

The Profile of Infant Carrying-induced Musculoskeletal Fatigue in Hong Kong Females

香港婦女揹嬰兒所引致肌肉疲勞的調查報告

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Abstract

A survey was conducted to investigate the profile of selection of infant-carrying methods and the prevalence of related muscle fatigue at different parts of body and its intensity in Hong Kong females. 266 mothers were interviewed. 93 mothers reported that they had carried their infants outside home in the period of seven days prior to the survey. 85 mothers carried their infants in front of their chest (Chest_C) while 8 mothers carried their infants at the back (Back_C). It seemed that mothers generally used Chest_C method when their infants were light and with small body size. When infants became heavier and bigger, infant carrying by mothers was less frequent and the method of Back_C instead of Chest_C was used. It was also noted that although the occurrences of severe muscle fatigue at shoulder and low back were reported in Chest_C and Back_C groups, the low back fatigue intensity in Back_C group was likely to be less than that in Chest_C group. Such findings implied that Chest_C method might possess higher risk of musculo-skeletal disorders by comparing with Back_C method. Further study for investigating the physical stress on low back muscles elicited from Back_C and Chest_C infant carry methods is suggested.

摘要

在華人社會，婦女仍是嬰兒的主要照顧者。為了加強親子感情及增加活動，揹嬰兒進行戶外活動越來越被現代媽媽所採用。揹嬰兒時，嬰兒的體重可能對媽媽身體造成疲勞。本文試圖探討不同揹嬰兒的方法對媽媽各身體部位所造成的疲勞程度的影響。

Introduction

In Chinese societies, mother is traditionally the major person responsible for looking after infants in a family. Infants carried at mothers' back with a backpack composed of a piece of square cloth with four straps at each corner has long been considered as an effective infant-carrying method as mothers' hands are available for doing daily works while the proximity of infants to mothers is minimum. Nevertheless, the work of infant carrying with enduring loading on working muscles is physically demanding (Gratz, Claffey, King, & Scheuer, 2002).

In the last three decades, the traditional backpack was modified based on the ergonomic principles of load carrying at human's back in an attempt to distribute the load of infant carried to different parts of upper body instead of imposing the entire load on a few muscle groups. While the backpack for carrying infant was being innovated during the period, people's concept of infant carrying was also changed with the concurrent improvement in socio-economy. Carrying infant was no longer only due to facilitate persons to do daily work while simultaneously looking after the infant. To develop the intimacy between baby and mother was also considered as a purpose to mothers to carry their infants with infant

carrier. As a result, carrying infant in front of the chest (Chest_C) nowadays is more preferable than that at the back (Back_C). Backpack was therefore modified as chestpack. The preference to Chest_C might be due to the fact that Chest_C allows mothers to have closer supervision relative to Back_C on their infants during carrying. It was reported that Chest_C could promote more secure emotional attachments between the infant and mother (Anisfeld, Casper, Nozyce, & Cunningham, 1990).

Infant caring is a long-term physical work to mothers. Infant carrying with either methods of Chest_C or Back_C imposes sustained mechanical load and physical stress elicited from infant's body weight on mothers' trunk muscles. It was not known whether long-term infant carrying could lead to severe muscle fatigue and injury in mothers' trunk muscles. The prevalence of musculo-skeletal fatigue resulting from long-term infant carrying in mothers in Hong Kong was not investigated. Evidences shown in previous study that sustained or repeated biomechanical stress due to ergonomic hazards in work places caused chronic fatigue in loaded muscles and eventually work-related musculo-skeletal disorders (MSDs) in workers (Armstrong, 1986). The possibility of muscle fatigue and MSDs caused by infant carrying with either methods of Chest_C or Back_C in mothers should not be overlooked. Kumar (2001) reported that the occurrence of MSDs was related to intensity and duration of load imposed on related muscles. The purposes of the study were to investigate the profile of infant carrying in mothers in Hong Kong including the selection of the infant-carrying methods and the prevalence of related muscle fatigue at different parts of body and its intensity.

Methods

Data Collection

Face-to-Face Interview was conducted on clients in a Government Maternal and Child Health Centre during two-week period. 266 mothers who were the major persons in their family to look after their infants and free from current/concurrent musculo-skeletal injury were requested to complete a questionnaire designed for this study. As the selected Maternal and Child Health Centre is located at a junction of several districts (Kowloon Tong, Wong Tai Sin and Kowloon City), the subjects therefore were expected with different socio-economical background.

