Relationship between duration of laptop usage and limits of stability in young adulthood

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OF

MASTER OF PHYSIOTHERAPY IN NEUROLOGY

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May, 2017

CERTIFICATE

The work described in this thesis entitled **"Relationship between duration of laptop usage of laptop usage and limits of stability in young adulthood."** has been carried out by **Navreet kaur(Reg. No. 11512751)** under my supervision. I certify that this is her bonafide work. The work described is original and has not been submitted for any degree to this or any other university.

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DECLARATION

I, hereby declare that the dissertation entitled “Relationship between duration of laptop usage and limits of stability in young adulthood” represents my ideas in my own words and where other ideas or words have been included. I have adequately cited and referenced the original sources. I also declare that I have stick to all the principles of academic honesty and integrity not misrepresented or fabricated or falsified any idea / data / fact / source in my submission. I understand that any violation of the above will be cause for disciplinary action by the school and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

This thesis encompasses the information generated by me based on based on experiment work carried out in the institute. I assure and hold full responsibility for its genuineness.

Navreet Kaur

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ABSTRACT

Relationship between duration of laptop usage and limits of stability in young adulthood

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Objective: To determine the relationship of short term and long term laptop usage on LOS and to compare the variations in LOS among short term and long term laptop users.

Study Design: observational study with cross sectional in nature.

Study Setting: Neurophysiotherapy research lab, Lovely Professional University.

Subjects and Methodology: fifty five healthy subjects with the age between 17-28 years, both males and females, who use laptop, were enrolled in this study. The subjects were divided into two groups conveniently according to duration of laptop usage as group 1 includes subjects with laptop usage upto 120 minutes per day and group 2 with laptop usage more than 120 minutes per day. The subjects were assessed for limits of stability parameters using Wintrack Medicapteurs platform.

Results: After the statistical analysis using Pearson correlation coefficient, the significant correlation coefficient was not found between laptop duration and limits of stability parameters, except eyes close anteroposterior average speed with long term laptop usage (group 2) with r value= .440, p value of 0.021 mild correlation was present but it was not significant with other parameters of limits of stability. Also, independent t test is used to find the significant difference between both the groups, but no significant difference was found between the groups.

Conclusion: The result of this study suggests that there is no relationship between short term laptop duration and long term laptop duration with limits of stability parameters in young adulthood.

Key Words: Limits of stability, Vestibulochollic reflex, cervicochollic reflex, centre of pressure, centre of gravity.

CHAPTER -1

INTRODUCTION

1.1 INTRODUCTION

The internet and information technology usage is increasing with rapid rate in all aspects of life[1,2] by 10% in 2016 and 354 million compared to 2015[3]. Global figures have predicted increase in shipment of laptops, desktop and tablet by 162.5 million units in 2021[4]. The recent evidences investigated the age of laptop computer ownership and usage among the population of selective countries as of September 2012 that is in U.S-68%, Austarlia-71%, Italy-80%, United states-68%, Germany-73% and U.K-75%[5]. College student's vulnerability to depend on internet is more than other age groups[6]. Laptop computers now days dominating the desktop computers in usefulness, specially in college students because of portability at different places[7]. According to Horrigon, one half of adults in America has laptop computer. In Australia also laptop usage increased by 63% as compared to desktops. Globally also similar trends are followed[8].

As compared to desktop computers, laptops allow various postures for its usage[8]. With increase keying, risk for computer workers head and arm musculoskeletal symptom increases[9]. Studies shown in children more time duration and length of time of laptop usage contributes in discomfort may be due to increase in angle of neck flexion, not in individuals who used from couple of months[10]. According to survey during one time range of laptop usage in minutes is 11.5-101.9 and in hours it is 3.2 on day basis and 16.9 hours on weekly basis[10]. Studies also revealed that laptop should be used for less time than desktop displays[11]. Even studies on musculoskeletal disorders related to users of computer revealed that more individuals are involved in keying like for 20 hours per week leads to 2.2 more increase in hand and arm musculoskeletal problems[9].

Many studies depicted that working on visual display and typing for more than 6 hours per day reported more prevalence of musculoskeletal symptoms in neck and using visual display for more than 20 hours per week typing work together leads to muscular disorders[12]. Most of the children use non desk sitting posture rather than desk sitting responsible for pain and discomfort[13]. This pain and discomfort can cause an adulthood musculoskeletal symptom which is more with increased use of laptop computer[14, 15]. With different non desk sitting postures different intensity of discomfort will be present[16, 17]. Report depicts compromised posture and increased stress and discomfort with use of laptops instead of desktop computers and increased neck flexion and neck protraction with laptop usage[11, 13].

Highest probability of musculoskeletal symptoms has found among computer users who are using computer 75% of work time and it is seen mostly in neck and shoulder, elbow and hand on the other hand individuals spending 25% time on computer reported only few of musculoskeletal symptoms in neck, shoulder, elbow and hand[18]. Laptop usage in various types of seated positions leads to flexion of neck causing displacement of COG of head away from center of rotation of cervical spine leads to increase in flexor moment. Center of gravity displacements express the whole body sway while center of pressure is the neuromuscular reaction combination to displacement of COG and position of COG itself and this shift of COG have marked affect on balance[17, 19]. Vertical position of COG over the BOS must be maintained so that individual can efficiently overcome the destabilizing affect of gravity and can move the COG actively to maintain proper balance[19].

Maintenance of balance or postural stability and posture building is the first function of postural control system; segment positioning and orientation fixation used as a frame of reference for action and perception according to external world is the second function, for which combine action of visual, somatosensory, vestibular and biomechanical components are responsible[20,21]. For the motor skills development postural control is the essential component and it is influenced by various sensorimotor processes[22, 23].

Methods to quantify postural stability are the measurement of limits of stability and changes in COP[24, 25]. The interval between minimum and maximum COP movement in each direction is consider as displacement amplitude and it is found that more is the value of displacement amplitude more worse is the postural instability[26]. It has been found that working on computer for 6 hours or more as compared to working on computer about 1 hour leads to severe forward head posture. Protrusion of

head results in extension of higher cervical vertebrae which causes anterior transition of COG. Hence using computer for longer duration leads to reduce posture control and mobility. Anterior transition of COG causes stretched knee and hip joints leads to restriction in lower limb joints control which effects body sway. More is usage of computer more will be the imbalance in posture, decrease in ability of motor control and balance[27]. Other measure of postural stability that is Limits of stability examination measures the center of gravity control[28].

The limit of stability is defined as the maximum possible displacement of COM in various directions from the center position without fall[29]. Limits of stability depicts the functional BOS of a person, it changes with age not BOS and neuromuscular responses are essential for it. Movement velocity (MV), Maximum COG excursion, end point COG excursion (EE) and directional control (DC) are the outcome measures for the estimation of LOS and according to research one balance test alone could not evaluate balance among participant because all have combination of unique constraints affecting balance[21, 23, 30].

Many subtle factors influence postural control but attention, proprioception and various musculoskeletal factors like forward head posture are the main components[23,26,27]. For proprioception, proprioceptors are responsible which provides information about orientation of movement and joint position, necessary component related to postural control and spatial orientation[31, 32]. According to system of postural control, person with fatigue and pain in neck depicts disturbed proprioception[33, 34], disturb control of eye movement and disturb balance[35,36,37,38]. Altered sensorimotor control of the cervical spine with the increased repositioning errors is believed to be a consequence of changes in sensorimotor integration. Gdowski and McCrea also have explained that neck proprioceptive afferences contribution to the shaping of vestibular nucleus outputs, contributes in postural steadiness[39].

As in cervical muscle pain, impaired proprioceptive afferences could result in mismatching between neck proprioceptors and normal vestibular system which results in sensorimotor integration disturbances disturbing postural control. The management of the cervical sensorimotor control impairments may include the strategies such as exercises along with spinal manipulative therapy aimed at improving the cervical proprioception and disability[39]. It is found that neck proprioceptors has affect on CCR that is cervicochollic reflex and VCR that is vestibulocholic reflex. Stabilization of head in association to space, Vestibulochollic reflex is responsible while for head on trunk,

cervicochollic reflex is responsible. According to studies that have been done working of both these reflexes and then integration in the CNS of these signals are required for posture and stability control. Neck relocation test are used to detect proprioceptive errors which has good intertester and test retest reliability[32].

As the visual system is also one of the main components of postural control system, visual system contribution in stabilization of trunk in space is more effective. Condition with eyes open results in decreased trunk rotations globally and increased reflexive trunk responses globally and this contribution is more in sagittal plane[41,42]. Researchers found that for the maintenance of stability few resources related to attention are required in postural control, it is not autonomous always[26,42] and role of attention is mainly examined in dual tasks during postural control studies. Indeed findings depict the changes in the variability of temporal structure of COP in response to secondary cognitive task performance[42]. Studies found relationship in body awareness that is both about sensory and motor inputs towards musculoskeletal disorders[21]. To check attention mindful attention scale can be used which has good test retest reliability[43].

Imbalance in postural control was also found in individuals with forward head posture[27]. Studies shown that forward head posture is linked to thoracic kyphosis which in turn disturb the loading mechanism due to shift of trunk mass anteriorly leads to neck dysfunction[44]. Individuals with neck pain had longer duration of gait cycle and greater sway[45]. Gender difference is also found during EMG studies as women have less stiffness and isometric neck muscle strength than males[46,47]. Women have 40% to 50% of moment generated by men and moment magnitude decreased linearly in vertical direction from lower level of cervical spine towards mastoid process[48]. Limits of stability also varies with gender, as more sway in boys then girls were found in some studies while in other studies non significant different was found but difference in age related to LOS was present as older adults has shown more sway[49,50].

There are various measurement tools available to evaluate LOS as it follows –Pro balance master system with 9’’x18 dual force plates to calculate COP and COG sway angle by pressure sensing material of a posturography system atop the force plate[21,23,30,51]. Equitest computerized dynamic posturography in which COP trajectory without height is used to measure sway angle of COM,

Nintendo WII balance board[21,51]. Neurocom smart balance master system with SOT, Accelerometer and Wintrack force platform (Medicapture)[21,52,53,54].

Wintrack platform is the advanced instrument used to find quantitative information about the gait of participant. It is used to get values related to foot pressure, static and dynamic postural stability, and gait analysis in barefoot walking[53]. It has high reliability in relation to foot pressure and measures for temporal gait[55].It is based on the instrumental methods used to detect deviations in patterns of plantar pressure and gait for postural, static and gait assessments. To understand the analysis of foot biomechanics these instrumental methods of measurement of distribution of pressure plays a major role and then with these measures assessment of many pathologies like diabetic neuropathy can be done[53].

It is also found that temporal gait parameters analyzed using conventional measures of foot prints showed greater difference when compared with wintarck measurement[53]. Wintrack is used for both parameter of gait and pattern of plantar pressure like average and maximum pressure which was shown more in protocol of 1 step gait than 3 step gait while in 1 step gait temporal variables are smaller with dimensions followed 1610 (length) x653 (width) x30 mm (height), thickness is 9mm and 12888 censors with frequency acquisition to 200 images per second[53,55].

