
RESEARCH REPORT

Project: Prevention of back pain caused
by sitting on a chair for a long time

ID Studio 7 DNB 311 Assessment 1

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ABSTRACT

Around the world, many people, from children to the elderly, suffer from back pain. This also appears to have an impact on individual efficiency and society. In this regard, various preventive methods have been studied and suggested worldwide to solve these problems. The topic investigated in this research report is the prevention of back pain caused by sitting on a chair for a long time. A review of academic sources analyses causes to identify preventive measures and analyses preventive measures associated with the causes. Surveys and systematic interviews were conducted with 39 participants and 4 subjects, respectively, using quantitative and qualitative studies. Based on research findings, the data collected is analysed using a variety of methods to identify subject-related information. The main result is incorrect posture habits and low understanding of chair function as the cause, and the prevention method is external support and simplification of chair function. These results are used to identify and evaluate design interventions on initial design concepts.

1. INTRODUCTION

Back pain is defined by location as pain that occurs between the lower edge of the ribs and the crease of the hip (Dionne et al., 2008). Back pain is a common symptom and has become the number one health problem worldwide, affecting people of all ages, from children to the elderly (Hartvigsen et al., 2018, Illes, 2015). In relation to the project, low back pain is caused by various work-related risk factors such as psychological, psychosocial, obesity, age-specific, whole-body work and poor posture (Ozguler et al., 2000). The occurrence of low back pain is a problem that can affect an individual's functional state in the industrialised world (Kovacs et al., 2004). These problems can reduce an individual's efficiency and cause work-related disabilities (Nachemson et al., 2000). As such, low back pain has various negative effects on human health and the surrounding environment worldwide, requiring innovative preventive methods to improve it. The ultimate purpose of this report is to address the various causes of low back pain caused by sitting for long periods of time, to understand the prevention of low back pain, and to identify potential opportunities for design interventions in problem areas.

This report will deal with various analyses of literature from a comprehensive perspective, such as incorrect posture, prolonged sitting, static sitting, and psychosocial aspects among the causes of low back pain caused by sitting on a chair for a long time. Also, as a preventive method to prevent or alleviate the occurrence of low back pain, this report will explore the literature on prevention methods through movement such as external support and stretching. The second part of the report briefly describes the research conducted, the advantages of the chosen research method, and the approaches and methods used. This is followed by study analysis, which describes the analytical methods used to analyse the study. In the following part, detailed and clear results will be presented based on the facts confirmed in the previous analysis. The final part of the report compares the findings from the literature review with the information obtained from the action study and discusses any new information and research gaps found. It also provides design direction based on problems or opportunities identified through analysis. Finally, the overall content of the report is summarised in the conclusion.

