RESEARCH

Evaluation of postural stress and risk factors for developing work-related musculoskeletal disorders among full-time women homemakers

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Abstract

Background Housework activities force women to work in poor and awkward postures which impose biomechanical stresses on various parts of the body. Therefore, the risk of musculoskeletal disorders (MSDs) is high among women homemakers. The aim of this cross-sectional observational study was to assess postural load risk in various household tasks among Iranian full-time women homemakers.

Methods Participants were 160 Iranian full-time women homemakers. Using face-to-face interviews and field observations, the main tasks typically performed by the homemakers were identified. These included sweeping floors, washing dishes (with two sub-tasks of cleaning dishes and placing dishes in the sink basket), cooking, washing clothes with a washing machine (including two sub-tasks carrying a basket of clothes and loading and unloading the washing machine), house cleaning, and ironing. Finally, the posture for each of these six tasks was assessed using the rapid entire body assessment (REBA) and the action level for each task was determined.

Results The REBA indicated that housework requires physical effort, and these tasks in particular put excess pressure on the body, meaning that homemakers performed their tasks with moderate to high postural load risk. Cooking had the highest level of risk and the mean REBA score (SD) for this task was 12.23 (1.91). Of the six tasks studied, the trunk and neck were exposed to the highest postural load risk.

Conclusion Overall, the data in this study indicated that doing housework tasks can be harmful to health and that intervention measures are necessary to reduce the risk of MSDs in homemakers. The findings of the present study can provide direction for implementing effective interventions to prevent MSDs in these women.

Keywords Full-time women homemakers · Biomechanical stress · Household tasks · Ergonomic interventions · Postural load risk · Health promotion

Abbreviations

MSDs   Musculoskeletal disorders
REBA   Rapid entire body assessment
BMI   Body mass index

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Background

Work-related musculoskeletal disorders (MSDs) can negatively affect the quality of life, reduce workability, decrease well-being, and lead to the loss of personal independence [1–3]. The pain caused by damage to muscles, nerves, and tendons by MSDs can lead to difficulty in performing tasks, increased absenteeism, disability, and turnover—and impose a great socioeconomic burden on societies [4, 5]. There are high prevalence levels of MSDs in both industrialized and developing countries, with nearly 150 million people worldwide being affected by these disorders [6]. The prevalence of MSDs is generally high in Iran, and more than 81% of working populations that have been studied report symptoms of MSDs in at least one area of the body [9]. Recent studies have highlighted the significant prevalence

of musculoskeletal disorders (MSDs) among homemakers, emphasizing the need for ergonomic interventions. For instance, Kaur et al. found that 79% of Indian housewives reported MSDs, with the most affected areas being the lower back and multiple regions [7]. Similarly, Fan et al. reported high rates of MSDs among Chinese homemakers, particularly in the neck, shoulders, ankles, and feet [8].

Women are more prone to MSDs than men due to their anatomical and physiological characteristics [10, 11] and the prevalence of these disorders is higher among women than men [12, 13]. In addition to the potentials for musculoskeletal injury that exist in the workplace, women are also at risk for MSDs while performing tasks in the home. That is, housework per se is a risk factor for MSDs in women [14]. Housework is a full-time unpaid activity for many women, and it includes tasks that require significant physical and mental demands. Previous studies have shown that housework has more workload than many other occupations [15], and the prevalence of MSDs in homemakers is high [13, 16, 17]. In Iran, housekeeping is recognized as a respectable job and the majority of women are engaged in it.

There are many different workstations in a home. Women perform a wide variety of activities in these workstations such as cooking, cleaning, washing, and caring for family members and children [2]. These tasks amount to a high physical workload and they put significant physical pressure on the body [2, 18, 19]. Thus, it can be realized that housework is associated with the development of MSDs [9]. Critically, housework tasks force women to work in poor and awkward postures and impose biomechanical stresses on various parts of the body. A review of the extant literature confirmed that no study has particularly addressed ergonomic interventions to reduce the risk of biomechanical factors in the development of MSDs in full-time women homemakers.

A first step towards this overarching goal is to understand precisely the ergonomic demands of key household chores. Self-reports can be helpful to describe tasks and associated pain and difficulty, nevertheless, such reports are necessary, but not sufficient. To implement effective ergonomic interventions, it is also essential to evaluate the postural load risks associated with various household tasks. In line with arguments that three dimensions are pertinent to understanding biomechanical exposure during physical work [20], this study used a postural analysis system that measures the load force/intensity, repetitiveness, and duration to appreciate the risk of musculoskeletal injury of selected housework jobs. Rapid entire body assessment (REBA) is a useful and valid assessment method for analyzing working postures and correcting poor and awkward postures [21]. REBA uses a systematic process for categorizing body postures, forceful exertions, and to account for types of movement or action, repetition, and coupling. This information will help practitioners determine priorities for interventions to reduce the prevalence of MSDs caused by housework. Accordingly, the aim of this study was to assess the postural load risk associated with various household tasks among Iranian full-time women homemakers using interviews, observations and REBA.