Evidences shown balance disturbances in healthy adults due to forward head posture and attention in computer users but studies are lacking in finding limits of stability in laptop users and its variations with short term and long term usage duration and any factors affecting limits of stability[27]. This study is going to find limits of stability in laptop users and various causes related to postural instability in them and relation of postural stability with forward head posture, attention and proprioception as these factors can also affect postural control and postural stability in the individuals.

1.2 NEED OF STUDY

These days all are using laptops due to easy carrying and portability of it. The laptop computers have the vital roles to play in every profession even for entertainment. The more roles to play the stronger are the attachment of the user with the device. The extensive use of laptops lead to many health issues, including neck pain, fatigue of neck, imbalance of emotions and other musculoskeletal symptoms. Unfortunately in this modern era, people mainly the younger generation become more dependent on laptops for academic, office work, projects, different study tasks and even for entertainment.

Prevalence of laptop users among young adults is increasing each year but there is lack of evidences regarding affect of laptop usage on postural stability. Although studies have been done on balance in long term desktop computer workers and also affect of laptop usage on musculoskeletal system but there is no published research study that have observed the affect on limits of stability of laptop use. Although postural sway is found in children and it is also found that with the use of desktop computers for different durations, intensity of musculoskeletal problems also vary but studies are not yet done to find limits of stability in adults in which usage of laptop computers varies. Even if it has affect on limits of stability of then the cause behind that is unknown, so the absence of this information creates a gap in understanding various risk factors in relation to laptop usage duration on limits of stability.

Previous studies focused on forward head posture and other musculoskeletal problem related to balance without taking consideration of factors like proprioception and cognitive abilities if the individual. Without knowing the relationship of laptop duration, proprioception, musculoskeletal symptoms and attention of the individual, treating postural instability in the future is impossible. This study in itself is a pioneer step towards screening of relationship of duration of laptop usage in Limits of stability.

1.3 SIGNIFICANCE OF THE STUDY

This study provides potential to create awareness among laptop professionals and can be used as a preventive protocol for postural instability in laptop users.

A better light on factors related to limits of stability may help to find some recommendations for laptop users.

1.4 AIMS AND OBJECTIVES

AIM: To find relationship between duration of laptop usage and LOS in young adulthood.

OBJECTIVES

Primary-

1. To determine the relationship between short term laptop usage with LOS in young adulthood.
2. To determine the relationship between long term laptop usage with LOS in young adulthood .
3. To compare the variations in LOS among short term and long term laptop users in young adulthood .

Secondary-

1. To determine the relationship between attention with LOS in short and long term laptop users in young adulthood.
2. To determine the relationship between proprioception with LOS in short and long term laptop users in young adulthood.
3. To determine the relationship between forward head posture with LOS in short and long term laptop users in young adulthood.

1.5 HYPOTHESIS

Alternate Hypothesis H_1:-

Primary-

Alternate Hypothesis ($H_1$1) – There will be the relationship of limits of stability and short term laptop usage in young adulthood .

Alternate Hypothesis ($H_1$2) –There will be the relationship of limits of stability and long term laptop usage in young adulthood .

Alternate Hypothesis ($H_1$3) – There will be significant difference between limits of stability in short term and long term laptop usage in young adulthood.

Secondary-

Alternate Hypothesis ($H_1$1) – There will be the relationship of attention with limits of stability in short term and long term laptop users in young adulthood.

Alternate Hypothesis ($H_1$2) – There will be the relationship of proprioception with limits of stability in short term and long term laptop users in young adulthood.

Alternate Hypothesis ($H_1$3) – There will be the relationship of forward head posture with limits of stability in short term and long term laptop users in young adulthood.

Null Hypothesis H_o:-

Primary-

Null Hypothesis (H_o1) – There will be no relationship of limits of stability and short term laptop usage in young adulthood.

Null Hypothesis (H_o2) - There will be no relationship of limits of stability and long term laptop usage in young adulthood.

Null Hypothesis (H_o3) - There will be no significant difference between limits of stability in short term and long term laptop usage in young adulthood.

Secondary-

Null Hypothesis (H_o1) – There will be no relationship of attention with limits of stability in short term and long term laptop users in young adulthood.

Null Hypothesis (H_O2) - There will be no relationship of proprioception with limits of stability in short term and long term laptop users in young adulthood.

Null Hypothesis (H_o3) - There will be no relationship of forward head posture with limits of stability in short term and long term laptop users in young adulthood.

1.6 OPERATIONAL DEFINITIONS

1. **Postural control:** It is defined as the maintaining the position of body in space for the purpose of both balance and postural orientation that is association between body segments with each other and external factors, it is the way according to which CNs is maintaining upright posture and balance by regulating different sensory information and then giving command to motor system.
2. **Postural Stability:** Balance or postural stability are the interchangeable terms, it is the maintenance of equilibrium in static as well as dynamic factors. It is defined as the ability to maintain COG and COM over its base of support that is the contact area between the body and its support surface and to quantify postural stability, limits of stability measurement is used.
3. **Limits of stability:** It depicts the functional base of support, boundaries of sway in which person is capable of maintaining the equilibrium without changing its base of support. During quiet stance it is the area between outer edges of the feet and any change in body's COG related to these boundaries produce random sway.
4. **COP:** Centre of pressure reflects the centre of distribution of sum of applied force to the supporting surface. It depicts the body movement to maintain COG over the base of support as COP continuously moves around the COM in order to maintain it within the base of support.

CHAPTER -2

REVIEW OF LITERATURE

II. REVIEW OF LITERATURE

In order to conduct any scientific study, the review of previous studies done on the topic is a preliminary requirement, as it avoids duplication of the study, adds up new ideas and helps in verification of theories and making of hypothesis. It implies finding the associated references, analysis of previous studies and other testimonials for scientific, logical and purposeful analytical application to the present research work. Taking into consideration these facts, extensive efforts have been put in to collect articles, papers, documents related to this study, even though less literature was available on this topic. In the present study, review of literature was made at the following places

- Library – 8C Block, Lovely Professional University, Phagwara, Punjab
- Various internet sites

This chapter presents the review of literature on limits of stability, Wintrack platform, Gender difference related to neck musculature properties, musculoskeletal symptoms related to desktop and laptop users, various subtle factors related to postural stability.

Paul Van Drunen et al (2015) investigated trunk stabilization during sagittal pelvic tilt in 6 healthy adults by evoking upper body sway with angular platform perturbations and seen co-contraction and proprioceptive muscle spindle feedback which is asscociated with trunk on pelvis stabilization and vestibular, visual feedback associated with trunk in space stabilization and is used in minimizing trunk sway. The study found that condition with eyes open leads to overall reduction in trunk rotations and increase in trunk reflexive responses depicts contribution of vision in trunk on space stabilization.

Priyanka Anand et al (2014) determined the relationship of brain gym intervention, conventional physiotherapy treatment and ergonomics with postural instability on 90 subjects with asymptomatic forward head posture and other alterations in cervical spine in computer users. The author divided subjects into 3 groups, group A in brain gym exercises, B in ergonomic + conventional, C with ergonomics only and then measured A-P and L-L sway with Wintrack Medicapteurs. The author found significant difference in post test readings in A and C group and between group A and C, B and C but not in A and B.

Sumandeep kaur et al (2014) did comparison on parameters of gait using Wintrack Medicapteur and foot print method on 30 healthy individuals, subjects were instructed to walk on wintrack as well as on 10m long line then gait velocity, stride and step length is measured. The author found significant difference in gait velocity, stride length and cadence except right step length.

Jip F Kamphius et al (2013) reviewed 247 articles to check association of asymmetry in weight bearing with postural instability in stroke and found different evidences related to greater weight bearing asymmetry leads to increase in postural sway and these associations were evident more with centre of pressure velocity than COP amplitude and in case of healthy population increase in regulatory activity that is centre of pressure velocities have been seen by adopting weight distribution asymmetry.

Jennifer L. stroskus et al (2013) investigated cervical joint position error test to test neck proprioception by locating again head after maximum or sub maximum rotation to center in sagittal and transverse plane by using laser pointer fixed on a head band age group 18-64 years in patients with cervicogenic dizziness and whiplash injury patients. The study found that test has poor to adequate ICC=0.35/0.44 (right/left) cervical rotation in healthy control while in chronic cervical pain it is adequate to excellent ICC=0.45-0.80 test-retest reliability on the other hand for whiplash injury significant difference was not found in healthy subjects, similarly interrater and intrarater reliability is less for healthy controls and more for whiplash injury.

David S. Black et al (2012) conducted study on 5287 Chinese adolescents to find the psychometric assessment of the mindful attention awareness scale in which 51% were male comprises of 15 items consists 1-6 scoring system. The study found that MAAS has good test retest reliability r=.35-.52, cronback's d=.89-.93 and convergent validity and there was no varience among males and females tested by metric, scalar, uniqueness and structural invariance testing.

Jung –Ho Kang et al (2012) determined the relationship of a forward head posture and postural balance in 60 computer users in which 30 subjects were using it for 6 hours (group-1) and 30 subjects rarely use computer (group-2). The author measured Forward head posture, centre of gravity and postural balance by computerized dynamic posturography and found more Forward head posture and shift of centre of gravity anteriorly in group-1 than group-2 and postural instability was also observed.

Ramachandran et al (2012) suggested that the 3- step gait protocol showed good reliability, with the Interclass Correlation Coefficients value ranging between 0.75 and 0.90 in cadence; step duration of the right foot; double stance duration and swing duration of the right foot; stride length of the right foot; step length and gait cycle of the right and left foot; and the area covered by the first, second and third foot. The authors concluded that the Win – Track platform provided reliable plantar pressures and temporal gait measures, and the 3-step gait protocol showed better reliability compared with the 1-step gait protocol.

June Quek et al (2012) determined the association of thoracic kyphosis and forward head posture with impairments related to cervical range of motion. The author measured thoracic kyphosis using flexicurve, craniovertebral angle using photograph with lateral view and cervical range of motion using cervical range of motion device in 51 older adults and concluded that increase in thoracic kyphosis was related to increase in forward head posture and forward head posture in turn was related to decreased cervical flexion and rotation except upper cervical rotation.

Judith Gold et al (2011) conducted a study to find difference between joint angles, range of motion and comfort in three different non desk settings in 20 healthy adults. The author observed joint angles of shoulder and trunk and kinematics of head, neck, trunk, right shoulder and elbow and humorous elevation using passive motion analyzer and concluded that in prone 70% of upper extremity discomfort and neck extension, pronounced shoulder elevation, 68 degree of elbow flexion was present while in seated couch feet up and down reported neck flexion, shoulder abduction (horizontal) 40 degree approx with elevation of 90 degree and wrist in neutral.

