

## Conference Paper

# Ergonomic Seating in Offices and Recent Trends to Prevent Work-related Musculoskeletal Disorders (WMSDs), A Literature Study

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## Abstract

Despite decades of research on seat ergonomics, it still takes several stages to find comfortable seats for 8- to 12-hours sedentary workers and to find its correlation to work-related musculoskeletal disorders (WMSDs). In addition, knowledge of seats, sitting posture, and worker behaviour while sitting are very limited. The purpose of this article is to understand sitting as a hazard, the body posture while sitting, and the behaviour of workers when sitting. The behaviour of a worker when sitting is determined by the profession, the type of work, the workplace, the seat used, and the individual variables. The method used in this research is library research. The result is that seats may cause work-related musculoskeletal disorders (WMSDs). The conclusion is that more research on chairs and posture is required because a good knowledge of chairs and posture can prevent workers from work-related musculoskeletal disorders (WMSDs).

**Keywords:** ergonomics, seating, work-related musculoskeletal disorders (WMSDs).

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## 1. Introduction

Office workers spend most of their time in the office sitting on chairs. A lot of research has been done to see and measure the comfort of office chairs. However, the seat measurements vary in results and in designs obtained. Comfort is the ultimate goal in ergonomics. What humans certainly sought with tools and machines is the level of comfort.

According to the 2005 Indonesian employee health profile as described in Permenkes No. 48 of the Year 2016, 16 percent of employees suffered from musculoskeletal disorders.

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The seats used vary in shape and size. The seats used in office A are not necessarily the same as those used in office B. Given the variations in the shape and size of the seat, the comfort and the suitability of each individual to the seat are also different.

Ergonomics comes from the Greek words 'ergos' meaning work and 'nomos' meaning the principle. Ergonomics studies the limitations and the abilities of humans with their work, whether it is the relationship with tools, materials, or environment [1].

Hazard means the situation or thing that has a potential to harm a person. Risk is the probability of an unwanted event which may or may not occur. MSDs or musculoskeletal disorders are injuries and disorders in body's soft tissues (muscles, tendons, ligaments, joints, and cartilage) and in the nervous system. They can affect almost all tissues, including the nerve and tendon sheath, and they are most often involved in the arm and back.

MSDs can cause a number of conditions, including pain, numbness, tingling, stiff joints, moving difficulty, muscle loss, and sometimes paralysis. Often, workers have to lose time from work to recover; some never regain full health. These disorders include carpal tunnel syndrome, tendinitis, sciatica, hernia, and lower back pain. MSDs excludes injuries resulting from slipping, tripping, falling, or similar accidents. WMSDs occur when the worker's physical capabilities do not match the physical requirements of the job. Prolonged exposure to ergonomic risk factors can cause damage to the worker's body and lead to WMSDs.

Work-related musculoskeletal disorders (WMSDs) are the major causes of the decline in labour, the increase in disability and compensation costs, and the loss of industrial country productivity. Labour aging and the presence of physically demanding jobs contribute to the widespread appearance of musculoskeletal disorders [2].

Musculoskeletal disorders are not a recent problem. In 1706, Bernardo Ramazzini, an Italian physician who is considered as the Father of Occupational Health, already wrote about office work:

The diseases...arise from three causes; first constant sitting, the perpetual motion of the hand in the same manner, and thirdly the attention and the application of the mind. Constant writing also considerably fatigues the hand and the whole arm on account of the continual and almost tense tension of the muscles and tendons. [2].

Workers who use chairs for most of their working time may experience work-related musculoskeletal disorders (WMSDs) or also known as low back pain (LBP), which is also a cumulative trauma disorder (CTD). The causes of WMSDs may vary, but this article will discuss about workers with the behaviour of sitting on a chair at the office.

## 2. Methods

The research methodology used for this journal is library research.

TABLE 1

Author	Year	Title	Highlights
E.N. Corlett	2007	Sitting as a hazard	"Many work seats have been designed, some designated 'Ergonomic' but with limited evidence of any serious claim to the title."
Alireza Choobineh, Majid Motamedzade, Maryam Kazemi, Abbas Moghimbeigi, Ahmad Heidari Pahlavian	2011	The impact of ergonomic intervention on psychosocial factors and musculoskeletal symptoms among office workers	"Top management support. Purchase of foot rest, improvement of some used chairs, purchase of ergonomics chairs for many workstation, individual adjustment of the chair."
Michelle M. Robertson, PhD, MS, Yuen Hsiang Huang, PhD, Jin lee, PhD	2017	Improvement in musculoskeletal health and computing behaviours: Effects of a macro ergonomics office workplace and training intervention	"Ergonomics climate scale to assess the worker's perception of how well their needs are listened to, RULA, OEA (Office Environment Assessment)."

