

Comparison of Back-Leg Muscle Strength in Physically Active and Inactive Administrative Job Workers: A Cross-Sectional Study

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ABSTRACT

This study has been undertaken to assess the back-leg muscle strength in administrative job workers and then compare the readings/values of physically active population with physically inactive population of administrative staff, in Dr. Vitthalrao Vikhe Patil Memorial hospital and medical college. The study used “IPAQ-sf Questionnaire” to estimate the level of physical activity and amount of sitting behaviour in hours throughout the day of the week and “Isometric back-leg-chest dynamometer” to assess the back and leg muscle strength of the 74 administrative staff, male (68.9%) and female (31.1%) involved in the study. The findings of the study indicated significant differences in the back-leg muscle strengths of both physically active and inactive population in both the male and female groups. On comparing the physically active population with physically inactive, in the male group inactive the results showed a significant difference in back muscle strength (0.0224) and leg muscle strength (0.0289) and in female group the leg strength (0.0200) showed a higher significant difference than back strength (0.0003). This workplace delivered that the more the physical active of an individual irrespective of the age and genders the better the back-leg muscle strength and the more number of years a person worked in a sitting-environment weaker the back-leg muscle strength.

Keywords: Physical activity, Physical inactivity, Dynamometry, Isometric Dynamometer, BLC dynamometer, Administrative workers.

1. INTRODUCTION

Rapid progress of civilization almost completely deprives of the opportunity to movement and physical effort. Physical activity is eliminated from the everyday life. “Human body was never created for a lifestyle involving continuously sitting tasks, it was created to move!”^[1] However, for a living, people sometimes have to compromise this fact and pursue certain types of occupation which demands long hours of sitting activity over movement. Adults spend at least one-third of the waking hours work is becoming more sedentary.^[2]

In the modern world, the workforce throughout has undergone a lot of modifications and so the jobs that require employees to remain seated i.e., to remain less active and more sedentary for extended periods are continually increasing.^[3] According to the official records published by “occupational requirements survey-2017”, among office and administrative occupations, by 65.6% of the work being spent as sitting, they are considered as sedentary jobs. Among legal occupations 78.1% of the workday goes in sitting position. On average, workers in computer and mathematical occupations spend 83.5% of the workday sitting. Business and financial operations workers also spend an average of 80.6 percent of the day sitting^[4,5].

These occupations frequently expose employees to prolonged periods of sitting that has been identified to be a potentially significant occupational health hazard and a major concern in recent times [6], since sitting for long duration of hours beyond a particular time period has increased prevalence of chronic diseases including coronary heart disease [7], diabetes [8], obesity [9], and breast cancer [10], as well as increased mortality from all causes [11]. According to a study by Serxner et al. [12] there was a link between behavioural health risk and absenteeism in sitting job workers. This was due mainly to the presence and prevalence of both metabolic and mental diseases associated with sedentary working conditions.

Risk of musculoskeletal disorders has also been linked to increased exposure to sitting at work [13]. Previous studies have demonstrated that there is a U-shaped relationship between LBP and PA [14,15]. These studies showed that sedentary lifestyle and strenuous levels of PA both are more associated with LBP than moderately intense PA [16-18].

What happens When You Sit?

When your body assumes sitting posture, explains Cornell University, much of your weight is transferred to the pelvis, particularly to the ischial tuberosity. When you sit, muscles do most of the work against gravity, as long as you practice proper posture. In this position, the muscles deep in your abdomen, pelvis and back - collectively known as the 9 core stability muscles (rectus abdominis, iliocostalis lumborum and multifidus muscles) - support your upright posture. However, if there is adaptation of the faulty posture due to prolonged sitting, these muscles supporting the spine become stiff and weak resulting in low back pain. The fascia though is tough being pliable it attains the shape of the faulty posture maintained throughout the day [1,19,20,21].

Because sitting leaves your leg muscles at rest, the Department of Health and Human Services at Victoria, Australia,

warns that prolonged sitting can lead to weakening of large leg and gluteal muscles. Extended periods of sitting also stress the hip flexors (iliopsoas muscle), causing them to shorten over time and leading to improper walking and irregular posture while standing which can be easily seen while standing. Additionally, the added pressure to the hamstrings can affect blood circulation, leading to muscle breakdown. [22] You also may notice that your hamstrings feel tight after a long day of sitting at your desk; this can cause them to pull on your lower back and create back pain. Along with all the focus on back pain, it has been ignored that prolonged sitting has proved to be one of the prime causes of "The dead butt syndrome" or so called in the textbooks "Lower cross syndrome" [23].

