Characteristics of the Physiological Response and Load Recognition with Child-Rearing Behaviors in Japanese

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Abstract

Dakko, an important child-rearing behavior in Japan, includes awkward postures and movements, and places a load on the neck and shoulders. For the childcare worker, there is concern regarding the accumulation of fatigue in the neck and shoulder due to the dakko movement. However, few studies have clarified the physical load of the dakko movement. This study clarifies the effect of the dakko movement on skin blood flow (SBF) and participants’ recognition of the discomfort in the scapular region. Two patterns of changes in SBF with the repetition of the dakko movement were observed. In the first pattern (pattern A), SBF increased with the load and remained high during convalescence. In the second pattern (pattern B), SBF decreased with the movement load and remained low during convalescence. Pattern B likely reflects the restriction of blood flow caused by repetition of the dakko movement. Changes in visual analogue scale (VAS) scores over time revealed increasing discomfort due to the load in 12 of 14 participants. These participants were aware that repetition of the dakko movement placed a load on the neck and shoulders. Reinforcement of the discomfort was not seen in two participants who were classified as having pattern B for changes in SBF. Lack of an awareness of the impacts of certain child-rearing behaviors, such as dakko, makes it difficult to alter the behaviors to disperse the high loads that can be associated with these types of movements.

ABBREVIATIONS

SBF: Skin Blood Flow

INTRODUCTION

In Japan, “dakko” is not only a method of carrying a child but also an important child-rearing behavior that facilitates communication between a parent and child as clinging behavior [1,2]; therefore, it is carried out daily [3]. Dakko comprises a series of movements, including lifting the child, holding the child, and putting the child down and these movements include awkward postures and movements. Thus, there is concern regarding the accumulation of fatigue in the neck and shoulder for childcare workers.

To improve the quality of the health of childcare workers, nurses should increase their understanding of the physical loads associated with childcare movements, and devise personalized interventions for individual childcare workers. However, few studies have clarified the physical load of the dakko movement.

Many child-rearing behaviors can result in back, neck, and shoulder injuries [4,5]. Shoulder stiffness is the most common subjective physical discomfort experienced by childcare workers in Japan [6], and is likely associated with the dakko movement [7].

Since shoulder stiffness is defined based on various subjective symptoms of tension and pain centered mainly around the scapular region [8], an objective evaluation may aid in understanding this condition. It is surmised that an abnormality in local blood flow is related to the shoulder stiffness, because a decrease in muscle oxidative function and ischemia of subcutaneous tissue have been found in people with shoulder stiffness [9,10]. Changes in blood flow of the neck and shoulder region are often used as an index to evaluate subjective symptoms of shoulder stiffness objectively.

This study clarifies the effect of the dakko movement on skin blood flow (SBF) and Symptoms of discomfort in the scapular region. Based on this, the association between dakko as child-rearing behavior and shoulder stiffness is considered. Our data on the physiological changes associated with the dakko movement highlight the potentially harmful effects this repetitive physical
load has on childcare workers and could lead to the development of objective assessments of the discomfort attributed to this movement.

**METHODS**

**Participants**

Fourteen healthy, right-handed women with no known neurological or musculoskeletal disorders gave their informed consent to participate in this study. The mean (standard deviation: SD) physical characteristics were: age 21.53 (0.99) years; height 158.03 (4.93) cm; body weight 51.60 (6.41) kg and body mass index 20.66 (2.28) kg/m². Women were selected as participants for the present study because most of the childcare workers in Japan are women and because a previous study in Japan investigated the prevalence of shoulder stiffness in female childcare workers [6].

This study was approved by the ethics review board of the Department of Medicine at Miyazaki University.

**Simulations of dakko**

The child to be carried, a 70-cm-tall baby model weighing approximately 5.5 kg, was seated in a stroller. The participants were instructed to perform dakko, that is, lift the child from the stroller, hold the child, and then return the child to the stroller (Figure 1). The entire dakko movement was performed in less than 1 min.

**Measurements**

The SBF was recorded using a computer-based laser blood flow meter (OMEGAFL-O-Lab, Omega wave, Japan). A 10-mm-diameter probe was fixed to the scapular region on the dominant-hand side, and blood flow 1 mm deep from the skin surface was measured. Blood flow was recorded by a personal computer every 0.1 s.

Subjective symptoms of the scapular region on the dominant-hand side were assessed using a 100-mm horizontal visual analogue scale (VAS) ranging from 0 to 100, with 0 indicating no discomfort and 100 indicating the most severe discomfort.

**Experimental protocol**

Following a 10-min rest, participants performed three sets of the movement load. One set of the movement load comprised 10 repetitions of the dakko movement. For movement load measurements, the SBF data were recorded for 1 min from each participant while relaxed in a sitting posture, and subjective symptoms of the scapular region were assessed by the VAS. As shown in Figure 2, these measurements were repeated before and immediately after the end of the movement load, and at the end of convalescence. The study was carried out at room temperature (25.5 ± 0.3 °C) and 57.0 ± 5.0% relative humidity.

