The Influence of Chair Design on Low Back Pain during Breastfeeding.

Nongnuch Klinpikul[1, a] and Panya Srichandr[2,b]

[1]Furniture Technology Programme, Faculty of Science and Technology,

Rajamangala University of Technology Krungthep, Bangkok, Thailand

[2]Integrated Product Design and Manufacturing Programme,

School of Energy, Environment and Materials

King Mongkut's University of Technology Thonburi, Bangkok, Thailand

[a]nongnuchglin@yahoo.com, [b]panya.sri@kmutt.ac.th

Keywords: Chair design, Breastfeeding, Back pain

Abstract. Proper chair design is important for reducing back pain of breastfeeding mothers. The objective of the present work are to investigate the effects of backrest angle and armrest height on back pain of breastfeeding mothers. Backrest angle of the breastfeeding chair was varied from 90 to 120 degrees, and the hight of the armrest from zero to 24 cm. during the experiment. Back pain was measured indirectly in terms of percentage maximum voluntary contraction (MVC) using electromyographic technique. The results showed that increasing backrest angle from 90 to 110 degrees resulted in lower MVC values, and increasing the armrest height to about 21 cm. yielded optimal results. Using armrests can reduce the MVC values as much as 80% compared with the value when using the chair without armrest. The results can be used as guidelines for design and development of chairs for breastfeeding mothers.

Introduction

It is well recognized that sitting for a prolonged period of time could result in back pain. Chair design which influences sitting postures of the occupants obviously plays a siguificant role on back pain and has been extensively studied in workplace settings [1,2,3]. The importance of breastfeeding has been increasingly recognized in recent years. The National Immunization Survey (NIS) in the USA reported that the number of infants born during 2000-2008 having breastfed were increasing. One reason for the increase was thought to be due to better education of the mothers [4]. In Thailand, it was found that breastfeeding was significantly associated with mother's education, income and occupation and there are several projects initiated by government bodies to promote breastfeeding through the establishments of foundations, clinics, and breastfeeding centres that provide knowledge and advice on breastfeeding[5]. The influence of chair design on low back pain of breastfeeding mothers has not been systematically studied.

Back pain can result from internal factors such as disc degeneration, sprains or strain, and external factors such as gender, age, and occupation[6]. A study on back pain showed that 21% resulted from sitting postures[7]. Sitting in bending postures results in bending of spine[1] causing muscle more strain due to increased pressure on disc, which ultimately lead to fatigue and discomfort[6]. To minimize back pain resulted from prolonged sitting, it is necessary to avoid sitting postures that cause bending of the back. The disc pressure is considerably reduced also when the lumbar support was increased and when armrests were used[2]. Anderson found that bad sitting posture could cause backward rotation of pelvis and suggested that degeneration of lumbar could be prevented or ameliorated by using a well-designed low-back support[8]. Some of the mass of a seated body can be supported by a backrest, so even with a rigid vertical backrest the apparent mass can be reduced by a backrest[9].

In addition, the upward reaction forces of the armrest on the arms, generated when leaning with the armrests, reduces spine compression[10]. The armrest reduced the mean maximum hip moment[11], and reduce seat forces by carrying some of the body weight[12]. Arm supports

reduce loads on the trapezius,[13] supraspinatus and anterior deltoid[14] and shoulder pain[3].

This study aims to explore the influence of chairs design on the back pain in breastfeeding mothers. Specific variables to be investigated are backrest angle and height of armrest. The knowledge from this research will be very useful for developing ergonomic chairs that are more comfortable and suitable for breastfeeding mothers.

Methods

The participants. The participants in this study were all Thai women. All of the 12 subjects had breastfeeding experience. The participants were ordinary people leading normal lives and having no serious health problems or other medical complications such as serious accidents or chronic diseases. Personal details of the subjects are summarized in (Table 1).