According to Cornell University, sitting puts about 40 to 90 percent more pressure on your back compared to standing. Those who perform office/desk work are sitting on average 8-12 hours/day during work days, and 7-9.5 hours/day on days off. These trends also have adverse effects such as weight gains, type-2-diabetes, obesity, DVT and cardiovascular problems (due to less energy expenditure). [1,19]

Prolonged sitting periods with poor posture and repetitive movements of the upper extremity, both of which have been linked as causes of neck and shoulder pain [24]. Studies have also shown that an individual having a job requiring sitting for a long period of time have a larger probability of facing neck/back pain due to stressful and static abnormal posture [25].

Prolonged sitting is a topic of concern in many occupational groups such as office workers [26]. High rates of sedentary behaviours with low physical activity have been demonstrated in particular groups of office workers including managers, professionals, clerical and administrative workers [27], public service workers [8], and health company workers [28]. One reason for this might be the shift to the 'paperless office' and the

growing prevalence of computerized work environments [1].

Observational studies of Australian office workers have demonstrated that up to two-thirds of a working day, or half of an office-worker's waking hours are spent in sedentary postures [26,29].

Because of specificity of work performed, all these desk workers are especially exposed to a risk of occurrence of such diseases [30] and that raises a problem of constructing programmed, intentional physical activity for this group of employees.

Preventive medicine, often helpless to well-known civilization diseases and especially to new health risks, calls for appreciation of importance of health prevention and health promotion [31,33,30,32]. It is thus justified to quantitatively assess not only total but as well everyday - low, moderate and vigorous habitual physical activity that will allow for an unbiased and relative appraisal of importance of these independent variables in health promotion and will help in constructing appropriate programs of physical activity.

Physical activity (PA) is typically defined according to Caspersen et al. as: "any bodily movement produced by skeletal muscles that results in energy expenditure beyond resting expenditure [34], usually over 1.6 metabolic equivalent. Physical inactivity is the absence of physical activity or exercise that fails to meet the standard physical activity for health [35]. Public health guidelines recommend regular PA to minimize the risk of chronic diseases [34,36,37]. It is commonly believed that nature of work of office employees does not require high physical efforts but there are still only suppositions about it since few data exist supporting that view.

Given that average working hours have generally increased over the past 32 years [38], with adults now spending an average of more than 8 hours of their weekday at work [39], the workplace is a key setting in which to introduce strategies to reduce sitting time and break up periods of

prolonged sitting to improve health and physical activity [40,41].

A typical official job which requires a person to work at desk sitting for 8 hours a day, 5 hours a week is enough to cause ill effects of a bad posture due to sitting. [1] Thus, the study tries to create awareness and give a feedback that- "relieving the body from ill effects of long-term sitting work demands is more important than punishing oneself to satisfy one's mind for monetary needs".

2. MATERIALS AND METHODOLOGY

2.1 Study Design – Observational, Cross-sectional study

2.2 Study Set Up- In Vikhe Patil Memorial Hospital and medical College, Ahmednagar city

2.3 Sample Size – 74

2.4 Sample Techniques - Purposive technique

2.5 Study Material- Back-leg-chest dynamometer, Laptop, weighing machine, a measuring tape, a notebook and a pen.

2.6 Inclusion Criteria: Healthy administrative job workers- both gender, age 24-55 years, with working hours of minimum 8-hours/day.

2.7 Exclusion Criteria: Administrative workers with any sports injury to limbs, any underlying neuromuscular or musculoskeletal disorder, any cardiovascular, respiratory diseases and Subjects suffering from any psychiatric disorder affecting their psychomotor abilities.

2.8 Outcome Measures:

➤ **INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE:** [20,21,22]

The regular physical activity of the patients was assessed and recorded with

the help of a questionnaire, through face to-face interview using, IPAQ-short form (IPAQ Research Committee 2005). It concentrates on three specific activities which are walking activity, moderate intensity activities and vigorous-intensity activities. The question on sitting activity indicates the time period utilized in sedentary activities but it is not included in the calculation of the total physical activity score. Scoring method of IPAQ is kind of different and is expressed in terms of medical equivalent (MET). The IPAQ can classify an individual's activity as "Health-Enhancing Physical Activity (HEPA)" when the total score is 3000 MET-minutes (50 MET-hours)/week or more, "Active" when the total score is 600 MET-minutes (10 MET-hours) or more, and "Inactive" when the total score is below 600 MET-minutes (10 MET-hours). In this study, "HEPA" and "Active" were considered as participate, and "Inactive" was considered as non-participate [22].