Questionnaire (Refer to appendix)

Questionnaire included content of the following aspects:

- General information, such as the age, body weight and height of the subjects and their infants.
- The general information of physical and mental fatigue related to taking care infant. Physical fatigue was defined as a state of disturbed homeostasis. Symptoms of fatigue can be from a slight feeling of tiredness to complete exhaustion (Edwards, 1983). Mental fatigue was defined as weariness or exhaustion, normally resulting from physical or mental work or lack of sleep (Borg, 1982).
- The frequency and duration of infant-carrying methods mostly used in the past 7 days and the sites and intensity of muscle fatigue elicited in each method. Muscle fatigue was defined as a condition in which there is a reducing in the force generating capacity of the muscle resulting from muscle activity under load which is reversible by rest (Edwards, 1983). Borg CR10 Scale was used to evaluate intensity of fatigue of each part of body. The scale of 0 denoted not fatigue at all and 10 being the maximum tolerable fatigue (Borg, 1998).

Data Analysis

The Statistical Package for the Social Sciences (SPSS) was used to analyze the data. All results were expressed as mean \pm SD.

Results and Discussion

In this study, the information of subjects' physical characteristics and that of their infants obtained through survey during a face-to-face interview were listed in the Table 1.

It was found that in all of the 266 mothers, 58% of them reported that taking care of infants led them to symptoms of mental fatigue including lost of short-term memory and emotional breakdown. 80% of them agreed with that taking care of infants caused physical fatigue and 38.5% considered that the physical work of infant holding and carrying were the major attribution to the physical fatigue. They further reported that low back, forearm and shoulder were the parts of body fatigued most when performing the sustained work of holding and carrying infant. 32.7% of the mothers experienced the limitations of the physical fatigue induced by infant holding and carrying to their daily work. 7.8% of the mothers further reported that they have received medical treatment during the period of taking care infant for MSDs that was attributed to holding and carrying infants.

By considering infant carrying, it was found that 93 (35%) of the 266 mothers had carried their infants while they were outside home in the period of seven days prior to the survey. 85 (90.4%) of the 94 mothers reported using the Chest_C method to carry their infants while only 8 (9.6%) cases used Back_C method. Table 2 shows the cases of fatigue reported in different parts of body and its intensity in the 93 mothers. Shoulder and low back were the two major parts of body fatigued most with infant carrying. It was found that 71 cases of muscle fatigue occurred at shoulder while 42 cases occurred at low back. Besides the shoulder and the low back, the occurrence of muscle fatigue at the body parts of neck, upper back and arms were reported occasionally.

For the mothers who carrying infant with Chest_C method, the frequency of infant carrying for each day was 1.9 ± 1.7 times while the duration of each carrying was 52.9 ± 39.3 min and the total time of infant carrying for each day was 80 ± 57.1 min. The average age of the infants was 7.8 ± 6.7 months; the median of the infants' age was 6 months. The infants' body weight was 7.7 ± 2.4 kg, and the median of the infants' body weight was 7.4 Kg. The ratio of the body weight between infants and their mothers was $14.4 \pm 4.7\%$.

For the 85 mothers used Chest_C method, 63 of them reported the occurrence of shoulder fatigue during the Chest_C infant carrying (Figure 1). Further, 52 of them reported shoulder as the most fatigued body part, with the fatigue score as 7.3 ± 1.9 (ranged from 2 to 10); 9 of them reported this area as the second most fatigued body part, with the fatigue score as 7.3 ± 1.5 (ranged from 5 to 10); 2 of them reported this area as the third most fatigued body part, with the fatigue score as 5.5 ± 3.5 (ranged from 3 to 8). 39 mothers reported low back fatigue occurred during Chest_C infant carrying. 14 of them reported low back fatigued most during the infant carrying, with the fatigue score as 7.3 ± 2.0 (ranged from 3 to 10); 20 reported this area as the second most fatigued body part, with the fatigue score as 6.6 ± 1.7 (ranged from 4 to 10); 5 reported this area as the third most fatigued body part, with the fatigue score as 7.4 ± 1.8 (ranged from 5 to 10).

For the 8 mothers reported using Back_C method in the past seven days to carry their infants, the frequency of infant carrying for each day was 2.6 ± 3.3 times, the duration was 37.9 ± 26.0 min and the total minutes they carried infant for each day was 89.2 ± 10.0 min. The average age of

the infants was 15.9 ± 9.0 months, and the median of the infants' age was 18 months. The average infants' body weight was 9.5 ± 3.9 kg, and the median of the infants' body weight was 9.8 kg. The ratio of the body weight between infants and their mothers was $17.7 \pm 8.6\%$.

