Anthropometric data of the Hong Kong Chinese population: a literature review and its application to a seated barbecue site design

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ABSTRACT

There is very little published anthropometric data of Hong Kong Chinese population. Between 1961 and 1967, three anthropometric surveys of school children and university students have been reported. However, dimensions measured in these surveys were few. In 1981, a comprehensive anthropometric survey of the Hong Kong Chinese population was carried out and its data was published by Pheasant in 1986. Since then, there has not been any published literature detailing the up-to-date anthropometric data of the Hong Kong population. A comparison of the stature data reported during the period from 1965 to 1986 reviews an increasing trend for the height of the Hong Kong Chinese population. With the continuous influx of new immigrants from China and the reviewed secular trend, an up-to-date anthropometric survey is needed. The usefulness of Pheasant's anthropometric data was evaluated in the design of a seated barbecue site. Twelve subjects were asked to sit in a barbecue site mock up designed using the anthropometric data for the Hong Kong population reported by Pheasant (1986). Subjective comfort ratings in different regional body-parts indicated that the subjects suffered discomfort in their back and hip regions. The twelve subjects' anthropometric dimensions relevant to the design were measured. Measured data with the six male subjects were longer (buttock-to-knee and buttock-to-popliteal length); higher (popliteal and knee height); and thicker (thigh thickness) than those reported by Pheasant (1986). No consistent trend was found, however, when the measured data with the six female subjects were compared with Pheasant's data.

Relevance to industry

Anthropometric data is a useful building block towards good ergonomics designs. This paper reviews the published anthropometric data for the Hong Kong Chinese population, analyzed possible secular trends; and reports an application of the existing anthropometric data to a seated barbecue design.

Keywords: Anthropometry, Hong Kong population, Height, Body dimension

1.0 INTRODUCTION

Historically, design of utilities in Hong Kong is mainly based on cost and engineering consideration rather than anthropometric consideration. This is partially due to the priority of putting cost before comfort and the incorrect concept that anthropometric design is always non-economical. With the improvement in living standard, the need for comfort is increasing and so is the importance of ergonomics considerations in the design of utilities. In Hong Kong, ergonomics design using anthropometric data is taught at many universities and colleges. However, without an up-to-date anthropometric data set, a large building block is missing in the design of ergonomically sound equipment to be used in Hong Kong.

2.0 PUBLISHED ANTHROPOMETRIC DATA FOR HONG KONG CHINESE

Less than ten publications concerning the body dimensions of Hong Kong Chinese population have been found in the last three decades. Furthermore, some of the reported publications shared the data from the same anthropometric survey and less than five different anthropometric data sets have been reported. Table 1 summarizes the reported stature of Hong Kong Chinese of 18 years of age.

In 1965, Chang *et al.* reported the heights and weights of 11,476 Hong Kong southern Chinese children aged from one month to twenty years. The data was used to establish standards and percentiles of normal body length at different ages. Duthie (1967) conducted an anthropometric survey on the first year under-graduate students entering Hong Kong University in 1965. These measurements included stature, weight, chest girth, chest width, chest depth, upper arm girth and lower arm girth.

Low and his colleagues conducted two five year surveys to study the anthropometric data of school children (1961-65) and pre-school children (1963-67). Body dimensions studied included stature, upper limb length, arm length, forearm length, skeletal structure of hand and wrist. Results of these surveys have been reported in Low (1971), Chan (1972), Low (1972), and Low (1978). The total number of children measured during these two surveys is 17,608 boys (2,188 of pre-school age and 15,420 of school age) and 16,382 girls (2,259 of pre-school age and 14,123 of school age).

In 1981, Lee reported a comprehensive survey of anthropometric data of Hong Kong Chinese population. More than 10 different dimensions were measured and the total sample size was 1557. Results of this survey have been published by Evans in Pheasant (1986). Since 1986, there has been no published literature detailing the up-to-date anthropometric data of the Hong Kong Chinese population. As a routine health check, some simple anthropometric related data (e.g. stature to weight ratio and waist to hip ratio) are being collected at local hospitals (e.g. Fong, 1996). However, no report of comprehensive anthropometric survey is found.