➤ **BACK-LEG MUSCLE STRENGTH MEASUREMENT:** [23,24]

Back leg muscle strength is measured in the study by an: "Isometric Back-Leg-Chest Dynamometer" with an analogue dial is an instrument used to measure muscular strength of the back muscles, leg muscles and chest muscles. The measurement base provides secure footing. Chain length is adjusted to accommodate for height differences or to vary the point of force application. Maximum reading remains until the unit is reset. The strength reading can be viewed as pounds or kilograms. The dynamometer can be used to measure various muscles all over the body however, for this research the dynamometer was used to measure only back muscles and leg muscles strength, both having different procedures to be measured.

2.9 Procedure:

Institution ethical committee approval was obtained before commencing the study. Healthy administrative workers were selected based on the inclusion and exclusion criteria. The subjects were explained in detail about the procedure, benefits and the need of the study and then the informed consent was obtained, in the language best understood by them, before involving them in the study. Basic demographic data and anthropometric measurements like: name, age, gender, dominance, weight, height, BMI; along with duration of occupational sitting hours and interval hours were documented on the data sheets. Their physical activity and sitting time period were calculated with help of "IPAQ-sf Questionnaire" and the back and leg muscle strength was measured with the help of an objective source, i.e., "Isometric back-leg-chest dynamometer". The administrative staff were then segregated into 2 groups depending upon their physical activity scores i.e., physically active (PA) population and physically inactive (PinA) population, and then the male PA population back-leg muscle strength were compared with male PinA and similarly the female PA population back-leg muscle strength was compared with female PinA

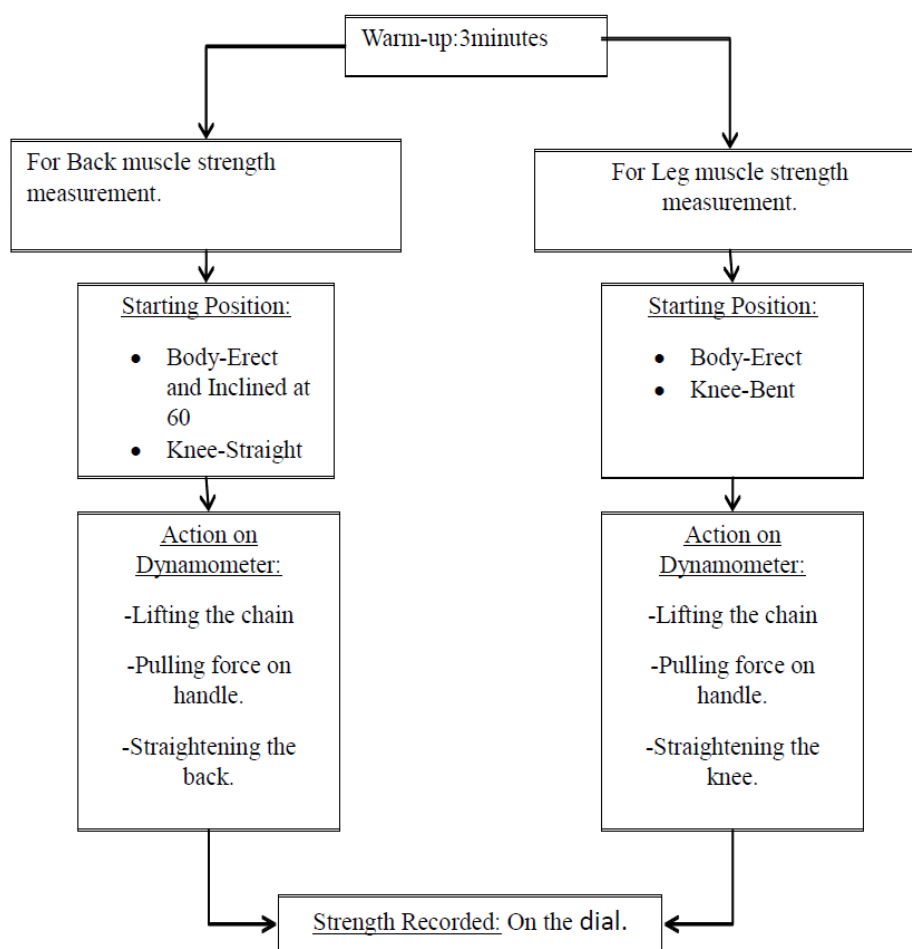
The procedure for measuring the back-leg muscle strength with an isometric back-leg-chest dynamometer is [49].