Methods

Study design and population

This cross-sectional observational research project was Phase 1 of a planned intervention study approved by the ethics committee of Tarbiat Modares University (No: IR.MODARES.REC.1398.038). Participants were full-time women homemakers, aged 20 to 65 years. Exclusion criteria were having a job other than homemaker, having a child under the age of two years, and having a congenital disease or accident affecting musculoskeletal tissue. Invitations to join the study were sent to women currently who were registered in a large health clinic in South Iran, with information regarding the objectives of the study, and joining the study. The formula used to calculate the sample size was [22]:

This study utilized the Rapid Entire Body Assessment (REBA) method to evaluate the ergonomic risk factors associated with various household tasks. REBA is a systematic tool designed to assess body postures, force exertions, types of movements, and repetition, enabling the identification of postural risks and the prioritization of ergonomic interventions. This method has been validated in multiple settings, including recent applications in evaluating musculoskeletal risks in healthcare and domestic environments [23, 24].

$$n = \frac{\left(Z_{1-\alpha/2}\right)^2 p(1-p)}{d^2}$$

The sample size calculation was based on the effect size (0.78) provided by Nazish et al. [4], an alpha set at 0.05, a $d = 0.1p$, and a power of 80%. To account for potential atrophy to the Phase 2 study, we increased recruitment by 30%, and recruitment continued until 160 homemakers gave informed consent to participate in the study.

Qualitative interviews and observations

Semi-structured interviews with open-ended questions and household task observations were conducted with all participants during a mutually convenient day, when their home was private, without the presence of others. Time for data collection was flexible and varied across the whole of one day, as preferred. In practice, many of the participants were

very pleased to discuss and demonstrate their work in their homes. The interviews began with a standard question about the participant's normal housework routine, which was then probed to provide a detailed answer concerning the ergonomic approach to the work they did. In addition, participants agreed to be observed as they proceeded to do their housework without any interference or intentional interruption to "pose for the camera". The working postures were recorded by the researcher using digital photography. Photographs were taken of each task undertaken, using profile, posterior and anterior viewpoints as applicable. Specific attention was made to capture bending, stretching, twisting and sustained holding of awkward positions of the neck, trunk, legs, knees, ankles, arms, and wrists, as well as the contribution and use of operational tools, during the course of each task. Participants were also asked to estimate the time they usually spent on each task using a self-report questionnaire.

Selecting the tasks and postures for assessment

The six main tasks performed by homemakers during a typical working day were identified from the interview data and researcher's observations. These tasks were sweeping floors (with a broom, mop or vacuum cleaner), washing dishes, cooking, washing clothes in a washing machine, house cleaning, and ironing. Table 1 provides a full description and picture to illustrate the tasks. The time needed to do each task was based on the data from a self-report questionnaire completed by the participants.

Posture analysis

Event-based or time-based sampling techniques can be used to select individuals' postures during work activities [16]. In this study, event-based sampling was used to analyze the most common and the worst postures adopted by the women when performing their household tasks. To evaluate ergonomic risk factors during a working day, the different postures of each homemaker were photographed. Following Okuyucu et al. [24], two researchers identified the most frequent and the most extreme working postures from the photographs, and these postures were selected to assess the postural risk of each task was assessed using REBA [21].

The REBA worksheet [21] divides the body parts into two groupings: A and B. Score A is derived from the use of the trunk, neck, and legs. There are 60 possible posture combinations which, using the REBA worksheet, produce nine possible scores. Then added to this is a 'load/force score' according to the key (e.g. when sitting the load/force is zero; when carrying > 10 kg the load/force is two). Score B is obtained from the use of the upper arms, lower arms, and wrists. There are a total of 36 postures which similarly produce nine possible scores, to which is added a 'coupling score' according to the use of other parts of the body (range 0–3, where 'high is bad'). The A scores and the B scores are then combined using score 2 in the REBA worksheet [21], and an 'activity score' is added to this. There are three occasions where a point would be added to the score 2 score. These activity scores relate to holding a body part static, repetition of actions, or rapid changes in posture. The score 2 and any added activity score yield a final REBA score and associated action level.

The range of final REBA scores is 1–15. Scores are categorized into five action levels (0–4) according to the risk of harm. Action level 0 (REBA score 1) has negligible risk, action level 1 (REBA score 2–3) is low risk, action level 2 (4–7) is medium risk, action level 3 (8–10) is high risk, and action level 4 (11–15) is very high risk [21]. The inter-rater agreement method was used to ensure the reliability of the posture risk assessment using REBA. For this purpose, the selected photographs were evaluated separately by two raters. The inter-rater agreement was measured using Cohen's Kappa coefficient.