## 3. Discussion

The hierarchy of control can be applied in office chairs:

1. Elimination
2. Substitution
3. Engineering
4. Administrative
5. Personal Protective Equipment (PPE)

With the support of top management, a proper working environment will be achieved. Also, the addition of a footrest and adjustable seats can add to the comfort of office workers [3]. However, this study does not cover the age, race, and size of a person's posture.

Sitting as a hazard can be prevented with the knowledge of chair sitting behaviour and by using the correct seat in accordance to someone's job [4].

According to Reason (1990), there are two types of errors: active errors and latent errors. Active errors are ‘immediate perceived effects’ and latent errors ‘tend to fall asleep in systems that are largely undetectable until joined by other factors to break through the defence system’. To prevent accidents or health problems, a proper defence system (defence/barrier) is required.

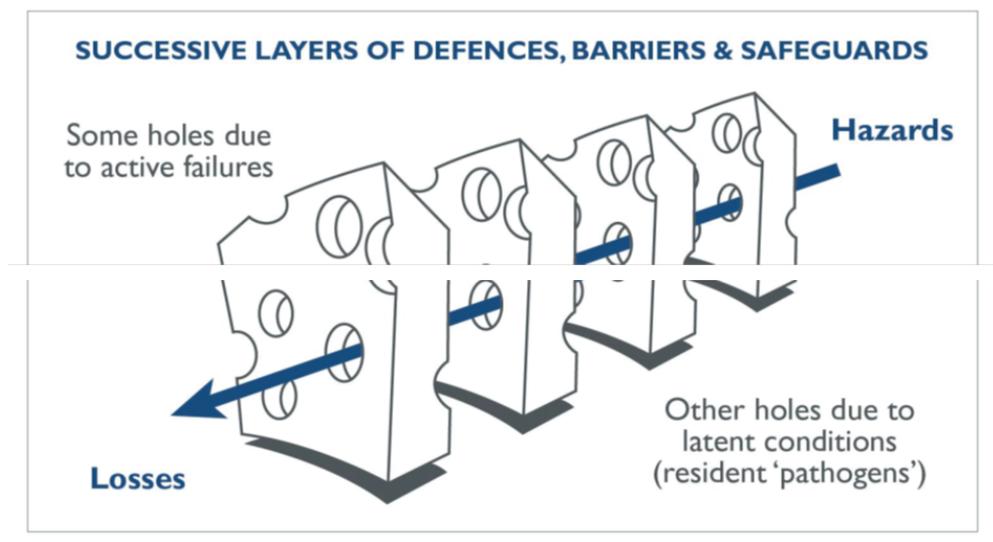


Figure 1: Reason's 'Swiss Cheese' model (BOK).

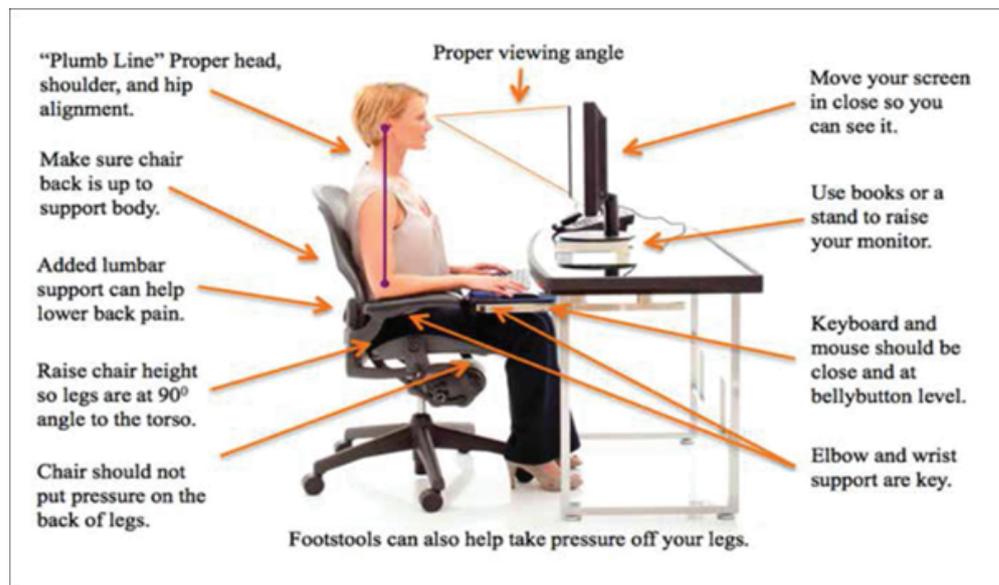
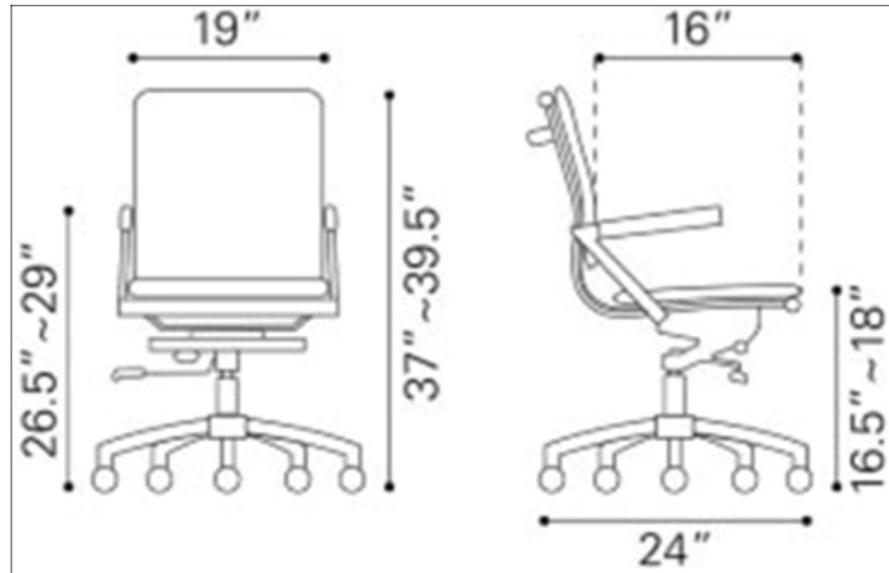