Figure 1: Leg muscle strength testing with an isometric back-leg-chest dynamometer.



Figure 2: Back muscle strength testing by an isometric back-leg-chest dynamometer



3. Statistical Methods:

Unpaired t-test was used to compare back-leg muscle strength of physically active and inactive populations of both male and female administrative workers.

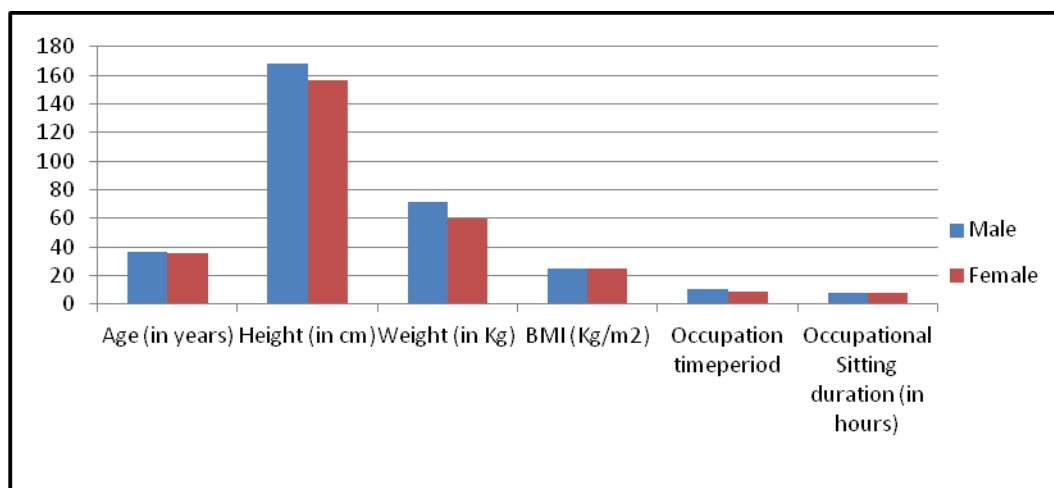
4. RESULTS

A total of 74 participants were examined, 51 males and 23 females. Descriptive statistics for the baseline characteristics of the participants by gender are presented in table 1. The average age for male and female administrative workers included in the study was 36.3 ± 8.5 . The

mean height and weight of the administrative workers was 164.42±9 and 164.42±9 respectively. The administrative staff were also interviewed for the amount of time they spent sitting performing their occupational tasks and on an average the hours were 7.3±0.7. The graph 1 below represents the results depicted in the table.

Table 1: Baseline characteristics of the administrative workers.

	Total Mean (SD)	Male Mean (SD)	Female Mean (SD)
Age	36.3±8.5	36.66±8.6	35.48±8.5
Height	164.42±9	168.07±5.7	156.3±11
Weight	164.42±9	71.85±11.8	59.68±6.8
BMI	24.9±3.8	25.1±3.5	24.55±4.2
Occupation time period	10.38±7.4	10.97±8	9±5.5
Occupational Sitting duration	7.3±0.7	7.26±0.8	7.39±0.5



Graph 1: Baseline characteristics of administrative job workers.

The male and female administrative workers were assessed for their physical activity with the help of “IPAQ: International Physical Activity Questionnaire-short form”. In the male group, the physically active population had a mean score of 1804.36 ± 2027 and the physically inactive population had a score of 202±221. In the female group, the physically active population had a mean score of 1652.8±1472.88 and the physically inactive population had a score of 215.92 ± 204.5.