In these 8 mothers, all of them reported shoulder fatigue (Figure 2). Moreover, they all put the shoulder as the most fatigued body part, with the fatigue score as 7.5 ± 2.0 (ranged from 4 to 10). Only 3 mothers reported the low-back fatigue as the second most fatigued body part, with the fatigue score as 5.7 ± 2.5 (ranged from 3 to 8).

The above findings indicated that Chest_C infant carrying method was habitually chosen as infant carrying method by the mother in Hong Kong, especially for the infants below 12 months. When infants became heavier and bigger, infant carrying by mothers was less frequent and the method of Back_C instead of Chest_C was generally used. Since there was a big difference in the number of subjects between the two groups of Chest_C and Back_C, we could not use statistical methods to identify the difference in physical characteristics of mothers and infants between the two groups. Nevertheless, we postulated that the preference of using Chest_C methods in most mothers might be due to the relative light infants' body weight to mothers that was reflected by the lower ratio of the body weight between infants and their mothers in Chest_C group by comparing with that found in Back_C group. The other possible explanation might be that the infants in Chest_C group were generally younger than those in Back_C group. Chest_C method could allow the mothers to give more caring to the younger infants. Infants in Chest_C group generally shorter by comparing with those in Back_C group might also be one of explanations as younger infants with shorter body height carried in front of mothers' chest would restrict less in mothers' stride length during walking by comparing with older infant with longer body height.

In this investigation, it was observed that the groups mean of fatigue score in shoulder in both Back_C and Chest_C groups were similar while the low-back fatigue score in using the method of Back_C was generally lower relative to that using the Chest_C method. This phenomenon could not be explained with the data found in the present study. Nevertheless, biomechanics of load carrying in human's upper body might provide some hints for explanation.

Humans are erect biped, the trunk extensors are important for maintaining posture and balance (Lehmkuhl & Smith, 1983). During standing and unsupported sitting, the central gravity of the body is in front of vertebral column. Therefore, trunk extensors require to perform long-term static or semi-static contraction for maintaining the body at erect position at a level corresponding to approximately 6% of the maximal voluntary contraction (MVC) of the trunk extensors measured at standstill. Theoretically, for carrying an infant in front of the chest, an additional load for augmenting the moment of the trunk flexion would result. In order to work against the augmented moment of the trunk flexion for maintaining the trunk at the upright position, additional force output exerted from the trunk extensors was required. Similarly, if the infant is carried at the back, the load elicited from the infant's body weight will augment the moment of the trunk extension. The augmentation of the moment of the trunk extension may benefit the trunk extensors for maintaining the upper body at upright position with less force exertion. Whether the Chest_C infant carrying method augments the physical loading to trunk extensors by comparing with that of Back_C and cause more severe muscle fatigue in the muscle group is not known. The task of carrying infant in most mothers is a long-term physical

work that is required to perform intermittently in whole day for each day for at least three years. For the Chest_C infant carrying method possibly caused the fatigue of trunk extensors more severe than that caused by Back_C method, the possibility that Chest_C method possess higher risk of MSD by comparing with Back_C method should not be overlooked. A comparison of infant-carrying methods with physical stress in Hong Kong females is awaited for study.

Conclusion and Suggestion

Infant carrying by using either Chest_C or Back_C method in mothers caused muscular fatigue. Shoulder and low back were the most fatigued body parts whatever carrying method was used. Nevertheless, the fatigue intensity caused by Back_C method at the low back was likely to be less than that caused by the method of Chest_C. Such findings implied that Chest_C method may possess higher risk of MSD by comparing with Back_C method. It also suggested that further study for investigating the differences in physical stress including overall physical exertion, kinematics gait performance, and perceived and physiological fatigue on trunk extensors elicited from Back_C and Chest_C infant carrying methods is necessary.

Table 1. Physical Characteristics of the Subjects and Their Infants.

		All (n = 266)	Chest_C (n = 85)	Back_C (n = 8)
Mothers	Age (year)	31.9 ± 4.7	33.8 ± 7.8	41.6 ± 7.6
	Body weight (kg)	54.1 ± 7.2	55.6 ± 8.7	54.0 ± 5.2
	Body height (cm)	158.3 ± 5.5	158.3 ± 6.0	155.9 ± 6.3
Infants	Age (months)	8.3 ± 8.7	7.8 ± 6.7	15.9 ± 9.0
	Body weight (kg)	7.3 ± 3.2	7.7 ± 2.4	9.5 ± 3.9
	Body height (cm)	65.9 ± 16.2	68.4 ± 12.4	80.6 ± 16.1
Ratio of body weight between infants and mothers (%)		14.0 ± 6.4	14.4 ± 4.7	17.7 ± 8.6

Data are means ± SD.