Table 1 Personal details of the subjects

Subjects No.	Age (years)	Height (cm.)	Weight (kg.)	Occupation
1	30	152	51	Sell clothes
2	25	156	50	Automobile assembly
3	20	157	53	Housewife
4	28	160	46	Weaving factory
5	24	150	58	Casual worker
6	27	164	54	Weaving factory
7	22	154	40	Casual worker
8	32	156	55	Automobile assembly
9	23	150	70	Weaving factory
10	33	155	54	Weaving factory
11	32	150	48	Weaving factory
12	20	153	54	Housewife
Mean	*26.33*	*154.75*	*52.75*	

Protocol. The research started with interviewing the subjects to gather relevant information. These include the number of children they have, breastfeeding periods, and durations, personal experience during breastfeeding, age, occupation etc. They were then measured for their weights and heights. The low back pain in this study was measured indirectly by electromyographic method. The equipment used in this study was ME3000P4 MEGA with 2 signal channels (Mega Electronics Ltd. Kuopio, Finland), and software version 2.3 was used for data analysis.

Fig. 1 Sitting posture of the subjects.

The skin corresponding to the lumbar area and wrist area of each subject were first cleaned by using cotton with alcohol. When the skin was dry, two surface electrodes (Blue Sensor P-00-S) were placed at L3 area and flexors of the wrist area. The pain of the subjects were measured in terms of percentage maximum voluntary contraction (MVC), the unit was in microvolts. The chair were adjusted to have backrest of different angle ranging from 90, 100, 110 and 120 degrees and the armrest were different in height ranging from zero (representing no armrest), 15, 18, 21 and 24 cm.

After the personal resistances of individual subject were measured, each subject was instructed to carry a baby doll and sit on an adjustable chair in the breastfeeding posture in

(Fig. 1).

The length of time used in measuring MVC for each test was 90 minutes with 15 minutes breaks between different measurements. Behaviors of the subjects such as body movements, facial expressions were observed and recorded during the experiment.

All the subjects were finally asked the questions regarding to comfort or discomfort during the experiment, and general feeling about the experience, when different backrest angle and height of armrest were used.

Results

Effect of backrest angle on MVC. The effect of the angle of backrest on MVC is as shown in (Fig.2). The results showed that MVC values lowered when the backrest angle was increased from 90 to 110 degrees and increased slightly when the backrest angle was further increased to 120 degrees.

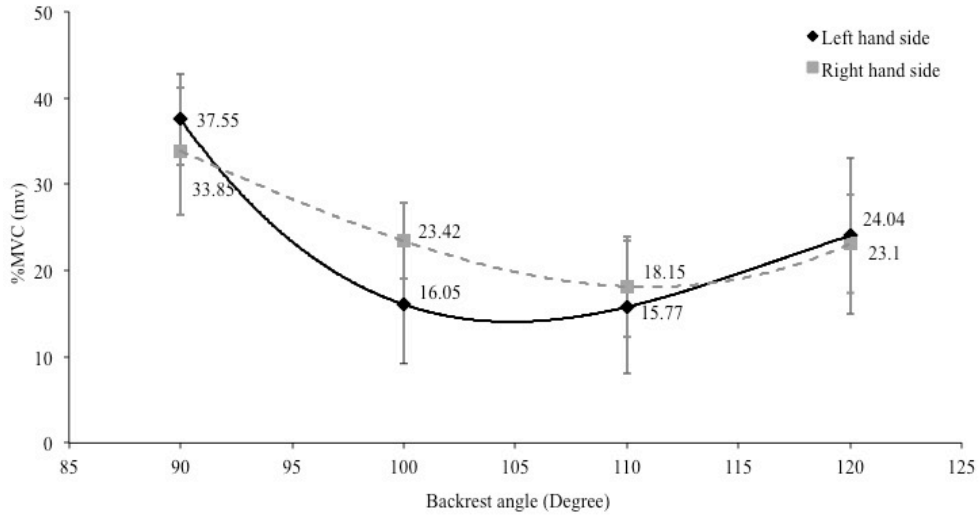

Fig. 2 The effect of backrest angle on MVC showing decreasing values of MVC with increasing backrest unit about 110 degrees after which the value increases.

This trend is true for right and left hand side although the decrease in the MVC value is slightly greater for left hand side compared with that for the right hand side. It might be concluded from the results that the most suitale backrest angle is about 110 degrees.

The post experiment interviews revealed that most of the subjects (54%) felt most comfortable when the chair had angle backrest of 100-110 degree. Some participants (24%) felt that 90 degree was the most comfortable while 22% felt 120 degree was the best. The results indicated that the 'feeling' of the participants and the measured MVC values were not 100% in agreement.