Figure 2: Source: Permenkes No. 48 of the Year 2016 [5].

The research from Professor Grandjean's laboratory indicates that the backrest of a chair which follows the back shape of a human body is good medically and economically. It relaxes the back muscles when leaning in a natural position and supports the lumbar position when the worker leans forward [6].

## Chairs

1. Seat size should be appropriate to the size of the employee using the chair.
2. Work chairs must be selected in accordance to the type of job assignment.
3. In general, the seat size is as follows (in cm):



**Figure 3:** Source: Permenkes No. 48 of the Year 2016 [5].

4. The seats should be stable and have five legs, either wheeled or non-wheeled.
5. The backrest should support the waist arch (flexible slope).

### Procedures related to seat usage:

1. Chair backrest.
  - (a) Adjust the position of the chair back up and down to fit the height of the waist arch (lumbar bone).
  - (b) Adjust the position of the chair back up and down to fit right in the waist arch.
  - (c) Set the tilt angle of the chair back ( $100^{\circ}$ – $110^{\circ}$ ) so as to provide comfort and prevent the occurrence of low back pain.
2. Seat chair.
  - (a) Adjust the width and depth of the seat to the employee who will use it.
  - (b) If it does not fit the depth of the chair, then set the backrest of the seat, which is advanced or reversed.



Figure 4: Source: Permenkes No. 48 of the Year 2016 [5].

(c) Set the seat height to knee height.



Figure 5: Source: Permenkes No. 48 of the Year 2016 [5].

- (d) The thighs are parallel to the floor, so that the back of the knee forms an angle of  $90^{\circ}$ . This will ensure the weight is distributed evenly along the biceps of the foot (behind the thigh). Make sure there is little or no pressure from the seat on the back of the knee, as this can limit blood circulation.



**Figure 6:** (Incorrect) Heel on the floor (Correct).



**Figure 7:** Thighs forming angle (Incorrect) Parallel thighs (Correct) Source: Permenkes No. 48 of the Year 2016 [5].

- (e) The mechanism for adjusting seat height should be easy and can be operated when someone is sitting.

### 3. Armrest

- (a) Armrest provides support for the upper arms and reduces pressure on the shoulders and spine.
- (b) Arrange the armrest according to the elbow height.