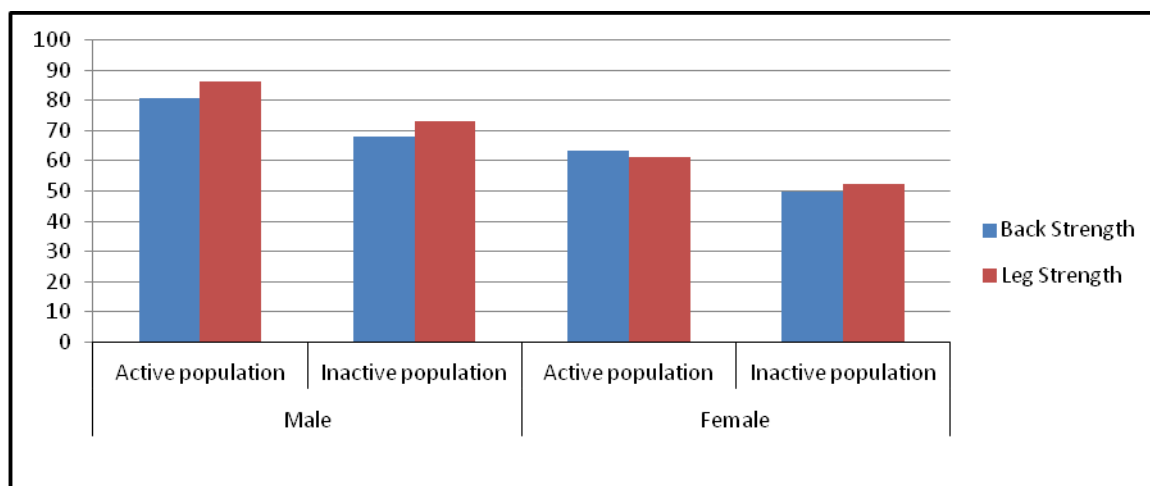
Table 2: Physical activity means scores of both active and inactive populations of administrative workers.

	Active population Mean (SD)	Inactive population Mean (SD)
Male	1804.36 ± 2027	202 ± 221
Female	1652.8 ± 1472.88	215.92 ± 204.5
Total	1737.24 ± 1771.038	201.85 ± 212.97

The overall back muscles and leg muscles strength in two different populations, physically active and inactive population, of administrative job workers were compared. The research selected an objective measure, “**Isometric Back-Leg-Chest Dynamometer**” to assess the back-leg muscles strength in every individual participant. The comparative statistics are given in Table 3.

Table 3. Comparison of physical activity score, back-leg muscle strength in active and inactive population of administrative job workers.

	Back-leg muscle strength	Active population Mean (SD)	Inactive population Mean(SD)	p-value
Male	Back muscle strength score Mean(SD)	80.78±16.74	68.17±16.95	0.0224
	Leg muscle strength score Mean(SD)	86.07±19.87	73.02±17.66	0.0289
Female	Back muscle strength score Mean(SD)	63.18±6.3	49.83±8.2	0.0003
	Leg muscle strength score Mean(SD)	61.18±8.8	52.42±7.9	0.0200



Graph 2. Comparison of back-leg muscle strength in physically active population of male and female groups in administrative job workers.

The back-leg strength of the two populations (Physically active and inactive) of male and female group when compared with each other showed significant difference for both back muscle strength (0.0004) and leg muscle strength (0.0033). In the male group, when the physically active participants were compared with physically inactive the results showed a significant difference in back muscle strength ($p=0.0224$) and leg muscle strength ($p=0.0289$). In the female group, when the physically active and inactive populations were compared the leg strength ($p=0.02$) showed a significant difference than back strength ($p=0.0003$).

4. DISCUSSION

There is change in the nature of modern occupational structure and physical functional demands making the jobs more and more sedentary based leading to increase in chronic sedentary diseases affecting working adults. Thereby, regular assessment and measurement of physical activity and basic strength testing of muscles that are most affected by sitting at the workplace has become more crucial in maintaining the productivity at the worksite and focusing on an individual's long-term health. The study was conducted since there is a lack of literature concerning back-leg muscle strength altering with the level of physical activity in administrative and so the study was conducted. A study conducted in

the USA on the administrative worker to assess the sedentary behaviour of the college employees was observed to have about 618 minutes (10.3 hours) of sitting activity throughout a working day. The results indicated that administrative workers ($73.2 \pm 17.7\%$) spent more of their working day sedentary than faculty members ($58.5 \pm 19.6\%$, $p < 0.05$)^[44]. Similarly, in this study as well all the administrative workers were evaluated for their sitting time with "The IPAQ-sf Questionnaire" and an average of the total hours spent by them sitting during their non-working hours and working hours was observed to be 10.49 ± 1.5 hours/day/week of the 24 hours in a day. An administrative worker in a medical college sits about 8 hours on an average for occupational needs, which according to the Indian occupational demands is from morning 9 am to evening 5 pm, with an interval of an hour. However, the sitting duration of any administrative workers is not affected much by the interval since in the interval too they spend their time sitting on a chair.