Karen J. Mickel et al (2010) conducted study on balance of school children and determined the effect of age and gender on postural stability of 84 individuals. The author checked static posture with dual limb stance, feet apart and together and single limb stance with dominant leg and also limits of stability using Lord Sway meter. The study showed greater sway in boys than girls and significant difference between groups is more in single limb stance and in dual limb stance conditions in 8 year children than older.

Hyekyong Shin et al (2010) surveyed the potential risk factors and characteristics of laptop computer use associated with musculoskeletal symptoms and relationship between duration of laptop computer use among 30 college students and found that discomfort group with musculoskeletal problems had been spending more continuous time on laptop but there was no correlation between duration of

laptop computer use and its seen that neck and upper back areas are more involved in discomfort. This laptop computer user screening survey has good test-retest reliability.

Katharine E. Forth et al (2010) determined the limits of stability in bipedal stance among 9 healthy adults using posturography system by leaning slowly in all the directions. Then LOS boundaries were calculated by the ellipse formation to the COM position data for each visual condition. It is found that LOS boundaries with close eyes were reduced as functional stability ellipse area was 363±54 cm^2 with eyes open that is more than 321±65 cm^2 (eyes close) which reflects the sensory information contribution in limits of stability. Study also found 20-59% closer function stability boundaries to the centre of stance as compared to anatomical boundaries.

Leon Straker et al (2008) compared the posture variations and muscle activity in 18 children while using tablet, desktop and paper. The author observed 3-D posture and muscle activity in shoulder and neck and found that more upright, less flexion and lateral bending and decreased upper trapezius and cervical erector spinae activation of muscle while using desktop than tablet. During tablet usage more left scapula elevation and right arm abduction was observed than desktop and paper work.

Eliza poole et al (2007) determined the standing balance difference on 40 elderly subjects divided into two groups, 20 subjects with neck pain and 20 subjects without neck pain. The author did Clinical test of sensory interaction in balance (CTSIB) and timed walking task on subjects using stride analyzer and force plate platform. The study concluded that subjects with neck pain had longer duration of gait cycle and time to complete , walk with greater sway and RMS amplitude is more (EMG studies) than the control group.

Fay B. Horak et al (2006) reviewed the neural control of balance and found different subcomponents in postural control system mainly biomechanical constraints like limits of stability; cognitive processing like attention and learning; orientation in space-perception, gravity, vision; sensory strategies and movement strategies and complexity level of task depicts the amount of contribution of cognitive processing in postural equilibrium and orientation.

Ryan T.Tierney et al (2005) conducted study on relationship of gender difference with dynamic stabilization and kinematics and variables of neuromuscular control response to the external force. The author checked EMG variables, head neck segment stiffness, flexor, extensor isometric strength and kinematics using EMG apparatus, external force applicator, microfet hand dynamometer and

peak motion analysis system in 40 subjects. Results shown that females had more angular acceleration, 79% more peak muscle activity, 29% faster onset latency while 29% less stiffness, 49% less isometric neck muscle strength than males.

H. Moffet et al (2002) evaluated the association of laptop computer design and working situations with upper extremity and neck muscles activity in 8 subjects. The author measured muscle activity of neck and upper extremity and alignment of head, upper arm and trunk using EMG apparatus, three dimensional video systems. Biaxial electrogoniometer and concluded that in desk situation forward head bending and backward trunk inclination and muscle load was less while elevation of upper arm and greater trapezius and deltoid muscle activity was seen than lap situation.

Heli Valkeinen et al (2002) conducted study on characteristics related to force production, endurance, pattern of activation/co activation of flexion, extension movement of neck in both genders. The author performed endurance test and force production test using EMG in 29 men and 28 women. This study concluded that greater force development rate was present in men and younger subjects where as co activation was more in older subjects. Significant difference in gender for co activation of antagonist muscle was not present while 60% longer force level was present in both flexion and extension in women.

Robin Mary Gillespie et al (2002) reviewed physical factors associated with electronic games and computers on children and adolescents. The author concluded that desktops has possibility of neurological, cognitive, behavioral disturbances in children and 82% discomfort was reported with laptop usage than desktop. The study depicted 40% of computer related symptoms with greater than 20 hours weekly usage.

Anita N. Vasavada et al (2001) conducted study on maximum neck muscle moment generation in three dimensions and relation with subject size and gender and variations according to cervical level. The author measured neck strength in 11 men and 5 women using experimental setup for neck strength measurement. The study shown women had 40% to 50% of moment generated by men and moment magnitude decreased linearly in vertical direction from lower level of cervical spine towards mastoid process. At higher level of cervical spine maximum axial rotation and extension moment ratio was maximum as compared to other moment ratios.

Michele Marcus et al (2001) conducted a study on postural risk factors related to musculoskeletal symptoms in 632 newly hired computer workers. The author measured gaze angle, head tilt angle, head rotation angle and determined that inner elbow keying with angle greater than 121 degree had shown more downward tilt of head, presence of arm rest depicted less neck or shoulder symptoms and more risk was associated when elbow height was below the height of J key and telephone shoulder rest was used.

Harvey W. Wallmann (2001) conducted study on comparison of limits of stability, functional reach and sensory organization in 27 elderly fallers and non fallers. The limits of stability and balance master system were checked through Neuro com smart balance master system including limits of stability and sensory organization test (SOT). The study concluded that there was no correlation of functional reach distance with forward displacement on limits of stability test while for sensory organization test composite score it was positive.

Courtency Harris et al (2000) surveyed the physical ergonomic factors and posture adoption, duration of laptop usage and problems associated with it in 314 school children. The author concluded mean minimum time was 11.5 minutes and maximum was 101.9 minutes (ranging up to 10 hours), weekly 16.9 hours (maximum-80hours), among subjects 34% preferred desk setting while 66% non desk setting. Long term users depicted more discomfort and 60% laptop users reported discomfort.

Patricia A. Hageman et.al (1995) determined the age and gender relationship with postural control measures using Balance master system to find limits of stability and function reach test results in 24 healthy subjects. This study showed non significant effect of gender for all the variables of postural measure while significant effect of age was present on all the variables as older adults had shown large area of sway, longer movement time, longer path lengths and shorter distance of functional reach test.

Leon Straker et al (1995) conducted study on comparison of posture adoption and discomfort with laptop and desktop usage in 16 healthy subjects. The author observed neck, trunk, shoulder, elbow, wrist angle, head tilt and scapula alignment through photograph analysis and concluded that with laptop usage more neck protraction and trunk, neck, shoulder, elbow angle and discomfort and performance index is noticed than desktop usage while scapula protraction is greater in desktop users.

CHAPTER -3

MATERIALS AND METHODS

III. MATERIALS AND METHODS

3.1 Study Design- Observational study with cross sectional in nature.

3.2 Study Setting- Neuro physiotherapy research lab, Lovely Professional University.

3.3 Population and Sampling – For this study population was students of lovely professional university including students from all the departments in which target population was laptop users. The total sample size was 55 (N=55) in which convenient sampling was done to divide subjects into two groups, Group 1 – short term laptop users and Group 2- Long term laptop users.

3.4 Criteria:

3.4.1 Inclusion Criteria -

1. Age between 17-28.
2. Both males and females are included.
3. Use laptop for more than or equal to 2 hours/day or use of laptop for more than 2 hours /day.
4. Use of laptop over 6 months to 10 years.
5. Both right and left dominant side.

3.4.2 Exclusion Criteria -

1. History of treatment for cervical, thoracic and lumbar disorders.
2. Joint pains like ankle, knee and hip present recently and limited mobility.
3. Any inner ear pathology.
4. Diabetic neuropathy.
5. Deformities like scoliosis, Kyphosis, flat foot, pes cavus, limb length discrepancy.
6. Any history of lower limb and spinal fracture.
7. Intensive activities prior 2 hours of assessment.

3.5 Outcome measures

Primary-

A. Postural deviations-

a. Width

b. Average deviation

c. Average speed.

B. Postural analysis

a. Area

b. Maximum pressure

c. Average pressure

Secondary-

- Attention.
- Proprioception (Cervical Joint Position Error Test).
- Forward head posture.

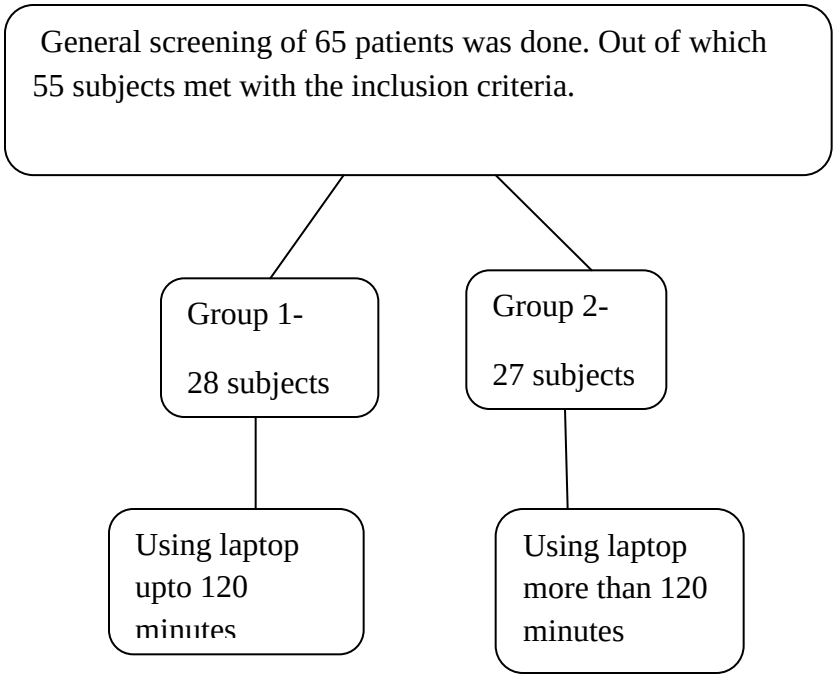
3.6 Instrumentation and Tool

Win track, laser pointer, Weighing machine, Measurement Tape, Tracker chart, mindfulness attention awareness scale.

3.7 PROCEDURE –

As first laptop usage population from LPU has taken then the subjects who met the inclusion and exclusion criteria were taken in the study. Then the participants were assigned in two groups according to their usage of laptop duration as group 1 was of short duration using laptop upto120 minutes and group 2 was of long duration using laptop for more 120 minutes.

FIG: 3.1 FLOW CHART



- Then explanation about the study was first given to the participants in details and get consent form signed from them. Physiotherapy assessment was done to rule out other problems.

-The subject's feet should be clean and naked before standing on the Wintrack medicapteur.

– Subjects were asked to fix an object kept at eye level with distance of 40 cm. Such closed distance requires convergence of the eyes and is known to produce optimal postural stability.

- Individuals maintained a quiet upright and standardized posture as Romberg position.