### 4. The seats should be made of fabric, not leather or synthetic materials.

Short break is done by the 20 – 20 – 20 method:

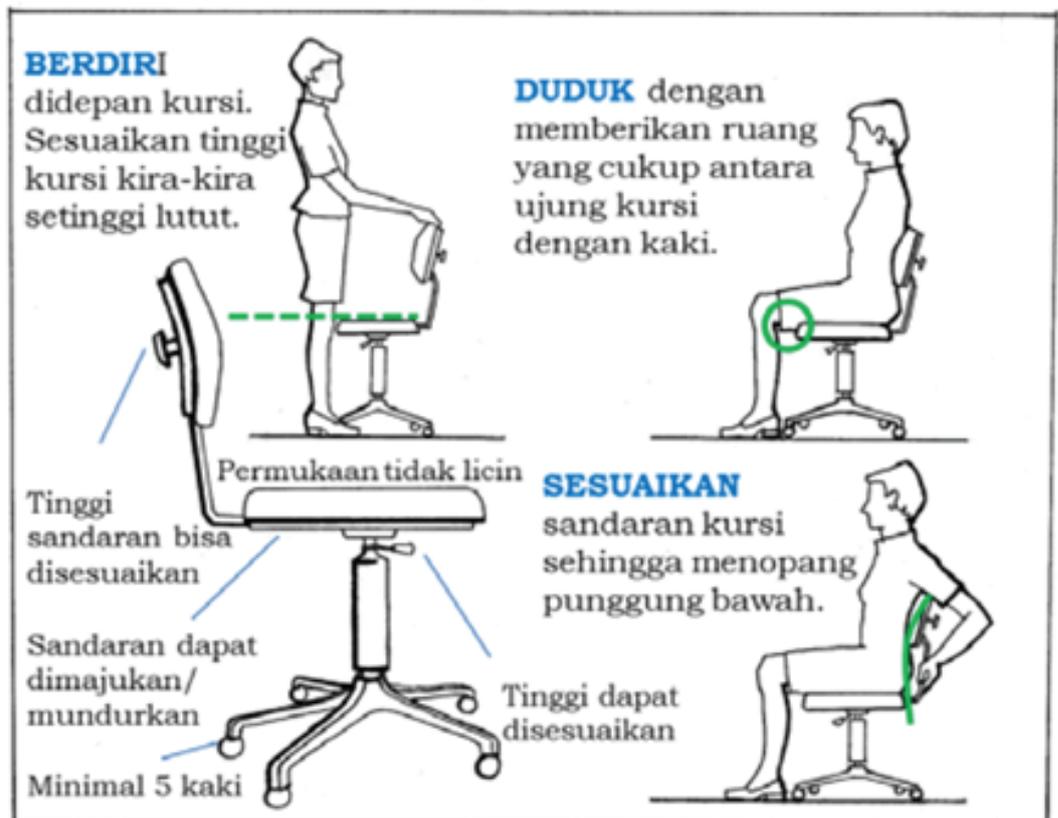


Figure 8: Source: Permenkes No. 48 of the Year 2016 [5].

1. Every 20 minutes using a computer.

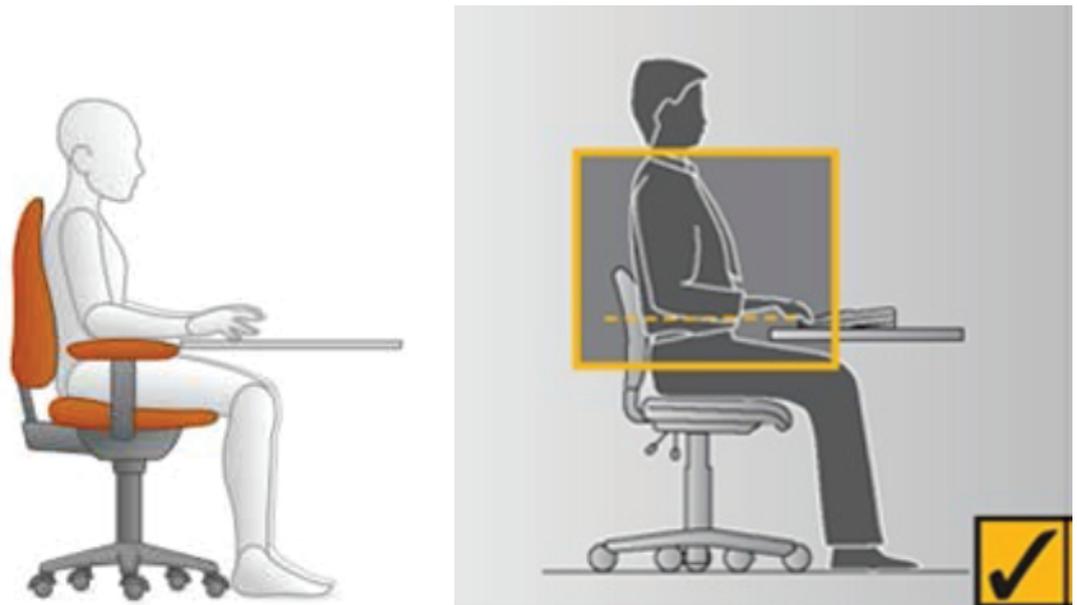


Figure 9: Source: Permenkes No. 48 of the Year 2016 [5].

