

THE IMPACT OF SEDENTARY LIFESTYLE ON MUSCULOSKELETAL DISORDERS

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Abstract

Background: Sedentary lifestyle is a common phenomenon where people sit for longer duration, spend a lot of time in front of screens, work in offices and are involved in less physical activity. These are The main cause of Musculoskeletal Disorders (MSDs) e.g. neck pain, lumbar pain, shoulder pain, stiffness of joints, limited mobility etc. Poor posture and decreased flexibility can have negative impacts on muscle strength, flexibility and overall quality of life. **Objectives:** The present review focuses the effect of sedentary lifestyle on musculoskeletal disorders and to identify the major risk factors, symptoms and health problems associated with long term physical inactivity. **Methods:** The present study is a review of published research articles on sedentary behavior and musculoskeletal disorders. Data were collected from journals, online databases and previous published studies of office workers, students, esporst players and adults, who sat for long periods of time. **Results:** Musculoskeletal disorders, especially of the neck, lower back, shoulder and wrist were strongly associated with long sitting duration and sedentary behaviour. **Conclusions:** Musculoskeletal disorders are strongly associated with sedentary lifestyle. High screen time, poor posture and low physical activity were linked with high pain, stiffness and fatigue and low physical function. The prevention and alleviation of MSDs and the improvement of health and quality of life require regular physical activity, ergonomic correction of posture, stretching exercises and lifestyle modifications.

Keywords: Screen time, Sedentary behavior, Prolonged sitting, Musculoskeletal problems.

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INTRODUCTION

Now the pattern of lifestyle has changed drastically due to the rapid rate of technological development, urbanization, and increasing reliance on screen-based activities. People of different ages have been deprived of opportunities for regular movement due to office work, distance learning, prolonged computer use, television viewing, and frequent smartphone use. The advent of remote work, mechanized transportation, and technology-based entertainment has increased sitting time and decreased active body movement in

occupational and non-occupational settings. These gradual lifestyle changes have contributed to various health-related problems and have become a significant public health concern worldwide [1,2].

Prolonged sedentary behaviour (PSB) is one of the most important lifestyle factors affecting musculoskeletal health. Sitting for prolonged periods, poor posture, repetitive activities, and inadequate ergonomic practices place considerable mechanical stress on the body, particularly on the cervical and lumbar spine. These factors may lead to muscle fatigue, postural imbalance, reduced flexibility, impaired circulation, decreased joint mobility, and chronic musculoskeletal pain, thereby affecting daily functioning, work performance, mental health, productivity, and quality of life [2,3].

Sedentary behaviour is increasingly recognized as a major threat to physical health. Therefore, understanding the effects of prolonged inactivity on musculoskeletal disorders and functional well-being is essential. Sedentary behaviour is defined as any waking behaviour characterized by an energy expenditure of

≤1.5 metabolic equivalents (METs) while in a sitting, reclining, or lying posture. Musculoskeletal disorders are conditions affecting muscles, bones, joints, ligaments, tendons, nerves, and other supporting structures, resulting in pain, discomfort, stiffness, and reduced mobility [4].

Sedentary Lifestyle

And this is increasingly being correlated with a range of chronic health issues, primarily due to our sedentary lifestyles. Sedentary Behavior (SB) is defined as any waking activity with an energy expenditure ≤1.5 metabolic equivalents (METs) while sitting or reclining, including computer use, television viewing, studying, driving and prolonged use of digital devices. Sedentary behavior is defined as any waking activity that involves energy expenditure ≤1.5 metabolic equivalents in a sitting or reclining posture. Physical inactivity refers to an individual's lack of exercise or physical activity. In the digital age, technology, urbanization and automation are changing our lives and work at an ever-increasing pace. The modern education system, office work, online communication and tech-based entertainment have replaced the need for regular movement with more screen-centred activities. Besides, virtual learning environments, remote working systems and mechanized transportation have increased inactive behaviours among populations. Extended periods of sitting have been associated with a variety of health outcomes and negative physiological effects. Prolonged sedentary behaviour can impair circulation, decrease energy expenditure, weaken muscles and disturb metabolism. Sedentary behaviour has been associated with obesity, cardiovascular disease, diabetes mellitus, mental health disorders and decline in musculoskeletal health. Sedentary lifestyle is one of the major public health problems with high prevalence and long-term health consequences, highlighting the need for effective preventive intervention strategies and public awareness [5-6].