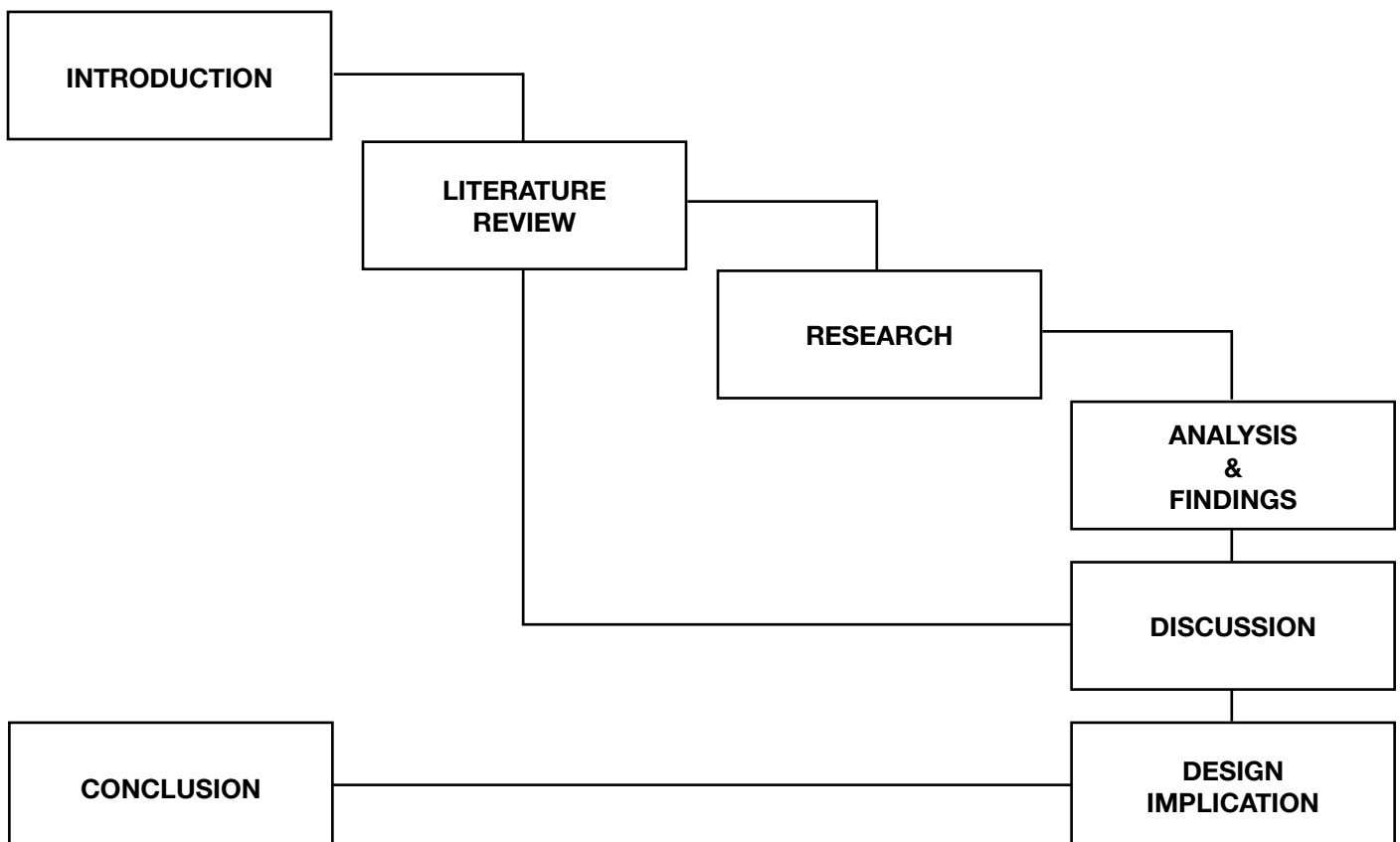


FIGURE 1. Visual graph of the overall project structure

2. LITERATURE REVIEW

Cause of back pain

Low back pain caused by sitting on a chair for a long time is one of the world's most widespread health problems, and its incidence is increasing (Illes, 2015). Back pain is one of the health problems that affects almost everyone of all cultures and peoples (Ehrlich, 2003). In this literature review, it will investigate the effects of sitting for long periods of time on the back and explore ways to improve and prevent it. Two aspects to be considered in this review are: Identify the various causes of back pain and identify methods or techniques that can help prevent back pain.

Prolonged sitting

There are different views as to the cause of back pain caused by prolonged sitting in a chair. Although some epidemiological studies suggest that sitting for a long time is a risk factor for exacerbation of low back pain (Fogleman and Lewis, 2002), the odds ratio was judged to be low. This supports the conclusion that sitting at work by itself does not mean that there is a significant increased risk of back pain (Hartvigsen et al., 2000, Lis et al., 2007). Nonetheless there is a finding that longer sedentary time and less physical activity have a greater impact on LBP risk (Park et al., 2018). This supports the opinion that prolonged sitting at work presents some risk factors for back pain (spyropoulos, 2007).

Incorrect posture

It is analysed that uncomfortable sitting posture, body vibration, and long-term static sitting behaviour are more likely to be the source back pain (Lis et al., 2007). These undesirable or unergonomic postures can lead to musculoskeletal disorders such as back pain (vink and hallbeck, 2012). In particular, non-neutral trunk postures (ie, bending or twisting the trunk forward) are considered undesirable (Lis at el., 2007). Sitting in the wrong posture for long periods, most people tend to bend or squat in a chair, which overstretches the spinal ligaments and strains the discs and muscles around the spine, causing back pain (Triano, 2010). The previous findings support the finding that poor posture is the cause of back pain (casas, Patino & comargo, 2016).