- They were instructed to place feet side by side central line of Wintrack platform and 4 cm distance apart.

-Subjects should be in quietly standing without any movement with arms on side.

- They should take normal breath and avoid speaking and closing the teeth tightly.

- Then subjects are asked to stand for 30 seconds with eyes open and then with eyes closed.

Then for the assessment of the Cervical Reposition Errors (CRE), Laser Cervical proprioceptive test or Cervical Joint Position error test was done.

This test is the one's ability to relocate head back to centre after maximal or sub maximal movements in transverse planes. Then assessment procedure to assess the CRE was already explained to the patient. Here the patient was asked to comfortably sit on the chair with the back rest for the back support with vision occluded with eyes closed. The target (Tracker Chart) was placed 90 cm far in front of the patient. This was the zero point or the centre of the target. The patient was fitted with the Laser pointer on the vertex of the head with the headband, to measure the magnitude of the head displacement from the starting position. The patient was instructed to perform active head movements (left and right side rotations) after which he or she should return back to the 'neutral' or starting head position. Then this distance is measured from the centre of the target. The point of the laser beam where it lands indicates global error related to the centre of the target.

Then the patients are asked to fill the questionnaire of mindful attention awareness scale. Then the participant was asked to read all the 15 questions given in mindful attention awareness scale carefully and then choose score from 1 to 6 in which score 1 means almost always and score 6 means almost never, it to be filled according to participant only.

FIG: 3.2 Therapist measuring the foot size

FIG 3.3: Therapist measuring the height of the patient

FIG 3.4: Therapist measuring the distance between the feet.

CHAPTER – IV

DATA ANALYSIS AND RESULTS

4.1 STATISTICAL TOOL AND DATA ANALYSIS

Data analysis was carried out using SPSS software after collecting all the outcome measures in group 1 as well as group 2. The following were the statistical formulas and tools which were applied for the data analysis-

- Mean
- Standard deviation
- Standard error
- Pearson correlation coefficient
- Independent sample t-test

Formulas for data analysis:

1. **Arithmetic mean**: It gives the average value of the whole range of the data given. Its value is obtained by adding together all the items and by dividing this total by the number of items. The formula used is;

$$A = \frac{1}{n} * \sum_{i=1}^{n} x_i$$

A = average (or arithmetic mean)

n = the number of terms (e.g. the number of items or numbers being averaged)

x_i = the value of each individual item in the list of numbers being averaged.

2. **Standard Deviation (SD):** It measures the absolute dispersion (or variability of distribution). The greater the amount of dispersion or variability, the greater the standard deviation (s) for the greater will be the magnitude of the deviations of the values from their mean. It can be calculated from the formula;

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$$

x = each value in the population

Σ = summation (or total)

n-1 = number of values in the sample minus 1.

3. **Standard error (SE):** It is the standard deviation of the sampling distribution of the statistic, most commonly of the mean.

$$\sigma_M = \frac{\sigma}{\sqrt{N}}$$

σ_M = Standard error of the mean

σ = standard deviation of the original distribution

N = sample size

4. **Independent sample t test**

The Independent Samples t Test compares the means of two independent groups in order to determine whether there is statistical evidence that the associated population means are significantly difference.

$$t = \frac{X_1 - X_2}{S_{X_1X_2} \cdot \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Where

$$S_{X_1X_2} = \sqrt{\frac{(n_1 - 1)S_{X_1}^2 + (n_2 - 1)S_{X_2}^2}{n_1 + n_2 - 2}}$$

$\sum X_1.X_2$ is an estimator of the common standard deviation of the two samples: it is defined in this way so that its square is an unbiased estimator of the common variance whether or not the population means are same. In this formulae, n=number of participants, 1=group 1, 2= group 2, n-1 is the number of degrees of freedom for either group, and the total sample size minus two (that is, n_1+n_2-2) is the total number of degrees of freedom, which is used in significance testing.

5. **Pearson correlation coefficient**

Pearson's correlation coefficient when applied to a sample is commonly represented by the letter r. It is the measure of relationship between two variables and that is continuous

variables. It is the covariance of the two variables divided by the product of their standard deviations. The Pearson product moment correlation, or *r*, is the average of the cross-products of the *z* scores for the X and Y variables. In mathematical notation,

$$r = \frac{\sum(X-\bar{X})(Y-\bar{Y})}{\sqrt{\sum(X-\bar{X})^2}\sqrt{(Y-\bar{Y})^2}}$$

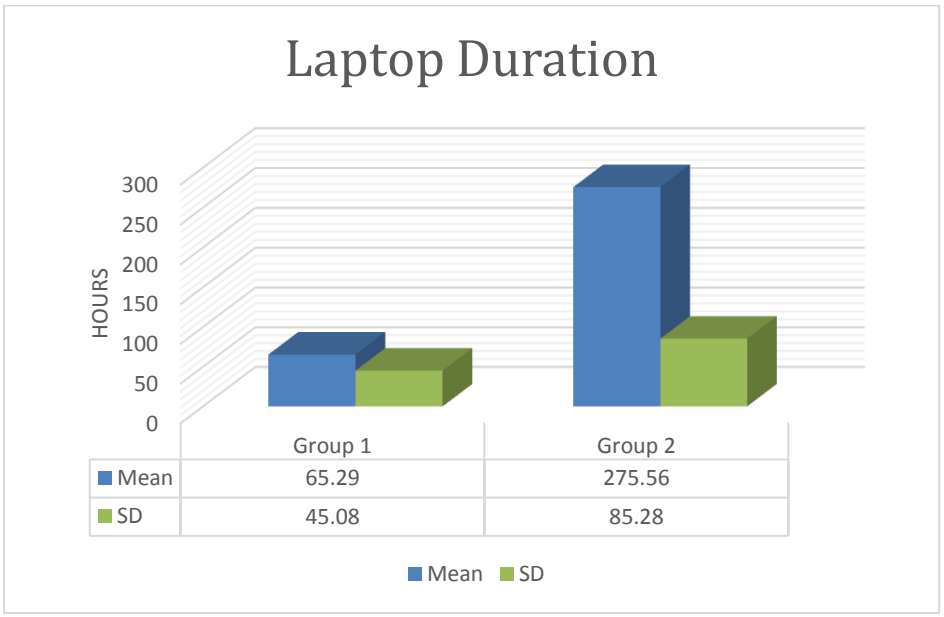
Where, $\bar{X}$= mean of X variable
$\bar{Y}$= mean of Y variable

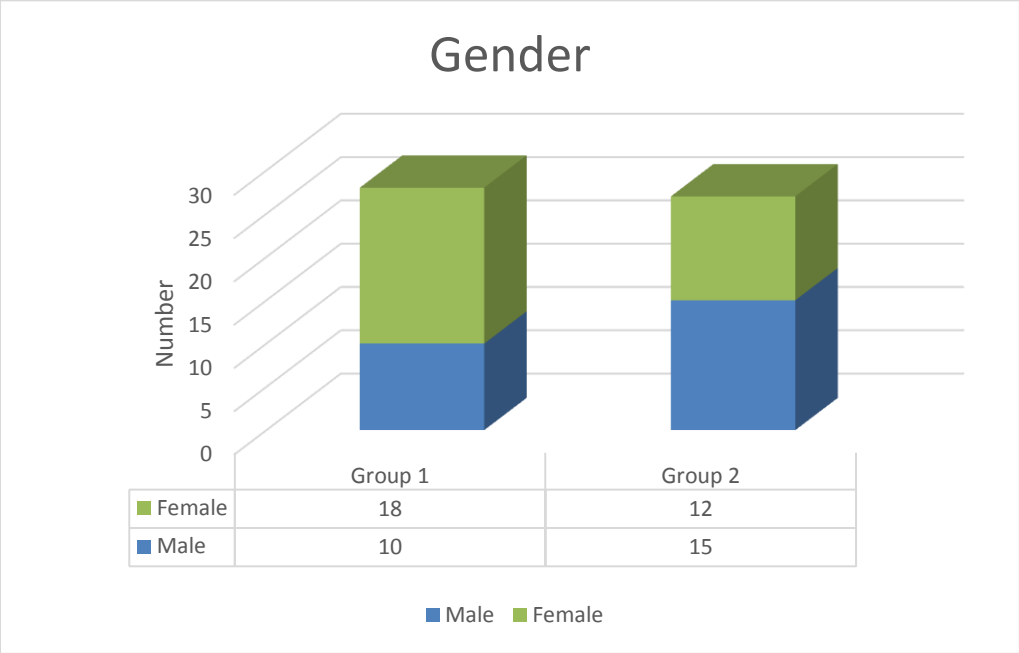
Table 4.1 General characteristics of participants

	Group-1 (n=28)	Group-2 (n=27)
AGE	21.71±2.56	22.37±2.66
MALE:FEMALE	10:18	15:12
BMI	23.24±4.19	22.96±3.85
LAPTOP DURATION	64.29±45.09	275.56±85.28

Values are mean ±standard deviation

Table 4.1 In the group-1 that is subjects using laptop for less than 120 minutes, the mean age of subjects was 21.71 years, their daily mean time using a laptop was 64.29 minutes with the mean BMI of 23.24; in the group -2 that is subjects using laptop for more than 120 minutes, the mean age of subjects was 22.37 years, their daily mean time using a laptop was 275.56 with the mean BMI of 22.96.