**Data analysis**

The ratio of change in SBF for each measurement period compared to baseline was used to evaluate changes in SBF. To evaluate changes in the VAS scores over time, differences during each measurement period were compared to baseline (i.e., no movement load).

**RESULTS**

Two patterns for the changes in SBF were observed with the repetition of the dakko movement (Figure 3). For one of the patterns (pattern A), the SBF increased with the load and remained high during convalescence. Seven participants...
(Nos. 4, 5, 6, 7, 10, 12, and 14) exhibited this pattern. The SBF increased 49.44% after the maximum load of the first movement. Notably, the SBF for participant No. 7 decreased after loads 1–3, but increased to baseline levels during convalescence. For the other pattern (pattern B), the SBF decreased with the load and remained low during convalescence. Seven participants (Nos. 1, 2, 3, 8, 9, 11, and 13) exhibited this pattern. The SBF decreased 46.63% after the maximum load of the third movement. Notably, the SBF for participant No. 13 increased after the first load, but continually decreased after the second load.

Three patterns were observed for the changes in subjective symptoms of the scapular region with repetition of the dakko movement (Figure 4). In pattern A, symptoms of discomfort increased with the load and remained high during convalescence. Nine participants (Nos. 2, 5, 6, 7, 8, 11, 12, 13, and 14) exhibited this pattern. The VAS scores increased by 60 differential alterations after the maximum load of the third movement. In pattern B, symptoms of discomfort increased with the load, but disappeared during convalescence. Three participants (Nos. 4, 9, and 10) exhibited this pattern. Two participants (Nos. 1 and 3) did not report any exacerbation of discomfort (pattern C). The VAS scores decreased by 21.5 differential alterations after the maximum load of the third movement.

**DISCUSSION**

Changes in SBF were used as an index to assess the load on the scapular region during repetition of the dakko movement. Two patterns of changes in SBF emerged in the present study. In pattern A, SBF increased with the movement load and remained high during convalescence. It has been reported that the dakko movement repeated routinely by a childcare worker in Japan involves aggressive action of the trapezius [7]. Repetition of the contraction and relaxation of the trapezius by the dakko movement was thought to cause changes in blood flow within the scapular region. In contrast, in pattern B, the SBF decreased with movement load and remained low during convalescence. Although blood flow may temporarily decrease from a vasoconstrictive reaction just after the movement load, recovery of the blood flow was not seen in these participants during convalescence. Therefore, participants exhibiting pattern B likely experienced sustained restriction of blood flow during repetition of the dakko movement. This result reflects a physical factor...
that may be responsible for the two different characteristics seen for the same movement load. Physical factors that are most often associated with shoulder stiffness are related to posture and movement repetition [11]. A previous study has shown that slight exercise of the shoulder significantly increases the concentrations of nociceptive substances in the interstitial fluid surrounding the trapezius muscle [12]. Moreover, it has been reported that the increase in local SBF is related to the release of “tension”, which is a shoulder stiffness symptom [13]. Therefore, decreases in SBF likely result in various unpleasant symptoms due to the accumulation of the nociceptive substances.

This study also used VAS scores as an index of the discomfort in the scapular region due to repetition of the dakko movement. According to changes in VAS scores over time, discomfort from the load increased in 12 of 14 participants, and for nine of those participants, it did not dissipate during convalescence. These participants were aware that repetition of the dakko movement placed a load on the scapular region. On the other hand, two participants did not report any exacerbation of discomfort. These participants were classified as having pattern B for the changes in SBF and experienced sustained restriction of blood flow. For the two participants exhibiting pattern B, it was more difficult to alter their behaviors to disperse the high loads that can be associated with these movements, which may have been a potential factor for the shoulder stiffness.

These results suggest that the physiological response to and load recognition of the dakko movement differ between individuals. Thus, understanding individual characteristics will be necessary to devise personalized interventions for the prevention of the shoulder stiffness caused by the dakko movement.

CONCLUSION

For changes in SBF with the repetition of the dakko movement, two different characteristics were seen for the same movement load. In pattern A, the SBF increased with movement load and remained high during convalescence. In contrast, SBF decreased in pattern B. Participants classified as having pattern B likely suffered from restrictions in blood flow due to the movement load. VAS scores indicated that discomfort with the load increased in 12 of 14 participants. These participants were aware that repetition of the dakko movement placed a load on the scapular region. However, two participants who were classified as having pattern B did not report any exacerbation of discomfort. This result illustrates that different characteristics can be seen for the same movement load, and understanding individual characteristics will be necessary to devise personalized interventions for the prevention of the shoulder stiffness caused by the dakko movement.

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