Psychological problems

Another study suggests that psychosocial factors, such as stress, anxiety, and depression, may be the cause of low back pain (Choi at el., 2021). However, while Zemp at el. (2016) suggests that numerous psychosocial aspects are responsible for low back pain, it highlights the lack of literature suggesting that a causal relationship may be linked to specific factors. This supports that attributing back pain to a psychological cause is equivalent to claiming that people are faking complaints or suffering from delusions (Bogduk, 2006).

Prolonged sitting and poor posture have been shown to be the cause of back pain. However, there is no evidence that any particular common cause is a contributing factor. Mork & Westgaard. (2008) analysed the causes of low back pain from various perspectives but found that it was difficult to establish a conclusive basis by epidemiological methods because low back pain occurs in the general population.

2. LITERATURE REVIEW

Prevention of back pain

The second topic of the review is the prevention of back pain. There are different views on how to prevent back pain relief. Although there is limited evidence for the scope and many aspects of prevention for back pain, there is evidence for a variety of outcomes that can help prevent back pain (Burton, 2005).

External support

One of preventions of low back pain is to get external help. The use of a backrest can help to activate the back muscles (Andersson, 1974) and reduce pain and discomfort (Vergara & Page, 2000), and height-adjustable seats (Koskelo et al., 2007) also reduce pain. Specifically, it tends to make small movements in the pelvic and lumbar parts of the spine when the user leans against the backrest (Vergara and Page, 2002). This supports the small pelvic movements around the posture that can prevent back pain by reducing muscle tension and increasing the range of motion in the lower back. (Reinecke & Hazard, 1994). It also suggests that devices that increase lordosis may also help reduce LBP (Gadge & Innes, 2007., McGill & Fenwick 2009). According to Houghton et al. (2020), proper adjustment of armrests increases the frequency of fine movements while sitting, suggesting that this may help prevent back pain that occurs while sitting. This supports the analysis that providing an appropriate armrest height can reduce lumbar disc compression (Harrison et al., 1999; Kayis & Hoang, 1999) and discomfort (Eggleston, 2020; Van Dieen et al., 2001).

Movement

Another prevention method and symptom relief for low back pain is movement. This literature suggests that the use of dynamic seating with motion can reduce low back pain caused by sitting through various activations and loads of spinal structures (van Dieen et al., 2001, McGill and Fenwick 2009). Changes in posture when seated in a chair help increase subcutaneous oxygen saturation, which has a positive effect on tissue viability (Reenalda et al., 2009). In addition, continuous change in posture through alternating activities of different parts of the trunk muscles can relieve back pain caused by sitting for a long time (Van Dieen, Looze & Hermans, 2001). This supports the analysis that subjects with back pain took a more static and sustained posture while sitting (Vergara & Page 2002, Telfer et al., 2009). There is also a preventative measure that increases macroscopic movements, such as changes in posture, such as standing or walking, while sitting for long periods of time, reduces back pain (Davis et al., 2014). This supports that people who change positions 20 to 30 times per hour while sitting report fewer complaints of discomfort (Graf et al., 1991). In summary, not sitting in the same position throughout the day, but periodically moving it can prevent back pain (Allie & Kokot, 2005).

The analysis results show that low back pain can be prevented or alleviated through dynamic sitting and external support. However, prevention appears to exist as a broad preventative measure rather than preventing back pain caused by a specific cause.

3. RESEARCH

The research conducted in this project consists of three research methods: a study of the online academic literature, a survey with 39 participants, and basic data collection through interviews with experts. A questionnaire is created based on the results obtained by collecting academic literature and related information. Participants ranged from 16 to 36 years of age and had a variety of occupations and had a common experience of low back pain. The interviewees were a nurse and a physical therapist with specific knowledge about low back pain and experience in related fields.