Laptop Duration
HOURS
300
250
200
150
100
50
0
Group 1
Group 2
Mean
65.29
275.56
SD
45.08
85.28
Mean
SD


Gender
Number
30
25
20
15
10
5
0
Group 1
Group 2
Female
18
12
Male
10
15
Male
Female

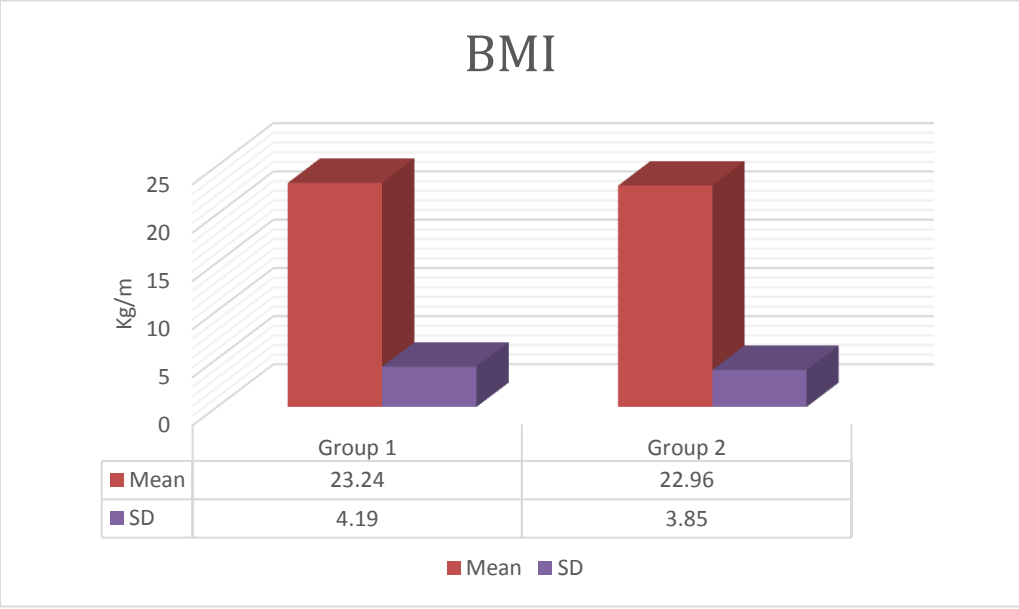

BMI
Kg/m
25
20
15
10
5
0
Group 1
Group 2
Mean
23.24
22.96
SD
4.19
3.85
Mean
SD

Table 4.2: Correlation of different outcome measures of limits of stability (postural deviation and postural analysis) with the laptop duration in both the groups –group 1 and group 2

Outcome measure	Group -1		Group-2	
	Eyes open	Eyes close	Eyes open	Eyes close
AP_WIDTH	70.80 ±75.20	92.64 ±82.22	113.01±87.29	80.44±73.66
AP_AVR_DEV	10.22 ±9.66	13.21 ±11.51	15.34±12.40	13.41±12.56
AP_AVR_SPEED	14.38±11.44	14.46 ±9.005	18.31±12.40	14.69±7.87*
ML_WIDTH	186.26±285.60	196.99±268.82	209.48±226.39	109.20±110.32
ML_AVR_DEV	34.62±61.78	39.87 ±67.52	33.07±53.71	15.16±15.38
ML_AVR_SPEED	16.39±15.10	18.45 ±15.52	23.69±31.56	14.27±9.62
LT_ AREA	65.32 47.700	59.96±28.06	79.07±49.31	68.00±23.70
LT_ MAX_P	1390.96±736.2	1271.96±470.29	1513.00±642.193	1339.74±494.52
LT_ AVR_P	569.96±217.93	561.00±226.86	628.00±221.96	542.93±176.82
RT_ AREA	67.29± 19.90	95.00±132.39	67.52±41.72	66.44±22.92
RT_ MAX_P	1578.86±748.8	1679.18±848.67	1574.15±41.72	1444.11±537.64
RT_ AVR_P	674.21±286.99	715.93±331.81	745.33±41.72	657.81±239.39

Values are mean ±standard deviation

*. Correlation is significant at the 0.05 level (2-tailed).

AP- Anteroposterior, ML- Mediolateral, LT- Left, RT-Right, AVR-Average, DEV-Deviation, MAX-Maximum, P-Pressure. Table 4.2 shows no significant correlation was found between different outcome measures of limits of stability in both the groups, group 1 with short duration of laptop usage and group 2 with long duration of laptop usage except -Eyes close Anteroposterior Average speed in participants with long duration of laptop usage (group-2) that is Pearson correlation coefficient (r)=440,p value=0.02.

Table 4.3 Comparison of outcome measures of limits of stability (postural deviations) between both the groups; group-1 and group-2.

Outcome measure	Laptop Duration	Mean	SD	N	T Test	P Value
EO _AP_WIDTH	UPTO 120	70.80	75.20	28	-1.923	0.060
	ABOVE 120	113.01	87.29	27		
EO_AP_AVR_DEV	UPTO 120	10.22	9.66	28	-1.713	0.093
	ABOVE 120	15.34	12.41	27		
EO_AP_AVR_SPEED	UPTO 120	14.38	11.44	28	-1.237	0.221
	ABOVE 120	18.31	12.13	27		
EO_ML_WIDTH	UPTO 120	186.26	285.61	28	-0.333	0.740
	ABOVE 120	209.48	226.39	27		
EO_ML_AVR_DEV	UPTO 120	34.62	61.78	28	0.099	0.921
	ABOVE 120	33.07	53.71	27		
EO_ML_AVR_SPEED	UPTO 120	16.39	15.10	28	-1.100	0.276
	ABOVE 120	23.69	31.56	27		
EC_ML_WIDTH	UPTO 120	196.99	268.82	28	1.573	0.122
	ABOVE 120	109.20	110.32	27		
EC_ML_AVR_DEV	UPTO 120	39.87	67.52	28	1.855	0.069
	ABOVE120	15.16	15.38	27		
EC_ML_AVR_SPEED	UPTO 120	18.45	15.52	28	1.196	0.237
	ABOVE 120	14.27	9.62	27		
EC _AP _WIDTH	UPTO 120	92.64	82.22	28	0.579	0.565
	ABOVE 120	80.44	73.66	27		
EC_AP_AVR_DEV	UPTO 120	13.21	11.51	28	-0.059	0.953
	ABOVE 120	13.41	12.56	27		
EC_AP_AVR_SPEED	UPTO 120	14.46	9.01	28	-0.103	0.918
	Above 120	14.69	7.87	27		

$p<0.05$-significant

EO-Eyes open, EC-Eyes close, AP- Anteroposterior, ML- Mediolateral, AVR-Average, DEV-Deviation.

Table 4.3-Describes the comparison of mean of all the outcome measures of limits of stability between group 1 and group 2. All the parameters in eyes open and eyes close, anteroposterior and mediolateral for width, average deviation and average speed in group 1 and group 2 have shown no significant difference.

Table 4.4 Comparison of outcome measures of limits of stability (postural analysis) between both the groups; group-1 and group-2.

Outcome measure	Laptop Duration	Mean	SD	N	T Test	P Value
EO_ LT_ AREA	UPTO 120	65.32	47.70	28	-1.051	0.298
	ABOVE 120	79.07	49.31	27		
EO _LT_ MAX_P	UPTO 120	1390.96	736.24	28	-0.654	0.516
	ABOVE 120	1513.00	642.19	27		
EO_ LT_ AVR_P	UPTO 120	569.96	217.93	28	-0.978	0.332
	ABOVE 120	628.00	221.96	27		
EO_RT_ AREA	UPTO 120	67.29	19.90	28	-0.027	0.979
	ABOVE 120	67.52	41.72	27		
EO_ RT_ MAX_P	UPTO 120	1578.86	748.85	28	0.024	0.981
	ABOVE 120	1574.15	691.14	27		
EO_RT_ AVR_P	UPTO 120	674.21	287.00	28	-0.825	0.413
	ABOVE 120	745.33	350.07	27		
EC_LT_AREA	UPTO 120	59.96	28.06	28	-1.145	0.257
	ABOVE 120	68.00	23.70	27		
EC_LT_MAX_P	UPTO 120	1271.96	470.29	28	-0.521	0.605
	ABOVE 120	1339.74	494.52	27		
EC _LT_AVR_P	UPTO 120	561.00	226.86	28	0.329	0.744
	ABOVE 120	542.93	176.82	27		
EC_RT_ AREA	UPTO 120	95.00	132.40	28	1.105	0.274
	ABOVE 120	66.44	22.92	27		
EC_RT_MAX_P	UPTO 120	1679.18	848.66	28	1.222	0.227
	ABOVE 120	1444.11	537.64	27		
EC_RT_ AVR_P	UPTO 120	715.93	331.81	28	0.743	0.461
	ABOVE 120	657.81	239.39	27		

$p<0.05$-significant

EO-Eyes open, EC-Eyes close, RT-Right, LT-Left, AVR-Average, MAX-Maximum,

P-Pressure.

Table 4.4 describes the comparison of mean of all the outcome measures of limits of stability between group 1 and group 2. All the parameters in eyes open and eyes close, left and right for area, average pressure and maximum pressure in group 1 and group 2 have shown no significant difference.

Table 4.5: Correlation of forward head posture, attention and proprioception with the different parameters of limits of stability (postural deviations) in both the groups, group 1 and group 2.

Outcome measure	**Forward head posture**		**Attention**		**Proprioception-RT**		**Proprioception-LT**	
	Group 1	**Group 2**	**Group 1**	**Group 2**	**Group 1**	**Group 2**	**Group 1**	**Group 2**
EO _AP_WIDTH	-0.16	-0.12	-0.288	0.09	-0.12	-0.40	0.09	-0.42*
EO_AP_AVR_DEV	-0.17	-0.03	-0.231	-0.04	-0.12	-0.47*	0.067	-0.44*
EO_AP_AVR_SPEED	-0.21	-0.06	-0.209	-0.06	-0.24	-0.41*	-0.09	-0.35
EO_ML_WIDTH	-0.13	-0.16	-0.250	0.08	-0.26	-0.32	-0.09	-0.22
EO_ML_AVR_DEV	-0.09	-0.06	-0.182	0.03	-0.32	-0.29	-0.55	-0.13
EO_ML_AVR_SPEED	-0.067	-0.06	0.153	-0.08	-0.17	-0.31	-0.134	-0.11
EC_ML_WIDTH	0.51**	0.19	-0.350	-0.09	-0.03	-0.27	0.06	-0.14
EC_ML_AVR_DEV	0.51**	0.21	-0.319	-0.02	-0.07	-0.31	-0.006	-0.21
EC_ML_AVR_SPEED	0.69**	0.22	-0.331	-0.003	-0.21	-0.30	-0.12	-0.13
EC _AP _WIDTH	0.52**	0.03	0.094	-0.27	-0.40*	-0.26	-0.12	-0.06
EC_AP_AVR_DEV	0.49	0.02	-0.044	-0.39*	-0.38*	-0.26	-0.17	-0.03
EC_AP_AVR_SPEED	.55**	0.02	-0.158	-0.09	-0.19	-0.20	-0.18	-0.20

*. Correlation is significant at the 0.05 level (2-tailed) **. Correlation is significant at the 0.01 level (2-tailed).

The value is pearson correlation coefficient (r)

Table 4.5 describes the correlation of forward head posture, attention and proprioception with different outcome measures of limits of stability. In group 1 correlation is significant at the 0.05 level in forward head posture with eyes close mediolateral width, average deviation and average speed and eyes close AP Average width and speed; at 0.01 level- proprioception(RT) with eyes close AP average width and average deviation .In group 2 it is present in proprioception-(RT)with Eyes open average deviation and speed, Proprioception (LT) with average width and deviation ,also attention with eyes close anteroposterior width.