Review Article on Musculoskeletal Disorder

Musculoskeletal disorders (MSDs) are a class of injuries and illnesses that impact the musculoskeletal system of the body. These include muscles, tendons, ligaments, joints, bones and peripheral nerves. People with these disorders experience pain, stiffness, tenderness, swelling, decreased range of motion and decreased physical performance. MSDs can be caused by cumulative biomechanical overload (gradual onset), or by excessive effort or trauma (acute onset). Common sites are neck, shoulders, thoracic and lumbar spine, wrists, hips, knees and lower extremities.

The incidence of MSDs is known to be increasing and this has been linked to modern day lifestyle and work practices such as prolonged postural loading and repetitive biomechanical stress. Limited postures of the body and poor ergonomic alignment with limited variation of movement and sustained maintenance of those postures causes muscular tension, spinal strain, decreased joint flexibility and altered postural balance. If these factors persist over a long period of time, they can result in muscle fatigue, loss of neuromuscular

coordination and progressive functional limitations interfering with daily life and work performance. In addition to the physical pain, MSDs result in a large socioeconomic and healthcare burden, including reduced productivity, absenteeism, functional impairment and long-term rehabilitation. Musculoskeletal disorders are increasingly recognized as a major occupational and public health problem worldwide, with a substantial impact on quality of life and physical well-being [7,8].

Epidemiology of Sedentary Behaviour

Sedentary behaviour is now recognized as a major public health problem with increasing prevalence globally across all ages, occupations and social conditions. The urban lifestyle and a greater reliance on digital systems have led to a change in the daily activity pattern, leading to less physical activity and more sedentary behavior. The sedentary lifestyle is more and more present among office workers, students, teleworkers, health workers and users of digital devices, who spend long periods working, studying and conducting recreational activities on the screens. The increase in online communication, virtual learning, electronic entertainment, and smart phones has led to more sedentary time each day in both developed and developing countries. These behaviours are a public health issue, as long-term exposure to sedentary behaviours has been linked to obesity, cardiovascular disease, metabolic dysfunction, psychological stress and deterioration of musculoskeletal health. Sedentary lifestyle affects physical health, occupational performance, social participation and well-being negatively and is a cause for economic burden on health care system. Sedentary behavior is a worldwide health problem that needs more attention, public health policies, and lifestyle-based preventive strategies [9,10].

Sedentary lifestyle and musculoskeletal problems: an overview

Sedentary lifestyle often causes musculoskeletal disorders and leads to biomechanical, physiological and biological changes of the body. Prolonged sitting puts a static load on the cervical, thoracic and lumbar portions of the spine. It causes higher pressure on the intervertebral discs and the adjacent structures of the vertebrae. This constant stress and strain can cause poor spinal alignment, stress on the ligaments and muscles that support the spine and the slow development of postural imbalance, pain and reduced mobility [11]. Poor ergonomic postures (unsupported sitting and forward head posture in particular) may contribute significantly to musculoskeletal pain and functional movement impairments, as well as increased muscular tension in the neck, shoulder, lower back and upper limbs [12].

From a biological perspective, extended periods of inactivity lead to a decline in skeletal muscle contraction, which in turn diminishes blood flow and oxygen delivery to musculoskeletal tissues. The reduced circulation also results in a reduced delivery of nutrients and a retardation of the removal of metabolic waste products. This contributes to pain and fatigue. Also, lack

of physical activity causes atrophy of postural stabilizing muscles, decrease in the lubrication of joints, decrease in the movement of synovial fluid and decrease in the flexibility of connective tissue. Physical inactivity also induces a pro-inflammatory response through cytokines such as IL-6 and TNF- α , which have been linked to pain and tissue dysfunction [11,12]. The combined biomechanical and physiological effects increase the risk of chronic musculoskeletal disorders and decrease physical performance and can lead to long-term functional limitations.