Online academic and literature research was an early research method that helped develop the topic, providing information from various perspectives on specific information on low back pain, its causes, and prevention methods. First, information on basic low back pain and various causes of low back pain is extensively analysed and recorded. Second, based on the key information found, it is analysed and recorded in detail and related to the topic.

The second study method used was a survey. Survey refers to a method of collecting information from a personal sample (Scheuren, 2004). Surveys have the advantage of being able to collect a variety of data with the benefit of the participation of different people and the flexibility of the format (Granello & Wheaton, 2004). The survey consisted of 13 multiple-choice and 2 subjective questions based on an online academic literature study. This survey focused on the empirical aspects of respondents' postural habits, sitting times, and individual methods of relieving back pain. This focused on analysing the cause of back pain based on the participant's understanding of the chair's function, specific posture habits, and sitting time.

The third research method used was interviews with experts. Interviews with experts have the advantage of collecting data based on more specialised knowledge and experience. The first interview is a face-to-face interview, and the other interview is a text interview taking into account situations. This interview consisted of 7 questions related to the causes and prevention of low back pain based on data collected from online academic literature research and questionnaires. This interview focused on gathering expert opinions on the causes and prevention of low back pain and understanding additional information and information specifically related to the topic.

4. ANALYSIS & FINDINGS

As the first analysis method used to analyse the survey data, the results of the survey responses are displayed in the form of a graph. For a holistic understanding, this analysis examines and records the results of the responses as an average number. The second analysis method used divided the questions into 4 categories and based on them, the main themes of the 39 participants' responses were recorded and analysed in detail to see if there were any common responses (Appendix 1). After this process was completed, the data for each question was summarised with key keywords to provide an easy-to-understand accurate information about the participant's responses. Additionally, to analyse the data for short-answer questions, this analysis listed all of the results for the responses. This allowed for a visual representation of all responses from the participant and a proportionally larger display of frequently used words (Figure 2).



Figure 2: Data visualisation of sitting posture

As a result of the survey data, four causes were identified as the origin of low back pain; static sitting, bad posture habits, sitting for a long time, and minimal understanding of chair functions. 52% of respondents sit in a chair for more than 5 hours a day, and 57% of respondents sit in a chair for more than 1 hour without movement (Figure 3&4).



Figure 3: Hours of sitting in a chair per day



Figure 4: Hours of sitting without moving

These results show that static sitting can cause back pain. Second, 57% of respondents do not use this feature despite having an adjustable armrest (Figure 5). Figures suggest that respondents have a low understanding of the function of chairs in preventing back pain. Finally, it shows that the majority of respondents have poor posture habits. This presents that incorrect posture is the cause of back pain.