Results

The study included 160 full-time women homemakers with a mean (SD) age of 41.6 (10.12) years and a mean BMI of 27.07 (4.09). The average weekly working hours were 42.33 h. The participants had an average of 2.77 (1.55) children. Educational attainment among participants was distributed as follows: 36% had a high school education, 43% had a diploma degree, and 21% had a university degree.

Cooking had a very high postural load risk level. The body parts at risk were the arms, trunk, and neck. The REBA score range associated with cooking varied from 4 to 14. Cleaning the house had a very high-risk level of all the activities for the homemakers. The mean REBA score was 11.86 and a very high level. The highest postural load risk was found in the trunk, arms, and hands. There was a wide range of REBA risk score associated with cleaning-ranging from 7–14. (Table 2)

Discussion

This study investigated the postural load risks in various housekeeping tasks performed by Iranian full-time women homemakers using the REBA method. Women actively participate in housekeeping tasks that involve frequent lifting and bending. Improper manual handling and poor and awkward postures can result in abnormal mechanical pressure on the spine [25]. Most postural load risk studies have been conducted in industrial and organizational workplaces,

Table 1 Description of the six main homemaker's tasks analyzed

Task	Sample picture	Description
Sweeping		The housewife sweeps the floor with repetitive reciprocating movements in the shoulder, arm, and trunk. Each time this task takes at least 40 minutes, and the number of repetitive body movements per minute is at least five. Sweeping takes approximately 280 minutes a week.
Cleaning the house		First, all the cleaning materials are collected and arranged by the housewife. Then, the surfaces are cleaned. The time to do this varies, but it takes an average of 420 minutes per week.
Washing dishes		The housewife first washes the dirty dishes inside the sink and then places them on the dish drying racks, typically over the sink. The arms, shoulders, and forearms move up and down alternately. All steps are done in a standing position. The most affected areas of the body are the wrists, shoulders, and neck. The task takes at approximately 60 minutes each day. The average time spent on this task per week is 420 minutes.
Cooking		Cooking is done by homemakers in a standing position. The most affected areas for this task are the back and the neck. The minimum time required for this task is 120 minutes per day, and 860 minutes per week.
Washing clothes		First, the homemaker places the clothes inside the laundry basket and then takes them to the place where the washing machine is located. The average weight carried by the housewife is 5 kg. The areas more frequently involved in this task are the hands, wrists, waist, and knees.
		The housewife then puts the clothes in the washing machine and after the washing cycle is complete, they remove the clothes from it, and take them to a place to dry. The most affected areas of the body are the neck and back. This task takes an average of 50 minutes. Altogether, the average time spent washing clothes is 350 minutes per week.
Ironing		Ironing clothes requires reciprocating motions in the shoulder, arm and trunk areas. The average time required to perform this task is 30 minutes per day. The average ironing time during the week is 210 minutes.

Table 2 Postural load risk analysis for the homemaker's tasks (N = 160)

Task	Body parts in the most extreme position	Mean REBA score (SD)	Range	Action level	Risk level	Action
Sweeping	Trunk Neck	11.68 (1.56)	6–14	4	Very high	Necessary soon
Cleaning the house	Hand Trunk Arm	11.86 (1.54)	7–14	4	Very high	Necessary soon
Washing dishes	Neck Hand Arm	10.7 (1.85)	6–14	3	High	Necessary
Put dishes to drain above the sink	Arm Forearm Neck	10.73 (2.26)	6–14	3	High	Necessary
Cooking	Arm Trunk Neck	12. 23 (1.91)	4–14	4	Very high	Necessary soon
Carrying dirty clothes in the basket to a washing machine	Hand Wrist Trunk	8.53 (2.24)	3–14	3	High	Necessary
Loading and unloading the washing machine	Trunk Neck	7.94 (1.90)	3–14	2	Medium	Necessary
Ironing	Trunk Neck	11.46 (1.59)	6–14	4	Very high	Necessary soon

however, in recent years, informal tasks, particularly housework, have received more attention [26] as for many women homemaking is equivalent to full-time employment. The results of the present study showed that housework tasks are indeed associated with high levels of postural load risk. Critically, homemakers typically perform repetitive tasks using the same poor postures day after day. Therefore, rapid intervention to correct such postures is clearly needed.

The findings of this study align with recent literature, which underscores the high prevalence of MSDs among homemakers and the associated ergonomic risks. Studies have demonstrated the effectiveness of REBA in identifying high-risk postures and guiding ergonomic interventions in various settings, including domestic environments. These studies support the necessity for immediate ergonomic interventions to mitigate the risk of MSDs among homemakers [23, 24].