Occupational and lifestyle risk factors

A sedentary person is prone to musculoskeletal disorders due to various factors related to life and work. Now with the advent of computers, people work from home environments and spend long hours of screen time. People stay in the same position for long periods, which puts extra strain on the neck, shoulders, back and upper limbs. Also, prolonged sitting and lack of awareness of position can lead to pain and strain in the musculo-skeletal system. The musculoskeletal system also has a role in physical activity in strengthening the muscles and improving their flexibility. This in turn decreases the susceptibility of the musculoskeletal system to pain and dysfunction. Obesity and high body mass index (BMI) are therefore also important mediators, as they increase the mechanical load on joints and spinal structures. In addition, psychosocial stressors such as job stress, mental fatigue, anxiety, and work-related stress can contribute to the development of musculoskeletal symptoms related to sedentary lifestyles through the increase of muscle tension, and thus increase the risk of chronic pain and functional limitations [13-14].

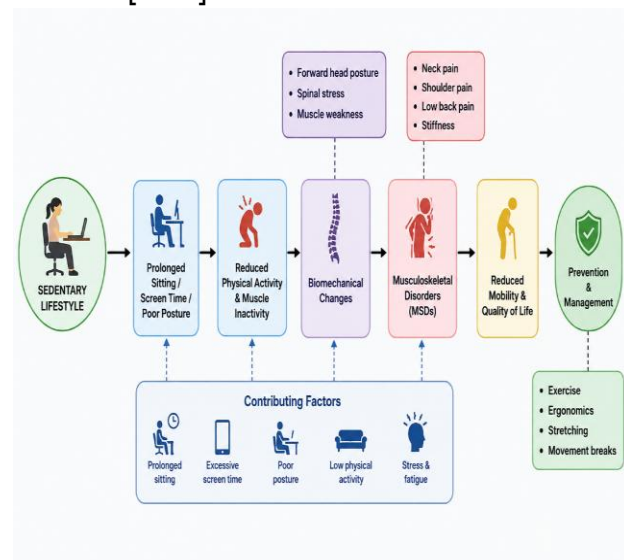


Figure 01: Conceptual pathway for association of sedentary lifestyle, musculoskeletal risk factors and preventive strategy for better musculoskeletal health

QUALITY OF LIFE FOR HEALTH AND MUSCULOSKELETAL DISORDERS

Musculoskeletal disorders can have a serious impact on the physical, psychological and social well-being of an individual. Sedentary lifestyle is a cause of

musculoskeletal disorders. Chronic musculoskeletal pain is often associated with chronic pain, decreased mobility and loss of function that affects daily life and work. Such conditions may lead to absenteeism and influence the productivity and efficiency of the persons concerned. This can be damaging for the employees and the employers. Chronic pain is associated with psychological problems like stress, anxiety and depression and restrictions in physical activity and quality of life. Chronic pain is associated with sleep disturbance and poorer emotional well-being which may contribute to the physical discomfort and functional limitations.¹⁵ High economic burden of healthcare costs, rehabilitation costs and loss of productivity due to long term management of musculoskeletal disorder. This level of reduced social participation and routine functional activities may be so severe that interpersonal relationships, independence and overall lifestyle satisfaction are affected by additional pain and movement restrictions. Musculoskeletal disorders represent a major problem for individual well-being and public health, which indicates the need for preventive and rehabilitative interventions [15-16].

Assessment of musculoskeletal disorders and sedentary lifestyle

Research studies should incorporate standardized instruments to evaluate sedentary behavior, physical activity levels, and musculoskeletal conditions. The Nordic Musculoskeletal Questionnaire (NMQ) is a widely used tool for assessing pain and discomfort in many areas of the musculoskeletal system, including the neck, shoulders, back, and lower limbs. The Sedentary Behaviour Questionnaire (SBQ) is a commonly employed tool for evaluating sedentary behavior, measuring the time spent sitting and participating in screen-related activities in everyday life. Physical activity is assessed with validated instruments, such as the International Physical Activity Questionnaire (IPAQ) and the Global Physical Activity Questionnaire (GPAQ), that classify individuals according to the intensity, duration and frequency of activity. These tools have been extensively utilized in public health and musculoskeletal research to assess sedentary behaviours and related health outcomes. Standardized questionnaires increase the reliability, validity and comparability of data collected from populations and research settings, provide an accurate assessment of sedentary behaviour and musculoskeletal disorders, and assist researchers in planning effective preventive and rehabilitative strategies [17, 18].