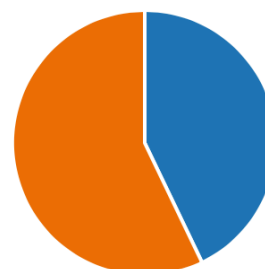


Figure 5: Using the armrest function

4. ANALYSIS & FINDINGS

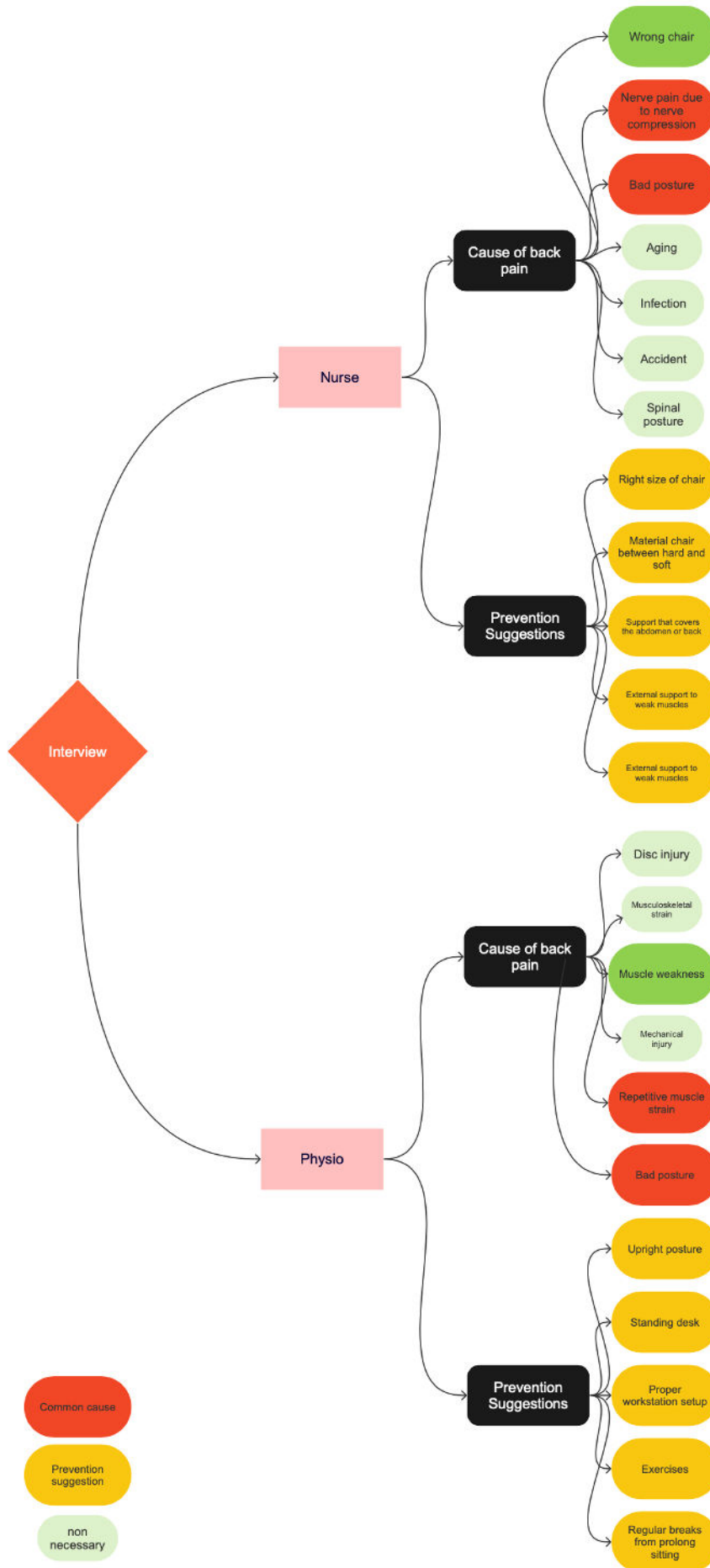
The data obtained from the interviews were lengthy written responses (Appendix 2), and the method used for the analysis was to evaluate and compare the responses of the two experts, and to summarise and list crucial information to identify possible problem areas. Identify recurring patterns or themes of important information summarised and noted, and group each by cause and prevention (Figure 6). The topics identified through the data are broken down into subtopics and analysed. This analysis compared the results obtained through the survey with the positions of these segmented experts and checked whether there were common themes or contradictory results.

The main results of the interviews of the two experts are information not found in previous studies and detailed and specific information about the findings already found. There are two opinions about the cause as the common opinion of the two experts. The first common result found was incorrect posture as the cause of back pain. It mentions the opinion that pain occurs due to deformation of muscles and ligaments due to incorrect posture, and also tightening and thickening of tense muscles. The second result found was weak muscles. Research provides information that weak muscles lead to poor posture and cause back pain. Finally, two experts present a method for back pain that occurs when sitting on a chair for a long time.

- Adjust the chair to fit your body
- External support to help or cope with weak muscles
- Supports that cover or support the abdomen (For correct posture, the back muscles, the muscles around the spine, and the abdominal muscles must be supported.)
- A chair that is neither too hard nor too soft (it is difficult to maintain an upright posture in a hard chair due to hip joint pain/ A soft chair requires more muscle strength to maintain an upright posture)

As a result of analysing the two surveys, this analysis identified common results of poor posture habits and low understanding of chair functions as the cause of back pain. Based on the postural habits found in the survey and the opinions of experts, it is necessary to discuss the areas where the wrong posture can be corrected by supporting weak muscles. In addition, the prevention method of adjusting the chair to fit one's body suggested by experts requires further discussion in relation to the low understanding of the chair's function found in the questionnaire.