Chest_C is those subjects using Chest_C method in the past seven days to carry their infants.

Back_C is those subjects using Back_C method in the past seven days to carry their infants.

Table 2. Cases of Fatigue Reported in Different Parts of Body and Its Average Fatigue Intensity.

	Neck	Shoulder	Back	Low-back	Arm
Cases	9	71	10	42	9
Intensity (Scores)	7.3 ± 2.3	7.3 ± 1.9	6.7 ± 1.6	6.9 ± 1.9	5.3 ± 1.2

Figure 1. The Absolute Number of Subjects and the Percentage of 85 Subjects in Chest_C group who Reported the Selected Body Parts as the Most Fatigued (Most), Second Most Fatigued (2nd) and Third Most Fatigued (3rd) Body Part with Infant Carrying. Chest_C is those Subjects using Chest_C Method in the Past Seven Days to Carry their Infants; I is the Fatigue Intensity.

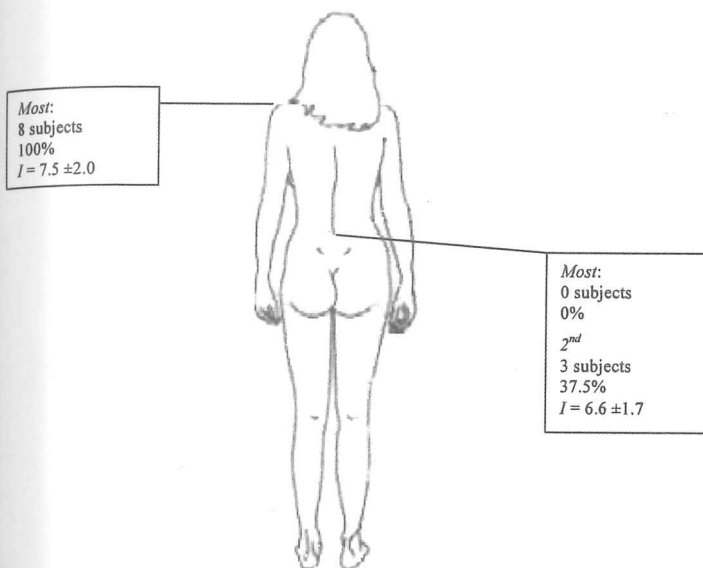
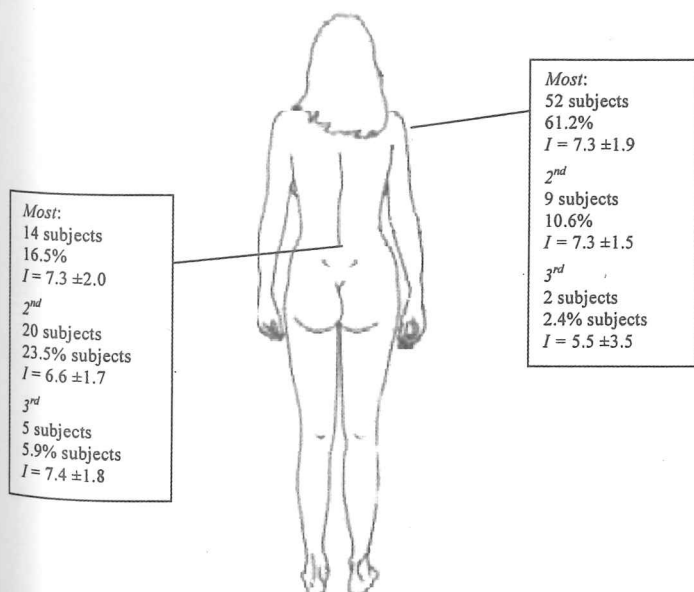


Figure 2. The Absolute Number of Subjects and the Percentage of 8 Subjects in Back_C Group who Reported the Selected Body Parts as the Most Fatigued (Most), Second Most Fatigued (2nd) and Third Most Fatigued (3rd) Body Part with Infant Carrying. Back_C is those Subjects Using Back_C Method in the Past Seven Days to Carry their Infants; I is the Fatigue Intensity.



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