PATHOPHYSIOLOGY OF MUSCULOSKELETAL DISORDERS AND SEDENTARY LIFESTYLE

The sedentary lifestyle has been associated with many pathophysiological mechanisms in musculoskeletal disorders, such as structural, cellular, vascular and neuromuscular changes. Musculoskeletal system. "Keep moving all the time to keep muscles strong, joints moving and tissues metabolizing. Longer periods of inactivity mean less mechanical stimulation of the

muscles and connective tissue and therefore less activation of the muscle fibres and slow degeneration of the postural stabilizing muscles. Less muscle support leads to more mechanical loading on the vertebral column, intervertebral discs, ligaments and joints around them, as well as less spinal stability and normal biomechanical alignment. Less movement means less circulation of the synovial fluid in the joints and less nutrition to the cartilage and the joints get stiffer. Mechanical loading can also affect the arrangement of collagen and flexibility of the connective tissue and therefore the ability of the tendons and ligaments to withstand stress. Over a period of time the cartilage and parts of the intervertebral disc wears out perhaps due to lack of activity. This causes chronic pain and loss of mobility. Other important changes are of the neuro-muscular and vascular systems. Decreased skeletal muscle contraction, decreased blood flow to periphery, less oxygen and nutrients delivered, and decreased removal of metabolic waste are known to cause muscle fatigue, sore tissues and slow recovery. Furthermore, sedentary behavior has been associated with increased production of inflammatory mediators (IL-6, TNF- α) that could negatively impact tissue repair and pain sensitivity. These pathophysiological changes lead to a high risk of musculoskeletal dysfunction and long-term physical disability [19, 20].

CHANGES IN THE WORK ENVIRONMENT AND ERGONOMIC INTERVENTIONS

Prolonged sitting, repetitive occupational activities and poor body mechanics during work activities place continuous stress on the musculoskeletal system and increase the susceptibility to pain, fatigue and functional impairment. Therefore, it is necessary to implement proper ergonomic techniques to reduce work related stress and to maintain the physical health of sedentary population. A properly set up workstation can help with good posture and avoiding unnecessary strain on joints and muscles. Supportive seating systems, height-adjustable workstations, correctly positioned display screens and easy-to-use input devices help to achieve optimal posture and minimize mechanical stress on the cervical spine, lumbar region, shoulders and upper limbs. Sitting at work also increases the risk of long-term postural stress and reduces musculoskeletal activity [21]. Getting up regularly during the day at work to prevent musculoskeletal pain is also very important. Simple activities like a few walks, mobility exercises, and readjustment and stretching routines, improve circulation, increase muscular flexibility and reduce the physical fatigue that comes with static work conditions. Besides the improvement of the physical work station, workplace health promotion programmes are also important in decreasing the burden of work-related musculoskeletal disorders. Changing the work tasks also helps avoid the repetitive motions that lead to overuse injuries and muscular imbalances. Organizational support for physical activity, educational interventions to increase awareness, ergonomic training and employee wellness programmes may support healthier

occupational behaviours and improved long term musculoskeletal outcomes. Regular ergonomic assessments and preventive occupational health policies can enhance the performance of the employees, reduce the absence rates and improve quality of work life.²²

NEW TECHNOLOGIES FOR SEDENTARY BEHAVIOUR ASSESSMENT

Advances in the measurement and monitoring of sedentary behaviour in both clinical and non-clinical settings have been facilitated by digital health technologies. Physical inactivity, sitting time, energy expenditure, variation in posture and movement patterns are often measured in real time with help of wearable devices such as smart-watches, fitness trackers, accelerometers, posture sensors and activity monitoring bands. These technologies enable the objective and continuous measurement of daily activity levels, overcoming the limitations of self-reported questionnaires and subjective assessments. Current wearable systems include motion sensors and artificial intelligence based algorithms that can detect long periods of sitting, postural deviations, step counts and insufficient physical activity [23].