Effect of armrest height on MVC. The effect of the height of armrest on MVC is as shown in (Fig.3). The results showed that MVC values lowered significantly when the armrest were used. As the armrest height was increased from 0(no armrest) to 21 cm., the MVC values were reduced from about 100 to about 23 for the left hand side and from about 120 to 42 for the right hand side. The MVC values increased slightly when the armrest height was increased to 24 cm. It can be seen that the armrest height had a profound effect on MVC values. Appropriate value of armrest height can reduce the MVC value as much as 80%. The MVC values for the left hand side differ significantly from those for the right hand side.

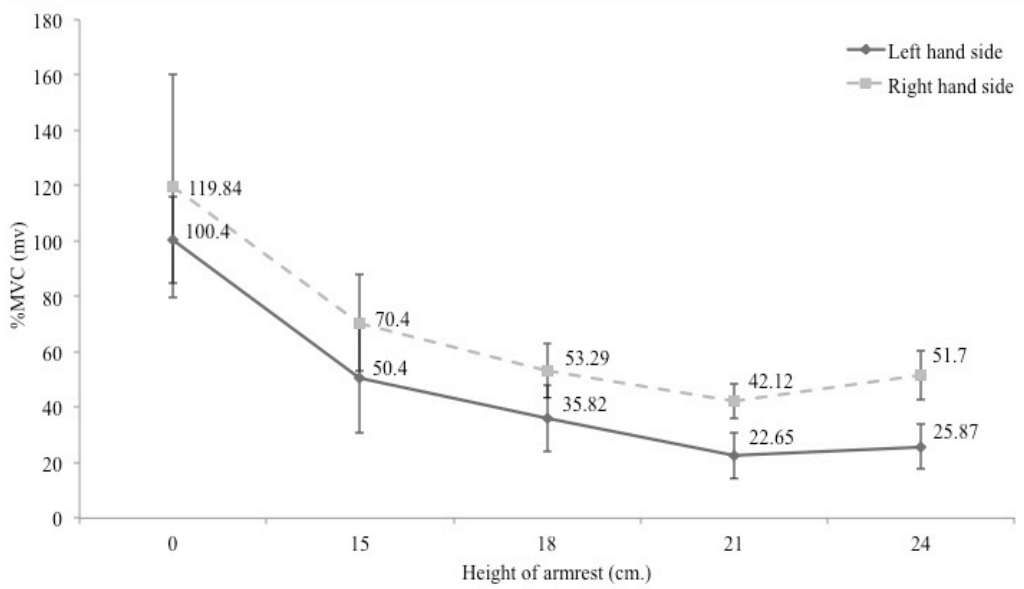

Fig. 3 The effect of height armrest on MVC showing that the MVC value decreases significantly when armrest were used.

The post experiment interviews revealed that most of the subjects (36%) felt most comfortable when the chair had armrest with height of 21 cm. Some participants (56%) felt that 18 and 24 cm arm support height were the most comfortable while 8% felt 15 cm height was the best. The results again showed that the 'feeling' and the measured MVC values are not 100% in agreement. All participants however agreed that the chair with arm support was more comfortable than that without support.

Discussion

The results showed that increasing backrest angle of the chair from 90 to 110 gegrees resulted in decrease in MVC values. This is thought to be due to greater transfer of body weight to the backrest. Effective body weight (and the weight of the baby doll) decreases with increasing backrest angle resultting in lower MVC values. When the backrest angle was increased too much (120 degrees), the MVC values started to increase because of too much strain in the body. The results are in general agreement with the work of other investigators studying low back pain of office workers [7].

The effect of armrest height is even more dramatic than that of the backrest, particularly when compared with the chair without armrest. This again can be explained in terms of body weight transfer. Without the armrest, all the weight is beared by the bottom part of the body resulting in high MVC values. With the armrest, part of the body weight (and the weight of the baby doll) is transferred to the armrest. Effective body weight is lower hence lower MVC values. The optimal armrest height of about 21 cm. corresponds to the position for the best weight transfer. The results are also in gernal agreement with the work of other investigator[1].