Table 1 Mean and standard deviation of the height of Hong Kong Chinese population.

References	Chang *et al.* (1965)	Duthie (1967)	Low (1971, 1978); Chan (1972)	Lee (1981); Evans (1986); Pheasant (1986)
Age	18	18-20	18	18-24
Occupation	school students	undergraduates	workers & students	workers & students
Male height (mm)	1670 (51) >148 samples	1685(89) 167 samples	1670 (57) 874 samples*	1691 (62) 416 samples
Female height (mm)	1556 (47) >148 samples	1576 (47) 104 samples	1556 (51) 614 samples*	1564 (56) 268 samples
Survey period	1961-64	1965	1961-67	1981

* The samples have included the 148 subjects reported in Chang *et al.*, (1965)

3.0 POSSIBLE CHANGES IN BODY DIMENSIONS OF HONG KONG CHINESE

Inspection of Table 1 reviews an increasing trend for the mean stature of male Chinese (age: 18) from 1961 to 1981. It is reasonable to assume that similar trend has occurred from 1981 to 1995. In recent years, large number of Chinese people has immigrated from China to Hong Kong. According to the official figure, 425,664 persons have moved from China to Hong Kong during the period from 1982 to 1995 (Ho, 1996). This constitutes about 7% of the whole population. The influx of immigrants may affect the average body dimension of the Hong Kong Chinese population. Cui (1995) reported that the height and weight of Chinese children in China have increased noticeably over the past 10 years.

4.0 APPLIED ANTHROPOMETRY: A SEATED BARBECUE SITE DESIGN

This study aimed to assess the usefulness of the latest published anthropometric data in the design of a seated barbecue site at the Hong Kong University of Science and Technology (HKUST). Seated barbecue is a common public utility in the parks and beaches of Hong Kong. The objectives of this study are: (i) to identify the constraint and criteria in the design of a seated barbecue site; and (ii) to compare the dimensions of the constraints as recorded in Pheasant (1986) with those measured from the subjects.

4.1 Method and design

A mock up of a barbecue site was setup in the laboratory. Six male and six female subjects were asked to sit in the mock up for 5 minutes. They were instructed to hold a barbecue fork with their dominant hands and rest their elbows on top of their knees (Figure 1). The vertical inclinations of their backs were measured and the subjective comforts in different regional body-parts were assessed using questionnaires. Examples of the questions are:

How do you feel about the forward angle (θ)? (Please mark your preference with an 'X' on the line)

|_____|_____|

too backward just right too forward

How does your back feel?

|_____|_____|

very uncomfortable just right very comfortable

After the experiment, five design-related anthropometric dimensions of the subjects were measured (see Table 2). Anthropometer was used in the measurement. The subjects were university staff and students and their age ranged from 18 to 39. Consent was obtained from the subjects and the experiment was approved by the University's Committee on Research Safety and Ethical Practice.

The general layout of the barbecue site is illustrated in Figure 1. It is a typical Chinese style barbecue site in which food is grilled by an individual with a hand-held fork. The height and the width of the seat have been chosen to be 310mm and 200mm, respectively. The height of the fork support (H_1) and the radial separation (L_1) between the seat and the grill were calculated according to the anthropometric data published by Pheasant (1986). Data used were: buttock-to-knee length; buttock-to-popliteal length; popliteal height; knee height; thigh thickness; elbow height; and knuckle height. The length of the folk was assumed to be 540mm and the calculated dimensions for H_1 and L_1 were: 555mm and 1238mm for male users and 515mm and 1193mm for female users, respectively. The dimensions for male users were chosen as the dimensions of the mock up for the following reasons: (i) there will be more male users than female users at the university; (ii) a longer L_1 will keep the users further away from the barbecue fire.