There has also been development of smartphone applications and mobile health (mHealth) platforms that help monitor screen time, sedentary duration and physical activity behaviour. These include reminder apps, vibration alerts and behavioural feedback systems to prompt people to take movement breaks, stretch and maintain good posture during long periods of desk work or screen time. However, new technologies such as machine learning, Internet of Things (IoT)-based health, and cloud-based monitoring platforms can be helpful in analyzing the behavioral data and in detecting sedentary lifestyle patterns with respect to musculoskeletal health risks. In addition, physical activity and ergonomic education are part of telehealth and remote rehabilitation technologies for sedentary populations. The amalgamation of these technologies may enable the prompt detection of sedentary behavior, improve postural awareness, and mitigate musculoskeletal problems [24].

POSTURAL AND BIOMECHANICAL ACCOMMODATION TO LONG SITTING

Sitting postures have negative consequences and biomechanical and postural effects on the musculoskeletal system. Prolonged sitting in the same position causes the mechanical forces to be transmitted through the spine in an abnormal manner. This is especially true in the cervical and lumbar regions of the spine. Prolonged periods of sitting place pressure on the discs of the spine and flatten out the normal curves of the spine. This causes sore muscles and bad posture. Prolonged computer work in flexed positions without ergonomic assistance can, over time, lead to forward head posture, rounded shoulders, thoracic kyphosis and pelvic imbalance. This postural deviation causes increased tension in the paraspinal muscles, ligaments and surrounding soft tissue leading to pain, stiffness and

loss of functional mobility. The effects of prolonged sitting on muscle activation pattern, joint biomechanics and spine are discussed. This results in less activation of the core stabilizing muscles, less postural control and spinal support, and an increased risk for development of chronic neck and low back pain. The most common adaptive tightness related to sitting is in the hip flexors and hamstring muscles. This results in a decreased neuromuscular activation and weakens the gluteal and abdominal muscles. These imbalances in musculature disturb the normal mechanics of movement and put extra stress on joints and connective tissue. Less activity means less synovial fluid circulation and less joint lubrication. This produces stiffness and a limited range of motion. The chronic biomechanical and postural adaptations result in a significant decrease in the efficiency of the musculoskeletal system and increase the risk of development of chronic musculoskeletal disorders associated with sedentary work [25, 26].

SCREEN TIME AND MUSCULOSKELETAL DISORDERS IN THE 21ST CENTURY

Digitalization has influenced the lifestyle of the modern age, with people relying more on electronic devices for work, study, communication and entertainment. The proliferation of digital technology including computers, smart phones, tablets and other devices has resulted in people of all ages spending much more time each day looking at screens. Long hours of screen use are generally associated with long sitting and recurrent movements that generate load to the cervical spine, shoulders, upper extremities and lumbar spine. Furthermore, poor postural habits during device use can cause musculoskeletal stress and biomechanical imbalance, such as forward head posture, sitting slouch posture and unsupported back posture. The more we stare at screens the more neck pain, shoulder stiffness, wrist pain, eye strain, upper back pain and less joint mobility we suffer. Long periods of texting or web-surfing on smart phones can cause repetitive strain injury to the muscles of the thumb, wrist and forearm. Trapezius and paraspinal muscle tension has also been reported during prolonged computer work [27, 28]. In addition, digitalization has decreased physical mobility and outdoor activities, which causes physical inactivity and muscular deconditioning. Furthermore, the online learning environment, remote working system, virtual meetings and long gaming behaviors have been found to contribute to the global sedentary lifestyle [29]. Some recent studies have demonstrated a positive correlation between increased screen exposure and the prevalence of work-related musculoskeletal disorders (WMSDs). People who spend many hours a day in front of screens often complain of increased fatigue, postural discomfort and a reduction in their physical efficiency. The major risk factors for chronic musculoskeletal problems are static postures, repetitive movements, poor ergonomics and lack of recovery periods. Therefore, preventative measures to mitigate the risk of musculoskeletal disorders associated with digitalization and to support long-term musculoskeletal health are needed, e.g.

reducing unnecessary screen time, assuming an ergonomic posture, including stretching exercises, and taking frequent movement breaks [27-30].