This research demonstrates conclusively that chair design plays a key role in the comfort or discomfort and back pain of breastfeeding mothers. The results can be used as guidelines for chair design and development so that breastfeeding mothers suffer minimum back pain. There are many other features of chairs, however, that could influence back pain which need to be researched in the future. Interview results indicated that characteristics of breastfeeding mothers, such as their ages and vital statistics, are also important and need to be considered in designing chairs.

Conclusions

The effects of backrest angle and armrest height of chairs on back pain of breastfeeding mothers are

investigated. The following conclusions may be drawn from the study;

1. Increasing backrest angle of the chair from 90 to 110 degrees results in lower MVC values which represent lower back pain. Further increase in backrest angle leads to an increase in MVC values.
2. Armrests have dramatic effect on MVC values. Chairs with armrests can reduce the MVC values as much as 80% compared to chairs without armrests. Armrest height of about 21 cm. was found to be optimal.
3. The feeling of being comfortable of the participants and the measured MVC values are not 100% in agreement. This means that the characterstics of breastfeeding mothers need to be taken into account when designing breastfeeding chairs.

Acknowledgment

The authors would like to thank the Commission for Higher Education and Rajamangala University of Technology Krungthep, Thailand, for financial support.

References

[1] C. Campbell, S.J. Muncer: *The causes of low back pain: a network analysis*. Social Science & Medicine Vol,60(2005),p.409-419.

[2] K. Grimmer and M. Williams: *Gender-age environmental associates of adolescent low back pain*. Applied Ergonomics Vol.31(2000),p.343-360.

[3] Aarås A, Fostervold KI, Ro O, Thoresen M, Larsen S: *Postural load during VDU work: a comparison between different workplace design*. Ergonomics Vol,40(1997),p.1255-68.

[4] Centers for Disease Control and Prevention. Breastfeeding/ Data and Statistics/ U.S. National Immunization Survey. Breastfeeding Among U.S. Children Born 2000-2008. Web site. http://www.cdc.gov/breastfeeding/data/NIS_data/index.htm. Accessed January 13,2012.

[5] UNICEF Thailand, Real lives/ Health, (2010, 08, 26).When breast is best. Web site. http://www.unicef.org/thailand. Accessed July 12,2011.

[6] Andersson GBJ: *Epidemiologic aspects on low back pain in industry*. Spine Vol.6(1981), p.53-60.

[7] Andersson BJ, Ortengren R, Nachemson AL, Elfström G, Broman H: *The sitting posture: an electromyographic and discometric study*. Orthop Clin North Am Vol.6(1) (1975),p.105-20.

[8] Beach, Tyson A.C., Parkinson, Robert J., Stothart, J. Peter, Callaghan, Jack P: *Effects of prolonged sitting on the passive flexion stiffness of the in vivo lumbar spine*. Spine Vol.5(2005),p.145-154.

[9] Naser Nawayseh, Michael J. Griffin: *Tri-axial forces at the seat and backrest during whole-body fore-and-aft vibration*. Journal of Sound and Vibration Vol.281(2004),p.921–942.

[10] Andersson, B. J. G: *Lumbar disc pressure and myoelectric back muscle activity during sitting*. IV. Studies on a car driver's seat. Scandinavian Journal of Rehabilitation Medicine Vol.6.3(1974),p.128-133.

[11] Arborelius, U. P.; Wretenberg, P.; Lindberg, F: *The effects of armrests and high seat heights on lower-limb joint load and muscular activity during sitting and rising*. Ergonomics Vol.35(11) (1992),p.1377-91.

[12] Gilsdorf, P., Patterson, R. and Fisher, S: *Thirty-minute continuous sitting force measurements with different support surfaces in the spinal cord injured and able-bodied*. J Rehabil Res Dev Vol.28(4) (1991),p.33-8.

[13] Bendix, T., Krohn, L, Jessen, F. AND Aaras: *Trunk posture and trapezius muscle load while working in standing, supported-standing, and sitting postions*. Spine Vol.10(5) (1985),p.433-439.

[14] Ericson, M.O. and Goldie, I: *Spinal shrinkage with three different types of chair whilst performing Video Display Unit work.* Industrial Ergonomics Vol.3(3) (1989),p.177-183.