2. Intersperse 20 seconds short break.
3. Look at something at least 20 feet away.

Every 2 hours, work should be interspersed with 10–15 minutes stretching. Examples of the movement of the stretching can be seen in the following picture.

## 4. Conclusion

Workers' sitting behaviour and the form of office seating in developing countries still require further research. This is just a small part of the ergonomics/human factor. The knowledge of proper sitting behaviour for workers and office chairs will improve the health of the workers. The seating in office should not be differentiated based on the level of work and the employee's position.

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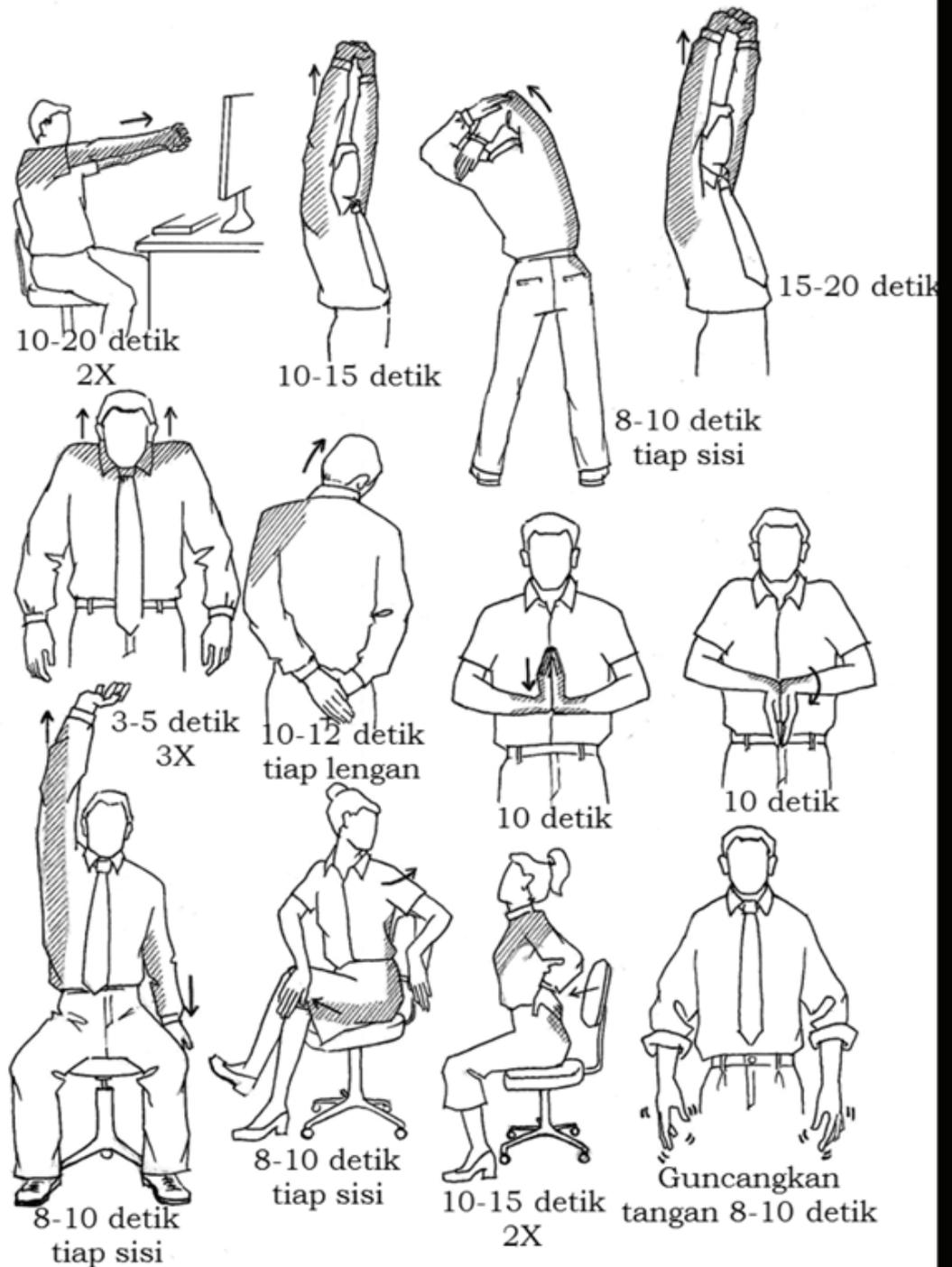


Figure 10: Source: Permenkes No. 48 of the Year 2016 [5].

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