Figure 6: Grouping and summarising of responses



5. DISCUSSION

The objective of this project is to explore effective ways to prevent back pain caused by sitting for long periods of time by collecting data in two ways. The studies conducted are related to the causes and prevention of low back pain presented in the reviewed literature.

A detailed literature review identifies the causes of back pain caused by sitting for long periods of time from various perspectives. Nonetheless, in the literature discussed, the information was comprehensive to analyse specific causes due to differences of opinion. The primary study conducted on the causes of back pain was able to fill the gap in the literature by analysing and collecting the causes based on the experiences of people. In conclusion, a tacit understanding can be drawn from the comparison of literature and research results, and several important causes can be identified. The causes of low back pain discovered through this study are prolonged sitting, static sitting, bad posture habits, and insufficient understanding of chair functions.

The second part of the literature review on how to prevent back pain is closely related to the results of the secondary study. As a preventive method confirmed in the literature review, two methods were found: dynamic sitting and support through an external force. In the secondary research result, the prevention method through correction of incorrect posture habits and support through external force appeared. Although there are subtle differences between the dynamic sitting suggested in the literature review and the correction of incorrect posture habits presented in the secondary research results, it leads to similar results by preventing back pain through correct posture. In conclusion, although subtle differences in preventive methods appeared, the reviewed literature and research results included similar concepts, therefore it can strongly support the existing preventive methods rather than analysing various preventive methods. Through this, preventive measures such as correcting poor posture habits, dynamic sitting, and understanding the function of a chair are discovered.

In summary, there was a close relationship between the information provided in the introduction, the literature reviewed, and the studies conducted, and identified the techniques and methods that can be developed by analysing the causes for discovery and the need for improvement through preventive measures. The results of the study were able to fill the research gap by evaluating the combination of causes and expert-suggested prophylaxis for low back pain commonly experienced by people and identifying the prophylaxis needed.

6. DESIGN IMPLICATIONS

The initial impact of the results of this report on design considerations was to design a specific improvement direction for the prevention of low back pain that occurs when sitting for long periods of time. It was able to set the direction of the design idea to solve the problem for two reasons: incorrect posture and insufficient understanding of the function of the chair. Studies show that many people sit in a chair for a long time with bad posture habits. This is one of the causes of back pain. An opportunity for design intervention is to correct and improve bad posture habits through external forces. A second identified cause is people's minimal understanding of the chair's function. Back pain may be caused by not using the function of the chair or using it incorrectly. The opportunity identified based on this is to simplify the function of the chair.

Correcting incorrect posture through external force

Studies have shown that many people have low back pain from sitting in a chair for long periods of time with the wrong posture. The identified design opportunity is to correct bad posture through external supports. Based on this, two identified design problem solving methods appear.

- It is a device or design that induces users to take an accurate posture on a chair.
- Provides a backrest or abdominal support design to support weak lower back and abdominal muscles.

The first proposed correct posture guidance device can be provided with a design that specifically transforms the flat hip part of the chair. For example, it is designed so that the part between the legs protrudes upwards to prevent crossing the legs when sitting on a chair. The second idea to support the muscles presented is to provide a design that can support the lower back. With this, the device to induce correct posture and the idea of supporting the abdominal and back muscles can not only prevent or relieve back pain, but also show an opportunity to adapt to correct posture habits.

Simplify the function of the chair

According to the second study, people do not use the function even though they have a chair with multiple functions. This shows that people have a low understanding of the function of the chair or do not feel the need for adjustment. The design opportunity identified through this is to provide a design that minimises the functional aspects of the chair or requires no adjustments. Based on the two opportunities, the discovered idea represents an opportunity to develop an integrated design of armrest and backrest. Another opportunity is to make the armrests out of an elastic material to provide a design that people don't need to adjust.

The opportunities identified above are also opportunities for design interventions that allow aesthetic design considerations while considering material properties and functional aspects in common.