Table 4.6 Correlation of forward head posture, attention and proprioception with the different parameters of limits of stability (postural analysis) in both the groups, group 1 and group2

Outcome measure	**Forward head posture**		**Attention**		**Proprioception-RT**		**Proprioception-LT**	
	Group 1	**Group 2**	**Group 1**	**Group 2**	**Group 1**	**Group 2**	**Group 1**	**Group 2**
EO_ LT_ AREA	0.05	0.06	-0.17	-0.09	-0.26	-0.39*	-0.15	-0.28I
EO _LT_ MAX_P	0.000	0.25	-0.13	0.09	-0.10	-0.39*	-0.14	-0.31
EO_ LT_ AVR_P	0.05	0.22	-0.23	-0.29	0.03	-0.18	-0.04	0.06
EO_RT_ AREA	-0.23	-0.11	-0.19	0.15	-0.21	-0.14	0.12	-0.10
EO_ RT_ MAX_P	-0.39*	-0.41*	-0.02	0.22	-0.22	-0.05	-0.20	0.34
EO_RT_ AVR_P	-0.36	-0.39*	0.005	0.13	-0.14	-0.003	-0.09	0.17
EC_LT_AREA	-0.32	0.09	0.06	0.29	-0.24	0.41*	-0.04	0.02
EC_LT_MAX_P	-0.03	0.46*	0.16	-0.12	0.19	-0.48*	0.045	-0.12
EC _LT_AVR_P	-0.07	0.56*	0.03	0.27	0.17	-0.26	-0.01	-0.01
EC_RT_ AREA	-0.24	-0.03	-0.21	0.23	0.12	- 0.21	0.09	-0.22
EC_RT_MAX_P	-0.04	-0.35	-0.24	-0.35	0.21	0.19	0.09	-0.16
EC_RT_ AVR_P	-0.06	-0.37	-0.15	-0.06	0.26	0.16	0.17	-0.18

*. Correlation is significant at the 0.05 level (2-tailed)

**. Correlation is significant at the 0.01 level (2-tailed).The value is pearson correlation coefficient (r)

Table 4.6 describes the correlation of forward head posture, attention and proprioception with different outcome measures of limits of stability. In group 1 correlation is significant at the 0.01 level in forward head posture with eyes open right maximum pressure also. In group 2 it is present in forward head posture in both with eyes open and eyes close right maximum and average pressure, proprioception-(RT) with both Eyes open and eyes close left area and maximum pressure.

4.2 RESULTS

In the present study, the homogenous subset of demographic data i.e. age and BMI was carried out. The n statistics represents the valid number of 55 for age, BMI and laptop duration. The mean age in group 1 is 21.71±2.56 and in group 2 is 22.37±2.66 with BMI in group 1 is 23.24±4.19 and in group 2 is 22.96±3.85, there is no much difference in age and BMI of both the groups.

The n number of gender value (female and male) among both groups is 55. The frequency value for female gender was 30 and percentage has shown 55% in the total of 100. The frequency value for male gender was 25 and percentage value showed 45% in the total of 100. Female gender has shown more frequency and percentage values than male gender.

The results of the present study are as per the following:-

- Pearson correlation coefficient was used to find the relationship between different outcome measures of limits of stability with laptop duration in group 1 and group 2.The significant correlation coefficient was found in eyes close anteroposterior average speed with long term laptop usage (group 2) with r value= .440,p value of 0.021. In other parameters of postural deviation that is eyes open and eyes close in both anteroposterior and mediolateral –width, average deviation, average speed with short and long laptop duration no significant correlation was found as all the r values are less than 1 with p value >0.05 except the value depicted above similarly all the parameters of postural analysis (COP) that is eyes open and eyes close-area, average and maximum pressure no significant correlation was found.
- Independent sample t test is used for the comparison of all the outcome measures of limits of stability between group 1(short term laptop usage) and group 2(long term laptop usage). The p value for the parameters of postural deviation that is eyes open and eyes close in both anteroposterior and mediolateral –width, average deviation, average speed between short term laptop usage (group 1)and long laptop usage (group 2), no significant difference was found as all the p value >0.05. Similarly in all the parameters of postural analysis (COP) that is eyes open and eyes close-area, average and maximum pressure no significant difference was found as all the p value >0.05. Hence no significant difference was found among all the parameters of limits of stability between group 1 and group 2.
- Pearson correlation coefficient is used to find relationship of forward head posture with different outcome measures of limits of stability in short term laptop users (group 1) and long

term laptop users (group 2). In group 1 correlation is significant at the 0.05 level in forward head posture with eyes close mediolateral width(r value=0.51,p=0.05), average deviation(r=0.51,p=0.05) and speed(r=0.69,p=0.00) and also with eyes close anteroposterior average width (r=0.52,p=0.004),speed (r=0.55,p=0.005) also with eyes open right maximum pressure at 0.01 level (r=-0.39,p=0.040). But this correlation is very mild, it is not strong enough to consider as the high significant correlation.

- In group 2 correlation is significant at 0.01 level in forward head posture with eyes open right maximum(r=-0.41, p=0.031) and average pressure(r=-0.39, p=0.041) and eyes close right maximum (r=0.04, p=0.015) and average pressure (r=0.56, p=0.003). But this correlation is very mild, it is not strong enough to consider as the high significant correlation.
- Pearson correlation coefficient is used to find significant correlation of attention with different outcome measures of limits of stability (postural deviations and postural analysis).In group 1 no significant correlation was found among all the parameters of limits of stability and attention, similarly in group 2 no significant correlation was found among all the parameters of limits of stability and attention except correlation of attention with eyes close anteroposterior average speed with r value =-0.039, p=0.047 that also not very strong correlation. Hence no significant correlation was found of attention with different outcome measures of limits of stability (postural deviations and postural analysis) in group 1 and group 2.
- Pearson correlation coefficient is used to find significant correlation of proprioception with different outcome measures of limits of stability (postural deviations and postural analysis) in group 1 and group 2. In group 1 correlation has been found at 0.01 level in proprioception with eyes close anteroposterior average width (r=-0.40,p=0.034) and deviation (r=-0.38,p=0.045). In group 2 correlation has been found at 0.01 level in proprioception with eyes open average deviation(r=-0.47,p=0.038) and speed (r=-0.41,p= 0.014),eyes open left area(r=-0.039,p=0.017) and maximum pressure(r=0.039, p=0.049), also eyes close left area(r=0.41,p=0.037) and maximum pressure (r=-0.48,p=0.011). Also correlation was found between proprioception (cervical repositioning error in left side rotation) with anteroposterior average width (r=-0.42,p=0.029) and deviation(r=-0.44,p=0.020) and these correlations were also not significantly strong.

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CHAPTER - 5

DISCUSSION

5.1 DISCUSSION

Laptop computers being a significant part of modern professions became an innate part of today's life. With the growing ages requirement to access information technology is also growing daily. Laptop computers have very superior features as compared to desktop computers due to their ease of portability, less weight so less widely increasing in the offices, universities and different workplaces.

The detrimental effects of laptop computer on the health of the people have been increasing, due to increase in the prevalence of laptop users' world wide. Its usage leads to malalign posture such as forward flexed position of head and neck results in disturbance in while biomechanics of spine[56] and increase stress on it which causes over activation of musculature of upper spine mainly erectors, trapezius and suboccipital muscle which again results in more deformation of spinal region that is responsible for impairments related to proprioception[57,58].

The present study were based on the aim to check relationship between duration of laptop usage and limits of stability in young adulthood, for that purpose 65 subjects were chosen who use laptop computers and among them only 55 subjects with the inclusion criteria. Then these subjects were divided conveniently into two groups, group 1 with 28 short duration laptop users and group 2 with 27 long duration laptop duration users. The rest of the 10 individuals who are not included in the studies due to these reasons, one individual had limb length discrepancy and other had severe lower back pain, four individuals from physical education department just came from heavy work out, two individual were using desktop computer only and other two were not interested to give readings on Wintrack for these reasons they were not included in the study.

Then these subjects of both the groups were assessed using Wintrack medicapteur to meet the primary objectives of the study that comprises relationship of short term laptop usage and long term laptop usage with limits of stability and then comparison of variations in limits of stability among short and long term laptop users. Then after limits of stability assessment for cervical repositioning error only in cervical rotation, forward head posture and mindfulness attention awareness scale scoring were also checked in the individuals to meet the secondary objectives comprises relationship of proprioception, forward head posture and attention with limits of stability in both short term and term laptop users.

According to Jung-Ho Kang, long duration computer users showed anterior translation of center of gravity and more affected limits of stability as compared to subjects who rarely work on computer[27] but there are not studies yet done on laptop users to check limits of stability in them, in this study no significant difference found between the short term and long term laptop users in limits of stability that may be due to less age of the subjects as compared to previous studies as most of the researchers did studies to check sway in older population as by Eliza Poole[59] and Harway W Wallman[28]. Non significant results also may be due to the presence of confounding factors as sitting posture of the subjects were not taken into consideration as according to Courtency Harris[10] , Judith Gold[8] and H Moffet[16] with different non desk settings, different values of forward head bending were shown and with each non desk setting involvement of different muscles has been seen. Also years of laptop usage were not taken into much consideration which also affects the anterior translation of COG and limits of stability explained by Jung-Ho Kang[27].

Using Pearson correlation coefficient it is found that there is relationship of eyes close anteroposterior average speed (one of the parameters of limits of stability) with long term laptop usage as compared to short term laptop usage but that correlation is also very weak, supported by Katharine E.Forth[60] as she found that limits of stability boundaries were more affected with close eyes as compared to open eyes. There is no significant correlation found in other parameters of limits of stability with long and short term laptop duration, supported by Hyekyong Shin[15] as according to her there is no correlation between duration of laptop computer use with musculoskeletal symptoms of neck and upper back areas.

The relationship of attention with limits of stability in both the short term and long term laptop duration was also checked, using Pearson correlation coefficient and found that in subjects with long duration of laptop usage weak negative correlation is present only in the parameter of eyes close anteroposterior average speed that is less attention leads to more effect on limits of stability, supported by Robin Mary Gillespie[13] according to which neurological, cognitive and behavioral disturbances are more in children who use computers and electronic games and Fay B Horak[23] that reviewed the neutral control of balance and found contribution of attention in postural equilibrium and orientation, other limits of stability parameters as well as it was absent in the individuals with short duration of laptop usage.

Pearson correlation coefficient is used to find relationship of forward head posture with limits of stability and found that in group 1 weak positive correlation was seen between forward head posture and eyes close mediolateral width, average deviation and speed and eyes close anteroposterior average and speed that is with increased forward head posture increase in these parameters has been seen but negative correlation of forward head posture with eyes open right maximum pressure and in group 2 with eyes open right maximum pressure and average pressure has been found, it means with increase in forward head posture these parameters will decrease. Also positive correlation was present between forward head posture and eyes close right maximum and average pressure that is inverse of eyes open condition, supported again by Jung Ho Kang as he founded that with anterior shift of COG or FHP leads to disturbed limits of stability. But correlations of forward head posture with limits of stability were more in subjects using laptop for short duration that may be due to presence of various confounding factors depicted above.

Similarly Pearson correlation coefficient is used to check correlation of proprioception with limits of stability. In present study it has been seen that in group 1 with decrease in proprioception (checked after cervical rotation), there was increase in eyes close anteroposterior average width and deviation but in group 2 its also seen in eyes open average deviation and speed and eyes open left area and maximum pressure as well as left area and maximum pressure supported by Gyoung-Mo Kim as he depicted proprioception effect on balance[61].