MANAGEMENT AND PREVENTION OF THE MUSCULOSKELETAL DISORDERS IN SEDENTARY LIFESTYLE

Prevention and management of musculoskeletal disorders associated with sedentary lifestyle should be tackled from a multidisciplinary perspective based on the promotion of physical activity, ergonomic correction and healthy lifestyle practices. Regular exercises, stretching exercises, correction of postures and periodic movement breaks are important to reduce muscular stiffness, improve flexibility and maintain musculoskeletal health. Adjustable chairs, desk height, lumbar support and positioning of computer monitor may help reduce the biomechanical stresses on the spine and upper extremities. Long-term screen time reduction, maintenance of a healthy body weight and an active daily routine can significantly reduce the musculoskeletal complications associated with sedentary behaviour. It is also important to carry out education on ergonomics, training in good posture and programs on healthy occupational habits to improve quality of life and to prevent long-term disability associated with MSDs. Such preventive measures are useful for long-term preservation of musculoskeletal function and reduce the burden of sedentary lifestyle-related disorders in occupational and non-occupational settings [31, 32].

OCCUPATIONAL AND ERGONOMIC RISK FACTORS FOR MUSCULOSKELETAL SYMPTOMS

Sedentary behaviour is linked with musculoskeletal symptoms and low levels of physical activity, occupational and ergonomic conditions. People who spend long hours at a desk, computer or office work, often suffer with discomfort of the neck, shoulders and lower back, due to the static postures maintained for long periods of time. Symptoms can range from mild to severe depending on the design of the workstation, posture, repetition of movements and the amount of time sitting without a break. Chairs wrong height, screen wrong height etc. Poor ergonomic support may also lead to mechanical stress on muscles and joints. The results suggest that ergonomic interventions and breaks in movement during the workday are important preventive measures for reducing the musculoskeletal load in sedentary populations [33, 34].

FUTURE RECOMMENDATION

Future work should aim to develop comprehensive, evidence-based interventions to reduce sedentary behaviour and prevent musculoskeletal problems in heterogeneous populations. More intervention in the workplace should be considered such as ergonomic workstation adjustments, posture improvement programs, scheduled breaks for movement and education on proper body mechanics when sitting for long periods of time. Such interventions may help to

decrease mechanical stress on muscles, joints and spinal structures and improve overall musculoskeletal function. Further studies are needed to evaluate the long-term effects of structured physical activity programs, stretching exercises and rehabilitative preventive interventions on pain relief and mobility in inactive persons. Community education and preventive health programs should be included in public health programs to increase awareness of adverse effects of prolonged sitting and lifestyle modification [35]. Technology-enabled systems, such as wearable fitness trackers, posture monitoring devices, and digital reminders, can help promote regular movement and early identification of musculoskeletal strain.³⁶ There is also a need for more research to identify biological and occupational factors associated with sedentary behaviour to inform prevention strategies and support long-term musculoskeletal health outcomes [35, 36].

CONCLUSION

The review found that sedentary lifestyle was one of the main contributing factors in the development of musculoskeletal disorders (MSD's), particularly in the neck, shoulders, upper back and lower back. The relevant risk factors of musculoskeletal discomfort and functional impairment were prolonged sitting, excessive screen time, poor posture and physical inactivity. Recently sedentary behaviour has been acknowledged as an independent risk factor. For a wide range of musculoskeletal disorders including low back pain, cervicobrachial syndrome, spinal abnormalities and soft tissue injuries. Furthermore, occupational and lifestyle factors such as repetitive work, static posture, ergonomic deficits, obesity and psychological stress worsen musculoskeletal symptoms and quality of life. The findings suggest that regular breaks from sitting, ergonomic modifications at workplace and postural correction are required to prevent MSDs associated with sedentary lifestyle. Early detection and prevention are important to reduce long term disability and improve physical functioning, occupational productivity and overall well-being. Therefore, promoting an active lifestyle and reducing long periods of sitting should be a high priority for public health in the prevention of 'musculoskeletal health complications musculoskeletal complications'.

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