It was observed in twenty studies (representing 11 data sets), all from developed world economies when reviewed and underwent a data analysis using a range of analytical techniques (e.g., accelerometer counts or pattern recognition algorithms) that: "Blue-collar" workers (Sedentary group of workers) were more sedentary and less active during nonwork compared with

work time (e.g., sitting 5.7 vs 3.2 h/d; moderate to vigorous PA 0.5 vs 0.7 h/d) [45]. These findings provided a firm background to check up on another set of the sedentary working group i.e., the administrative department of a medical college.

This study consisted of a total of 74 administrative job workers, 51 males, and 23 females, from medical staff in Dr. Vitthalrao Vikhe Patil Foundation, from which 2 male participants dropped out due to the presence of mechanical low back pain during the time. Thereby, resulting in a study sample of 72 participants. About 66.21% of the population was physically inactive and 33.78% were physically active.

The above-mentioned sitting behaviour of nearly 10 hours/day/week depicts administrative workers performed the least activity throughout a day. Therefore, providing a platform to identify the nature of physical activity a medical college administrative staff presents with. In a particular study conducted in the city of Milagro, Ecuador Graciela Mercedes Alvarez et al. used the IPAQ-sf Questionnaire consisting of 7 questions to identify the level of sedentary behaviour and physical activity of the administrative public sector workers. Similarly, this study too used the same IPAQ-sf Questionnaire to identify the sitting behaviour and physical activity of the administrative medical college workers [46].

Furthermore, upon administering “The IPAQ-sf Questionnaire” on the medical administrative workers based on MET scores, they were segregated into two groups: physically active population (≥ 600 MET-minute/week) and physically inactive population (< 600 MET-minute/week) [47]. The mean physical activity score of the total physically active population of administrative job workers was found to be 1737.24 ± 1771.038 , which is quite higher when compared with that of the physically inactive population 201.85 ± 212.97 . The physical activity of the total inactive population stands to be higher than people lying in bed. On average a Physically active

male depicted an activity score of 1804.36 ± 2027 and an inactive male depicted an activity score of 202 ± 221 . On a similar line in the female group, the physically active population scored 1652.8 ± 1472.88 , and the physically inactive score only 215.92 ± 204.5 .

The nature of their work is such that it provides the administrative workers with fewer opportunities to undertake physical activity and a closed office environment is what may affect muscle atrophy and reduce the MVC (maximal voluntary contraction) [48], which in this study is taken account for by assessing the back and leg muscle strength with the help of an “Isometric Back-Leg-Chest Dynamometer”.

A study conducted by Shyamal Koley et al. used a back-leg-chest isometric dynamometer to correlate back strength and leg strength among Indian Inter-university cricketers [49]. In this study, a similar isometric back-leg-chest dynamometer was used to compare the back strength and leg strength of physically active individuals with that of physically inactive individuals, from all the 72 participants.

When the physically active population ($n=14$) was compared with the physically inactive population ($n= 37$), in males: there was a significant difference for both back strength ($p=0.0224$) and leg strength ($p=0.0289$).

When the physically active population ($n=11$) was compared with the physically inactive population ($n= 12$), in females too: there was a significant difference for both back strength ($p=0.0003$) and leg strength ($p=0.02$).

Somewhat similar results of physical inactivity (moderate to vigorous PA 0.5 v/s 0.7 h/d) and sitting hours (5.7 v/s 3.2 h/d) in sedentary workers and so-called “Blue-collar” workers were seen through a systemic review study considering about 20 studies all from developed countries [45].

In the present study, more insight about the specific physical activity has been provided by focusing on the back strength and leg strength of the administrative job

workers which was never compared in such a sedentary behaviour population before.

In males (n=51), the physically active population was 14 and the inactive population was 37. Apart from there being a significant difference in the values of the physically active and inactive population, the mean leg muscle strength scores (86.07 ± 19.87) of the physically active population were seen to be the highest of all followed by the mean back muscle strength scores (80.78 ± 16.74).