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5.2 Limitations

- Analysis has not been done on the basis of year of laptop usage.
- Subjects using spectacles are not taken in consideration.
- For analysis consideration was not given for how many days they are using laptop per week.
- Study did not consider the non desk settings used by the subjects while working on the laptop.
- Use of Win track Medicapteur was also the one of the limitation as instrument was not easily accessible.

5.3 Future Scope of the Study

- Future researches need to be carried to find relationship of limits of stability in desktop computer and laptop computer users.
- Studies can be done to find relationship of limits of stability in different age groups.
- Different subgroups of laptop duration usage can be used to find relationship of limits of stability in these different subgroups.
- In future studies groups can be divided on the basis of spectacles use that is subjects using specs and without specs.
- In future subgroups can be taken according to the non desk settings or posture adopted used by the subjects for laptop usage.

CHAPTER – 6

CONCLUSION

6.1 CONCLUSIONS

Present study hypothesized that there will be a relationship of limits of stability with short term laptop duration and long term laptop duration, also influence of forward head posture, proprioception and attention on limits of stability in short term and long term laptop users. After analyzing the two groups, this study found that there is no significant correlation of limits of stability with short term and long term laptop users, no significant difference was found in short term and long term laptop users and weak correlation was found between forward head posture and proprioception (repositioning errors) with limits of stability so it may contribute in postural instability but there was no correlation between attention and limits of stability found in this study.

CHAPTER - 7

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CHAPTER – 8

APPENDICES

8.1 Appendix - 1

INFORMED CONSENT FORM

PERSONAL DETAILS:

Name:

Address:

Phone No:

Email Address:

Date of Birth:

Occupation:

Please carefully read and sign this form.

1. I understand that it is important that I give the most accurate health history and information to my physiotherapist so that any planned treatments and therapies are in by best interest.

2. I understand that my physiotherapist will discuss any assessment and treatment plans with me before they are administered.

3. I understand that information given by me will be kept confidential and private during the study.

4. I understand the importance and method of assessment and treatment used in the study as discussed with my physiotherapist.

5. I understand the risk of physiotherapy treatment can include but it is not limited to an exacerbation of symptoms, strains, sprains allergic reactions, electrical shocks and burns.

6. I understand the consequences of not receiving treatment can include but is not limited to a continued exacerbation of symptoms or no improvement of symptoms.

7. I understand that I can discuss my interest or disinterest in the treatments with my physiotherapist.

8. I have read and understand the contents of this form. I hear by grant permission to my physiotherapist to perform the assessment and treatments that may that may be necessary to treat my condition or injury.

9. I understand that my physiotherapist will also provide further details regarding the benefits, risks, consequences, and availability of alternative and adjunctive therapies specific to my symptoms during the course of the assessment and treatment.
10. I also understand that I can withdraw consent to any component of the assessment or treatment at any time.

DATE:

PATIENT'S SIGNATURE:

8.2 APPENDIX- 2

MASTER CHART

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN
1	NAME	SEX	STREAM	SPECS	Laptop_Duration	YEAR	AGE	HEIGHT	WEIGHT	BMI	Laptop_Duration	FHP	ATTENTION	Proprioception_RT	Proprioception_LT	EO_AP_WIDTH	EO_AP_AVR_DEV	EO_AP_AVR_SPEED	EO_ML_WIDTH	EO_ML_AVR_DEV	EO_ML_AVR_SPEED	EC_ML_WIDTH	EC_ML_AVR_DEV	EC_ML_AVR_SPEED	EC_AP_WIDTH	EC_AP_AVR_DEV	EC_AP_AVR_SPEED	EO_LT_AREA	EO_LT_MAX_P	EO_LT_AVR_P	EO_RT_AREA	EO_RT_MAX_P	EO_RT_AVR_P	EC_LT_AREA	EC_LT_MAX_P	EC_LT_AVR_P	EC_RT_AREA	EC_RT_MAX_P	EC_RT_AVR_P
2	A1	1	MPT	1	2	2	23	168	57	20.2	180	28	3.6	10	15	9	2.2	5.3	11.7	2.1	4.8	107.6	17	16.2	92.5	15.7	13	56	1767	819	46	471	271	53	1575	800	62	1223	451
3	A2	2	BPT	0	1	3	20	161	60	23.1	120	16.2	3.93	5	4	102.8	12.9	16.7	148.5	12.1	19.9	141.2	11.2	19.2	76.3	11.7	11.4	60	1289	567	77	1198	456	53	1217	634	75	1410	562
4	A3	2	BPT	0	2	4	24	168	56	19.8	360	16.9	3.2	5	10	122.1	15.5	11.8	179	15.1	22	217.5	29	33.1	276.5	52.7	31.1	59	1507	718	73	1259	484	88	1535	716	145	1702	528
5	A4	2	BPT	0	2	4	21	157	45	18.3	300	15.4	3.4	8	6	10	1.9	4.9	11.7	3.1	4.4	70.9	6.3	15.3	90.4	19.2	11.1	43	1344	642	59	807	329	43	1054	463	68	1385	484
6	A5	2	BPT	1	1	2	21	152	40	17.3	120	15.6	2.6	8	7	95.1	12.2	17	145.6	15.7	21.7	787.2	73.7	55.4	105	7.1	12.3	38	1078	486	74	1049	466	40	2201	1165	49	3409	1398
7	A6	2	BPT	0	1	2	19	162	66	25.1	20	24.6	2.46	3.5	4.8	9.7	2.6	4.4	12.3	2.8	3.5	876.5	170.1	70.6	204.2	30.6	33.9	57	1380	631	68	1369	517	92	1078	473	300	1608	540
8	A7	2	B_phar	0	2	4	24	166	47	17.1	240	27	5.46	4	9	14	2	4.2	50.7	10.3	5.5	125.1	14.4	18.6	70.1	13.8	10.2	54	1450	727	60	733	311	48	1928	868	70	975	460
9	A8	1	MPT	1	1	4	23	167	72	25.8	20	9.4	2.33	8	19	127.9	17.8	18	199.2	13.1	12	19.9	4.6	5.3	14.7	2.7	9	67	1291	539	74	1751	878	49	598	281	72	1731	856
10	A9	1	BPT	0	2	2	21	170	65	22.5	240	24.6	3.2	3.5	3	201.4	23.5	29.1	248.8	25.7	21.1	44.6	6.2	7.3	41.6	6.6	14.6	76	1491	587	105	1228	531	86	1222	541	63	91	351
11	A10	2	MPT	1	2	2	24	158	47	18.8	360	9	4.6	5	3.5	16.7	3	8.8	9.8	2.2	9	125.5	15.4	11.8	95.2	12.9	15.5	29	913	368	43	1837	862	36	1258	613	49	1933	909
12	A11	1	ME	0	2	4	21	158	59	23.6	300	14.8	5	9	7.2	137.4	15.4	12.3	163	9.7	13.3	175.6	15.5	14.6	122.5	17.7	11.3	67	1628	740	43	1805	813	65	1359	570	45	1980	878
13	A12	1	ME	0	2	2	19	168	70	24.8	180	6.8	5.6	6	5.5	214.7	21.3	25.3	560.1	69.4	27.4	8.6	1.9	5.4	15.5	3.6	10.8	85	1325	650	176	1445	606	52	717	267	87	1324	657
14	A13	1	CSE	0	2	4	20	175	60	19.6	360	11.2	5.53	8.5	6	15.2	3	12.3	22.2	5	8.5	18.5	6.2	10.6	16.4	2.1	10.7	48	1132	405	54	1991	873	54	885	405	51	1945	814
15	A14	1	CSE	1	2	2	17	167	65	23.3	240	11.3	4.46	10	6	156.3	17	20.2	210.9	24.9	14.6	16.2	3.4	6.4	7.5	1.4	12.7	70	1489	688	66	1563	894	54	852	358	62	1429	776
16	A15	1	ECE	0	2	2	17	174	53	17.5	360	23.2	4	8	5	21	4.4	16.5	13.1	2.7	7.9	27.6	4.5	9.4	23.8	4.9	13.7	59	970	510	48	1099	526	63	1177	473	47	946	519
17	A16	2	MPT	1	1	2	24	148	67	30.6	120	10.3	5.26	6.4	11	17.5	4	13.5	25.9	5.6	5.6	138.8	13.2	10.4	128.7	18.1	11.6	64	966	392	84	1465	634	71	1625	671	77	1459	625
18	A17	2	MPT	0	1	2	24	162	70	26.7	60	19.4	3.3	3.7	3.8	188.7	25.9	30.9	707.9	133.6	42.1	252	236.2	27.8	236.2	46.1	39.5	259	1973	667	77	1169	523	146	997	412	159	1580	662
19	A18	1	ME	0	1	2	19	164	52	19.3	60	12.8	4.06	10	6	24.3	5.1	12.5	24.3	4.6	12.4	6.8	1.6	9.3	16.5	4.2	10.2	34	806	372	47	2055	893	36	1099	368	50	1730	817
20	A19	1	CE	0	2	2	24	169	59	20.7	240	11	3.13	7	4	11.1	2.1	11.8	21	3.5	9.3	28.6	6.4	8.5	23.3	3.6	15.3	39	589	291	71	1318	709	52	775	299	71	1251	667
21	A20	2	BPT	1	1	2	18	153	60	25.6	30	9.8	5.06	8.2	9	98.7	13.9	10.7	152.5	13	19.4	18.1	3.7	5.5	16	1.9	6.6	61	1776	742	84	1441	577	62	1364	547	81	749	370
22	A21	2	BPT	1	1	2	18	146	47	22	120	12.9	4.26	2.4	3	220.8	29.8	40.1	968.4	250.7	66.8	147.1	13.7	20.7	158.8	19.5	19.6	60	4199	1104	96	2816	1378	48	1280	553	59	1069	492
23	A22	2	BPT	1	1	2	18	147	49	22.7	10	16.2	4.33	12	10	65.7	13.6	10.1	153	18.3	18.1	12.5	2.7	4.9	10.9	2.2	4.9	49	2048	923	55	819	400	51	1529	746	45	570	289
24	A23	2	BPT	1	1	2	18	146	42	19.7	60	19.2	4.26	2.1	3	10.5	2.5	3.3	7.6	1.8	2.1	107.2	18.2	15.6	101.1	13.5	11.6	48	1553	674	42	646	271	46	1299	723	46	953	392
25	A24	1	CSE	1	2	4	27	179	100	31.2	180	9	4.46	5	5	258.1	23.2	27.9	564.3	78.3	48.7	181.1	14.1	21	116.2	16.4	11.2	204	1730	657	79	1262	519	96	1642	686	90	1468	747
26	A25	1	CSE	0	1	4	20	175	88	28.7	30	10.1	4.4	6.5	4.6	28.4	6.1	13.5	31.4	6.4	7.4	165.9	18.6	11.7	90.9	22.6	17.2	78	1519	604	66	1707	790	70	1636	690	69	2576	1135
27	A26	1	CSE	0	1	4	20	157	76	30.8	120	12.3	3.2	4.3	3	11.1	2.3	5	12.1	3.5	4.7	71.8	6.5	16.3	91.4	18.2	10.3	42	1211	730	61	756	320	45	1162	452	59	1284	489
28	A27	1	CSE	0	1	4	22	174	92	30.4	120	11.6	4.73	6.9	5.2	11.3	2.3	2.9	6.9	2.9	3.1	117.3	19.1	17.2	102.3	12.4	10.3	44	1447	573	40	592	268	44	1284	714	44	896	386
29	A28	1	BPT	0	1	4	21	171	59	20.2	10	6.8	3.4	2.5	3.2	235.9	39.2	54.7	971.2	178.2	45.6	14.6	3	5.8	9.5	2	7.7	190	2352	974	107	3844	1152	62	1747	823	41	637	286
30	A29	2	MPT	1	2	2	25	148	58	26.5	180	15.6	3.466	5.5	2.3	206.4	17.1	16.8	465.2	80.7	42.4	39.7	11.7	6.7	17.2	4	7.2	129	2117	659	32	897	507	73	1524	631	73	1136	342
31	A30	2	BPT	0	1	4	21	157	60	24.3	10	13.2	3.8	8	9	10.2	2.8	4.7	11.6	3.1	5.2	968	255	33.2	175.9	32.6	35.8	62	1842	879	30	520	284	83	1988	958	720	4447	1613
32	A31	2	BPT	0	1	4	20	150	37	16.4	60	13.8	4.53	3.3	5.1	116.2	13.6	13.5	157.9	10.2	20.7	164.7	15.2	18.3	93.5	12.7	10.2	39	952	538	63	1454	688	43	1411	823	45	1317	573
33	A32	2	MPT	0	2	1	23	152	40	17.3	240	8.3	3.93	5.5	8	123.6	9.9	17	182.7	11.4	21.1	21.4	5.4	6.8	12	2.2	7.3	48	1404	784	55	1112	589	47	1228	530	49	862	368
34	A33	2	BPT	1	2	4	21	161	53	20.4	180	14.2	3.66	4	7.5	201.9	27.3	55.8	965.9	260.1	165.1	10	2.3	5.3	8.5	1.9	6.4	146	2992	1368	51	2777	1537	78	1332	513	57	883	259
35	A34	2	BPT	1	2	4	23	151	68	29.8	300	15.8	5.06	5.4	7.5	145.1	16.2	12.8	159.4	14.2	17.9	20	4.5	4.4	10.9	2.3	5.8	81	1888	693	79	1659	683	80	1432	680	62	601	278
36	A35	2	PE	0	1	2	25	161	49	18.9	30	16	3.6	4.5	9	167.6	17.4	25.2	530.8	112.3	33.1	524.9	61	27.7	133.8	11.5	17.9	45	1272	619	98	1398	639	13	391	279	95	1584	598
37	A36	1	PE	0	1	4	26	168	61	21.6	20	9	3.6	7	10	230.7	22.6	17.4	574.3	95.1	28.3	23	15.2	4.8	10	2.7	5.9	54	847	472	113	1649	726	52	1136	464	49	1646	770
38	A37	1	BPT	0	2	2	21	168	70	24.8	240	18	5.4	3.5	8.5	85.8	16	16.7	157.7	18.3	12.1	10.3	2.7	5.1	8.9	2.6	10.1	61	1112	431	63	1709	884	60	1326	452	62	1559	728
39	A38	1	BPT	0	2	2	19	174	66	21.8	180	17.6	3.33	2.5	8	21.6	5.6	12.1	19.9	5.3	8	185.8	17.2	12	123.7	19.2	17.9	49	1177	402	73	1667	741	69	2215	810	58	2014	956
40	A39	1	BPT	0	1	4	23	165	72	26.4	120	15.8	5.26	2	8.5	35.2	7.5	9.2	28	6.7	5.4	405.3	64.9	39.2	345.6	35.9	17	76	1017	431	68	1483	615	138	1840	640	62	1731	778
41	A40	2	MPT	0	1	1	23	166	50	18.1	120	8.7	4.6	3	7	14.8	2.1	6.7	21.8	5.2	5.2	136.8	28.8	15	107.5	17.4	13.6	39	442	236	63	1523	674	38	650	365	52	1764	852