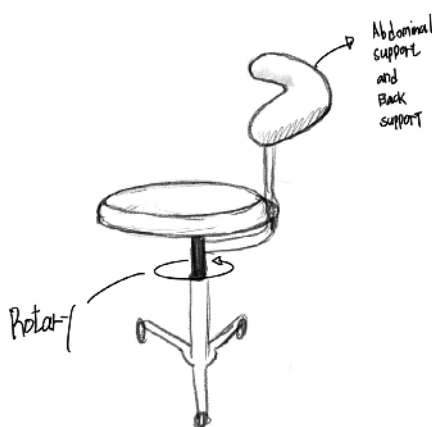


Figure 7: Sketch 1

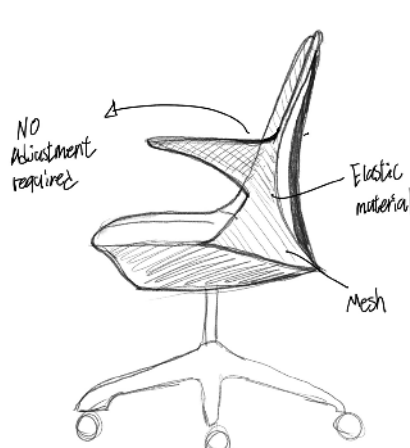


Figure 8: Sketch 2

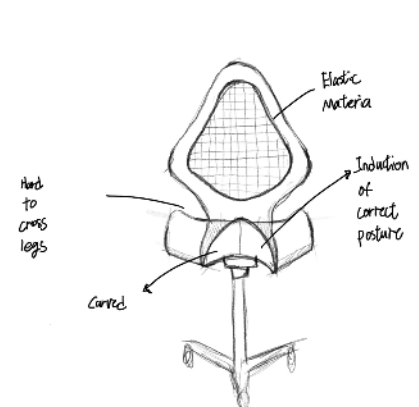


Figure 9: Sketch 3

7. CONCLUSION

Many people around the world suffer from back pain. It affects people and society and causes problems. In conclusion, by preventing back pain caused by sitting for long periods of time, you can reduce these socially influential problems. Literature reviews and behavioural studies have been conducted to understand the impact of low back pain on people and society and gain insight into how to prevent low back pain caused by prolonged sitting. According to the literature reviewed, the causes of low back pain caused by sitting for long periods of time include static sitting, sitting for a long time, bad posture habits, psychological problems, and various causes from a comprehensive perspective. Also, as a preventive method for back pain, dynamic sitting and help from external forces are shown. For this report, a behavioural study using an online survey of 39 participants was conducted. The findings of behavioural studies supported by the literature provide information about the causes of low back pain found in the general population. In addition, in the secondary study, interviews with two experts with experience or knowledge in fields related to back pain were conducted. Interviews of two experts were analysed to provide information on specific and specialised topics. This showed that back pain occurs due to poor posture and weak back muscles, and external forces are needed to solve it. Design opportunities are design interventions that improve functional aspects, such as devices that support the lower back and abdomen, devices that induce correct sitting posture, and streamline the functionality of a chair. This could be another opportunity to improve work and work skills by reducing the back pain that people experience in a sitting environment.

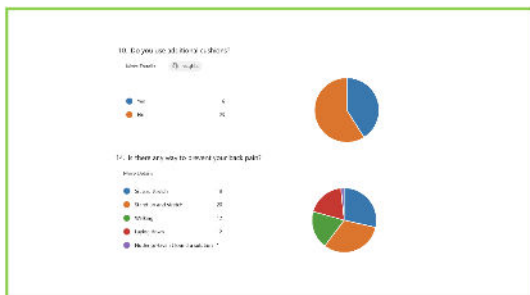
APPENDICES

Information about respondents who have low back pain (39)