Working in the kitchen is one of the most important tasks of a homemaker. It has previously been reported that women experience discomfort, fatigue, and stiffness from the physical workloads exerted on the body when cooking, underpinned by poor postures in the neck and trunk [27]. Similarly, a study by Sandhu et al. showed that one-quarter of their sample of 240 Punjabi women reported pain in the neck and back while working in the kitchen [28]. The present study provided a probable reason for these findings and can account for at least some of the pain and discomfort homemakers can experience. That is, we found that many of

the participants performed repetitive cooking and dishwashing tasks using poor postures, especially when involving the neck and back. Performing tasks on a regular basis in a poor posture and for a long time (increasing exposure time) can greatly increase the risk of developing MSDs [29]. In addition, the participants in this study performed their cooking and dishwashing tasks in a standing position, which has also been associated with higher prevalence rates of MSDs, especially in the lower back [30]. One of the reasons for the poor postures adopted by the participants when performing kitchen tasks can be due to an unsuitable height of the stove, sink and dish drying racks. This problem was also observed in the ironing task. Moreover, women iron clothes for a significant period of time in poor postures. Accordingly, one of the ergonomic solutions to reduce the harmful effects of poor postures when doing these tasks is to design the height of kitchen appliances and other tools such as ironing tables to fit homemakers' anthropometric characteristics. These tasks also need to be performed intermittently, both standing and sitting.

Sweeping is one of the tasks performed by homemakers daily. Many ergonomic risk factors for MSDs are involved in this activity, including repetitive wrists and arm movements, excessive back flexion, and abnormal neck posture. We found that the participants performed repetitive movements using poor postures, which resulted in a great deal of biomechanical pressure imposed on their bodies [31]. The observations showed that when using a

vacuum cleaner, participants usually did not pay much attention to the adjustable vacuum cleaner handle. This strongly suggests that teaching the basics of working with such devices would be very helpful in reducing postural load risk. Poor postures were also present when homemakers were carrying out house cleaning and laundry tasks, and for these tasks the postural load risk was also high. Therefore, for minimizing MSDs, it is necessary to teach housewives how to perform housekeeping tasks and how to adopt the most suitable postures by holding training sessions and providing instructions on correct ergonomic principles.

The present study showed that women homemakers who do regular household chores can experience significant biomechanical loads, especially in the upper limbs. Repeatedly performing these tasks using poor postures, in the long run, can lead to MSDs in homemakers [25, 32]. Certainly, ergonomic evaluations in other studies among housemakers have shown that tasks such as sweeping, washing dishes and clothes, and cleaning surfaces are generally performed without observing ergonomic principles [33]. Furthermore, unlike other formal duties, housekeeping tasks are performed daily and for most of the lifespan of women homemakers. Therefore, performing these tasks under good ergonomic conditions can have a direct impact on the quality of life of women homemakers. Although they are exposed to different ergonomic risk factors, to date, no specific intervention studies have yet been performed towards providing guidance to ameliorate the prevalence of MSDs in housewives. On the other hand, previous studies showed that self-efficacy is a strong determinant of behavioural change and so many previous interventions were not able to help individuals to change unhealthy behaviours for a long time [34].

One of the most important limitations of this study was the use of observational data only to assess postural load risk. For the most detailed and accurate evaluation, it is recommended to use a combination of observational and electromyography methods. This is very costly, and it was beyond the resources of this study. Nevertheless, REBA is an established method for use in naturalistic observation studies. Also, this study was conducted only on full-time women homemakers in one area of Iran. Nevertheless, from our observations and experience we can confidently assert that the tasks performed by the women in this study were very similar to the tasks performed by homemakers in other areas of Iran, and elsewhere. For postural load risk assessment using observational methods, filming is recommended. However, due to the cultural conditions of Iranian society this was not possible. Thus, to solve the problem, several photos were taken from the participants while performing each task.

Conclusions and practical implications

The findings of this study provide direction for implementing effective interventions to prevent MSDs in women homemakers. Overall, this study showed the trunk and neck areas were exposed to the highest postural load risk. An analysis of the REBA scores indicated that housekeeping is demanding and that homemakers performed their tasks in a work environment with moderate to very high postural stress. The REBA scores indicated a need for intervention and changes in the home environment to improve the health and quality of life of homemakers. In addition to the non-ergonomic design of the home environment, especially the kitchen, the poor, awkward, and long-term static postures of the homemakers indicated that they were not aware of ergonomic principles. Altogether, this suggests that guidance and training in the performance of tasks and the use of equipment using good ergonomic principles is needed to ameliorate the risk of developing MSDs among homemakers.

Declarations

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