	7	16.8
Metatarsus latus	7	38.3
Metatarsus primus varus	6	24.3
Bound feet	1.5	
Hypermobility of the metatarsus	0.9	13.1

hensile strength since it was often used to hold fishing nets and fishing lines taut so that the hands were free. The prehensile strength of the fore part of the foot was also called into play to enable the subject to get a good grip while moving about on his rocking boat. This illustrates foot function when the foot is unrestricted by shoes. Other affections of the fore part of the foot detected were metatarsus primus varus (24.3 per cent) and hypermobility of the metatarsus (13.1 per cent). However, in this group of subjects with a high degree of derangement of the metatarsus, complaints referable to the fore part of the foot were nonexistent. Mobility of the foot was the most striking finding in our whole survey. The unshod foot had laxity of the joints and tissues producing, in its natural form, a flexible foot with a degree of metatarsus latus, metatarsus primus varus, and hypermobility.

#### SHOD FEET

There are various types of footwear worn by the shoe-wearing Chinese (Fig. 3). The three principal types are:

1. The kehk (wooden clog) is the common type of footwear worn around the house, and consists of a wooden base cut out to conform with the shape of the sole of the foot. At the front part, a piece of stiff leather about one to one and one-half inches wide is attached. To wear it, an individual must squeeze the fore part of his foot in until the strap is tight against the widest portion of his foot, the line drawn from the end of the little toe to the base of the great toe.

2. The canvas shoe is a typical type of footwear and has a thin leather sole. The top is open and the feet are slipped in through this opening. In order to keep the shoe on it must fit tightly since there is no possibility for adjustment. The foot, especially the fore part, is squeezed into a confined area—often the contour of the little toe can be seen bulging through the canvas.

3. The leather shoe is the type of shoe worn by the poorer classes. It is made of low grade leather with a thick reinforced sole usually cut from an old automobile tire.

The deformities present in those who wore shoes were common and numerous, although none of the subjects complained. There is an interesting comparison (Chart I and Table II) between the deformities in the shod and unshod. We see that mobility and deformity are in inverse proportions; as mobility increases, deformity decreases. This conclusion is best exemplified by the classic deformity found in people whose feet had been bound. This occurs more frequently in the older age group since the custom has long since been condemned.

Callosities on the sole were frequent in the feet of those who wore shoes. On the weight-bearing points—the heel and heads of the first and fifth metatarsals, there was the expected thickening of the sole. Over the lateral aspects of the fifth metatarsal especially, the skin was thick and showed the effects of friction from footwear. In those who had metatarsus atavicus, the abnormally short

first metatarsal caused weight-bearing to be taken over by the head of the second metatarsal. Inevitably in these subjects there was a patch of thickened skin on the sole of the foot over the head of the second metatarsal. This patch is pathognomonic of a short first metatarsal and in many subjects it was used as a diagnosis before complete clinical examination and roentgenograms confirmed the diagnosis of metatarsus atavicus.

#### CONCLUSIONS

The foot in its natural unrestricted form is mobile and flexible without any of the static complaints often encountered. When the foot becomes restricted by the wearing of stockings and shoes, its natural form becomes altered and static deformities develop.

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