4.2 Results and discussions

The constraints related to the barbecue design were found to include: buttock-to-knee length; buttock-to-popliteal length; popliteal height; knee height (sitting); thigh thickness; elbow height; and knuckle height. The subjective comfort ratings showed that the angle of inclination was too far forward; the back region and the hip region were not comfortable. This indicates that the criteria of the design are: (i) the distance (L_1) between the seat and the fire cannot be too long, otherwise the users will have to lean forward and introduce discomfort at the back; (ii) the depth of the seat pan (currently, 200mm) cannot be too short, otherwise excessive pressure can be generated at the interface between the hip and the seat.

Measured anthropometric data with the six male subjects were longer (buttock-to-knee and buttock-to-popliteal length); higher (popliteal and sitting knee height); and thicker (thigh thickness) than those reported by Lee (1981) and Pheasant (1986) (see Table 2). No consistent pattern was observed for the female data. Mann-Whitney U-Wilcoxon Ranks tests showed that the button-to-knee length, button-to popliteal length, and the thigh thickness of male subjects were statistically larger than those of female subjects (p<0.02 for all three dimensions).

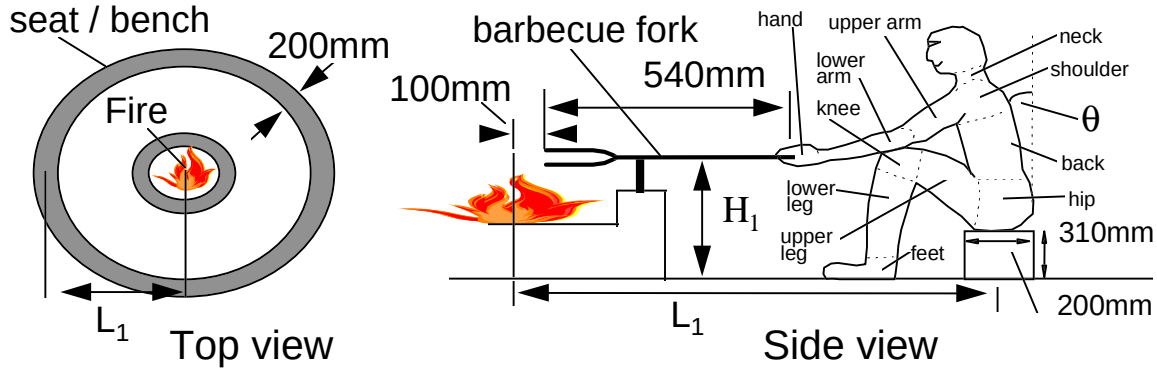

Figure 1 General layout of the barbecue site and an illustration of the different regional body-part.

Table 2 Comparison between the measured anthropometric data and the published data from Pheasant (1986).

	Male		Female	
Age in years / Dimensions in mm	Measured	Lee (1981); Evans (1986); Pheasant (1986)	Measured	Lee (1981); Evans (1986); Pheasant (1986)

Age	18-39	18-30	18-79	18-39	18-30	18-79
Buttock-to-knee length	579 (26)	551 (29)	552 (29)	515 (14)	517 (30)	518 (30)
Button-to-popliteal length	470 (21)	448 (27)	449 (26)	415 (14)	433 (29)	434 (29)
Popliteal height	417 (28)	406 (27)	403 (25)	381 (24)	379 (28)	373 (29)
Knee height (sitting)	505 (39)	496 (27)	495 (26)	481 (16)	460 (28)	456 (27)
Thigh thickness	153 (8)	131 (21)	128 (20)	136 (11)	123 (27)	121 (25)

The dimensions of the barbecue site (H_1 and L_1) have been re-caluated using the measured anthropometric data and the new H_1 and L_i are both higher and longer than the original values. However, the increases are small (less than 4%).

5.0 CONCLUSIONS AND RECOMMENDATIONS

Four published anthropometric surveys are found and the latest published anthropometric data for the Hong Kong Chinese population is dated at 1981. The height of Hong Kong Chinese has increased during the period from 1961 to 1981. Due to secular trend and continuous immigration from in-land China, there is a need for up-to-date anthropometric data.

A small survey showed that five lower limb related dimensions measured with male subjects are consistently larger than those reported by Pheasant (1986). Further investigations with more subjects are desirable.

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