In females (n=23), the mean leg muscle strength differed in physically active (61.18 ± 8.8) and inactive population (52.42 ± 7.9) and back muscle strength inactive (63.18 ± 6.3) and inactive populations (49.83 ± 8.2) too differed.

However, the gender differences in maximal strength are minimal since they are mainly dependent on differences in the size of muscle fibers, with a cross-sectional muscle fiber area in women being about 75% of that in men [50], the number of fibers of a muscle being about the same in both genders. Thus, no strength difference is found between women and men when strength is considered concerning the cross-sectional area of the tested muscle [51].

It was observed during the study that when the participants were interviewed regarding the recreational activities they involved in their daily routine, the physically active population mentioned them being either of the following: yoga, gym, cycling, and walking, taking into account their surroundings environment.

These specific physically healthy administrative workers were observed to have good leg and back muscular strength. This is not surprising because numerous previous studies are backing up the results. Of all the recreational activities Yoga, walking and cycling were observed to be among the common practices of their daily routine since these activities require minimal equipment or none. Also, regular yoga practice is observed to be widely practiced moderate physical activity just as effective as high physical activities such as

stretching-strengthening exercises in improving functional fitness [52].

Out of 74 administrative workers, it was observed that 5.4% had high physical activity, 24.32% had moderate physical activity and 70.27% had low physical activity.

Some administrative workers who were in the 24.32% group of moderate physical activity were also involved in certain farming activities. However, others, the ones' who were categorized as physically inactive were the ones' who after their 8 hours of occupational sitting would either prefer to sit at home, talking to family and friends, for longer hours or merely lie down watching television and taking rest. Little did they know they were exposing themselves to the prolonged harmful effects of sitting causing low back pain and various other musculoskeletal disorders. [53,54,55,56]

The reduction of physical activity has been known to induce muscle atrophy [57,58], which results from atrophy of type II fibers recruited during intensive efforts [59]. The rate of atrophy is not uniform in all muscles, and for the lower limbs, it can be 2-12% after 5 weeks of bed rest [59]. In many muscles, but not in all, atrophy can be reduced by resistance training alone and by resistance combined with vibration stimulation (during 60-day immobilization in bed) [59]. And so, the sedentary population needs to be given awareness about not being too late to realize the facts and start with even certain amounts of physical activity be it a 20-minute small walk in the park twice a day.

Nevertheless, our study reveals the highest back-leg strength values in the physically active population of administrative workers, which may indicate that even the relatively low physical activity of active administrative workers (moderate activities 3x1 hour/week) was sufficient to maintain or increase muscle strength in the subject.

The findings of the following study carry immense practical application in Job-sectors helping both the job workers as well

as job providers. The study spreads awareness about why an individual's selection of a job/occupation, work premise, and the healthy habits of daily living are of so much importance. Also, it is helpful to a company to decide upon its health policies while providing a job offer to an acclaimed professional.

All the community physical therapists working in industrial sectors as a health guide out there will be able to make the company owners, and health policy decision-makers understand the importance of workstation exercises and providing individuals with proper ergonomic conditions to work with intermediate regular breaks for preventing Musculoskeletal problems along with other health problems (Predisposition to DM, BP, obesity, etc.).

5. CONCLUSION

The main finding of this study is that when physically active and inactive populations were compared with each other for back and leg muscle strengths both the genders (male and female) showed a significant difference.

Both the back and leg muscle strength are equally important in administrative job workers as in any other sedentary or desk job workers. The data from this clearly showed that even a small amount of physical activity in an administrative worker showed a significant difference in his/her back-leg muscle strength, thereby reducing their chances of getting into a vicious cycle of Musculoskeletal or any other health problems.

In the case of the desk-job workers, a moderate level of daily physical activity, and preventing body weight and fat gain should be recommended for prevention and management of low back pain. Increases in exercise training enhance skeletal muscle mass and decrease musculoskeletal pain [61].

Because of this, the desk-job workers should perform the levels of physical activity recommended by the World Health Organization, which is at least

150 min of moderate-intensity aerobic physical activity throughout the week or at least 75 min of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate and vigorous-intensity activity [61].

In addition, the male desk workers should take up vigorous activities gradually over some time only if they are going to continue the same or better avoid engaging in the same. Similarly, the female desk-job workers should avoid vigorous physical activity which may cause back muscle strains or ligament strains, such as: lifting heavy objects, twisting or sudden movements [62,63,64,65].

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