Analyse environmental factors by collecting information from participants

Prevention



Behavioral analysis for people to prevent persistent back pain

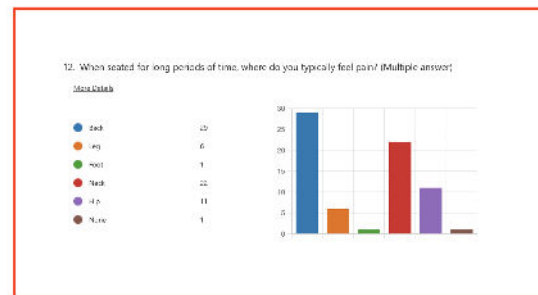
1. SURVEYS ANALYSIS

Related to cause



- The material of a chair is analysed to be a part of the influence of low back pain.
- Analyse whether the functions of the installed chair itself are used correctly or are helpful to prevent back pain. Incorrect function use causes low back pain.
- It is analysed that sitting in a chair for a long time can provide the cause of back pain.
- Analyse that incorrect posture can cause back pain.
- It can be supported that there are various causes for the occurrence of low back pain.
- Analysis of various types of incorrect posture

Pain area



Identify the parts of the body where people feel the most pain, including back pain

What profession are you in?
Nurse

How long have you worked in this field?
2 and a half years

Do you have any expertise in back pain?
I have various knowledge and experience working in the main ward of the Department of Neurosurgery (VS), Orthopedic Surgery (OS), and Rehabilitation Medicine (RB) of a university hospital

Have you ever cared for a patient suffering from back pain? So, what causes back pain?
I took care of patients as a nurse in charge of patients with back pain.
Aging (mainly compression fractures)
Infection (Spondylitis, spinal tuberculosis)
Fall accidents, traffic accidents (fractures, nerve damage)
Spinal stiffness (Spondylosis)
Bad posture and injury to the spine while lifting heavy objects

What is the biggest cause of back pain in patients who complain of back pain after sitting for a long time?
In the case of HVD (herniated disc) patients, nerve pain due to nerve compression. Pain in the lower extremities (leg, pelvis, feet) or upper extremity pain (shoulder, arm, hand) according to the related nerves

Do you think the cause of people's back pain is the wrong chair? Or do you think it's bad posture?
Both factors are causes and are closely related.
Difficultly maintaining correct posture when sitting in the wrong chair. Even if you maintain the correct posture in the wrong chair, it is thought that it can cause back pain by maintaining a state of tension in the muscles around the spine.
Bad posture is a posture formed over a long period of time and is thought to result in deformation of the muscles and ligaments around the spine. Depending on the posture, the tense muscles become tight and thicken, and the muscles on the other side stretch, resulting in muscle pain.
If you are a patient with scoliosis, the tension in the muscles around the spine increases, and as the tension in the muscles around the spine increases, the degree of lateral curvature of the spine becomes more severe, making it more difficult to correct the posture.

If so, is there any way to prevent back pain that occurs when sitting in a chair for a long time? (Minimization of pain)
A chair that is the right size for your body type
Chair with backrest and arm rest
A chair that is not too hard and not too soft (It is thought that it is difficult to maintain an upright posture in a hard chair due to pain in the hip bone (sacral bone). Also, there may be stimulation of the femoral nerve. If it is too soft, more muscle strength is used to keep the back straight and maintain an upright posture.)
A support that covers or supports the abdomen: For correct posture, the back muscles, the muscles around the spine, and the abdominal muscles must be supported.
Ergonomic forces that can help or cope with weak muscles

Physio
What occupation are you working in?
Physio
How long have you worked in this field?
7.5 years
Do you have expertise in back pain?
Yes
Have you ever cared for patients suffering from back pain? If so, what are the causes of their back pain?
Yes. Disc injury, musculoskeletal strain, muscle weakness, mechanical injury
What is the biggest cause of back pain in patients who suffer from back pain after sitting for a long time?
Repetitive muscle strain
Do you think the cause of people's back pain is the wrong chair? Or do you think it's a bad posture?
Bad posture
So, what posture should you sit in to prevent back pain?
Upright posture with back support and regular breaks eg. Standing desk
Is there any way to prevent or self-medicate?
Prevention: Proper workstation setup Exercises Regular breaks from prolong sitting Medication- painkillers, NSAID cream/gel for short term relief

2. INTERVIEWS ANALYSIS

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