	NAME	SEX	STREAM	SPECS	_Duration	YEAR	AGE	HEIGHT	WEIGHT	BMI	_Duration	FHP	ATTENTION	ception_RT	ception_LT	_AP_WIDTH	_AVR_DEV	_AVR_SPEED	_WIDTH	_AVR_DEV	_AVR_SPEED	_WIDTH	_AVR_DEV	_AVR_SPEED	_WIDTH	_AVR_DEV	_AVR_SPEED	LT_AREA	_LT_MAX_P	LT_AVR_P	_AREA	RT_MAX_P	_AVR_P	_AREA	_MAX_P	_AVR_P
1																																						
42	A41	2	MPT	1	1	1	22	158	54	21.6	30	11.9	4.66	5	9	27.2	5.6	13.4	51.6	15.7	9.7	32.9	7.2	8.8	32.9	7.2	8.8	78	1211	553	51	1025	468	78	1364	566	44	819	353
43	A42	1	MPT	0	2	1	28	177	91	29	480	10.6	2.06	5	3.2	131.7	36	25.3	170.2	16.7	27.1	162.2	16.5	13.5	95.7	29.6	13.8	72	710	374	204	1341	618	123	1180	487	117	1393	587
44	A43	1	BPT	0	2	4	24	169	67	23.5	180	11.6	4.66	10.2	8.5	11	2.5	6.4	13.4	3.4	5.3	29.3	9.4	5.3	16.5	2.9	8.9	71	806	343	59	1437	751	76	839	358	57	1574	800
45	A44	2	MPT	1	2	2	24	153	53	22.6	420	14.2	4.2	12.5	9.2	79.1	11.9	15.4	175.1	22	13	186.7	18.2	12.9	92	11.9	15.3	53	1302	634	48	1989	918	58	1447	653	52	1922	828
46	A45	2	BPT	1	1	2	21	164	62	23.1	120	9.7	3.33	5	2.7	25.3	1.1	10	90	23.4	10.1	46.4	7.8	6.9	19.6	3.6	7.9	59	1843	511	60	2582	1004	58	721	266	68	2043	762
47	A46	1	BPT	0	2	2	20	160	70	27.3	240	22.4	5.2	2.9	3.4	303.6	55.6	50.4	496.8	114	63.2	499.9	75.8	43.6	141.6	14.7	16.1	232	3319	869	113	1198	566	115	2721	821	60	1526	673
48	A47	1	BPT	0	1	2	22	159	58	22.9	10	11.5	4.06	5.9	9.2	20.1	4.3	7.8	44.4	9.4	12.3	132.2	27.1	12.9	29.4	5.9	8.6	31	1849	540	54	1893	896	41	2113	580	54	2517	1122
49	A48	1	MA	1	2	2	24	153	59	25.2	420	15.7	4.86	3.2	2.4	223.1	23.7	15.7	323.4	50	26.6	156.1	31.8	29.8	118.2	19.1	41.8	101	1925	801	20	2125	1010	65	1089	316	90	2313	962
50	A49	2	CSE	1	2	4	23	152	55	23.8	300	11.2	3.13	2.7	2.3	120.8	27.1	25.2	130.7	10.9	13.7	277.9	39.9	24.8	272.6	41.4	16.8	123	2365	634	9	1299	497	117	2268	669	40	1076	581
51	A50	1	CIVIL	0	1	3	24	159	62	24.5	120	15.5	3.6	3.9	2.7	9	2	7.9	5	1.1	4.3	11.6	2.8	5.3	66.1	10	11.9	42	705	258	59	1996	881	57	818	361	64	2317	835
52	A51	2	MPT	1	1	2	26	158	70	28	50	13.8	5.33	7.2	5	44.7	8.2	14.9	87.9	13.6	18.5	145.4	25.8	21.2	180	10.8	26.6	55	897	408	54	2860	1217	63	1593	641	65	2477	1207
53	A52	2	MPT	0	1	1	26	160	45	17.6	60	14.6	4.4	4.6	3.8	10.9	2.3	11.2	23.9	6.2	13.1	23.5	4.7	16.8	18.2	3.5	12.3	40	568	260	51	1685	727	51	718	282	51	1408	690
54	A53	2	MPT	1	1	1	24	158	48	19.2	30	11.2	5.4	5.1	4.6	22.1	6.4	7.5	21.3	5.1	8.6	24.1	4.7	10.9	19	3.4	12.2	58	614	276	68	1463	536	49	756	231	65	1286	594
55	A54	2	MPT	1	2	1	24	162	65	24.8	240	11.2	5.53	4.7	3.4	108	16.2	17.9	177.1	16.8	14.6	55.3	11.8	16.5	128.5	22.3	23.1	49	1620	750	46	3755	1748	43	884	365	52	2069	1056
56	A55	2	MPT	1	2	1	23	160	66	25.8	300	10.5	3.4	8.2	6	102.5	14.7	16.6	152.2	17.1	12.9	146.5	21.9	20.4	134	17.3	25	31	779	412	48	2719	1347	42	709	315	55	2411	1102
57																																						

8.3 APPENDIX- 3

ASSESSMENT SCALE

8.3.1 Mindfulness attention awareness scale

1	2	3	4	5	6
Almost Always	Very Frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never

I could be experiencing some emotion and not be conscious of it until some time later.	1	2	3	4	5	6
I break or spill things because of carelessness, not paying attention, or thinking of something else.	1	2	3	4	5	6
I find it difficult to stay focused on what's happening in the present.	1	2	3	4	5	6
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	1	2	3	4	5	6
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	1	2	3	4	5	6
I forget a person's name almost as soon as I've been told it for the first time.	1	2	3	4	5	6
It seems I am "running on automatic," without much awareness of what I'm doing.	1	2	3	4	5	6
I rush through activities without being really attentive to them.	1	2	3	4	5	6
I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	1	2	3	4	5	6
I do jobs or tasks automatically, without being aware of what I'm doing.	1	2	3	4	5	6
I find myself listening to someone with one ear, doing something else at the same time.	1	2	3	4	5	6

1 Almost Always	2 Very Frequently	3 Somewhat Frequently	4 Somewhat Infrequently	5 Very Infrequently	6 Almost Never

I drive places on 'automatic pilot' and then wonder why I went there.	1	2	3	4	5	6
I find myself preoccupied with the future or the past.	1	2	3	4	5	6
I find myself doing things without paying attention.	1	2	3	4	5	6
I snack without being aware that I'm eating.	1	2	3	4	5	6

Instructions: Above is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what really reflects your experience rather than what you think your experience should be. Please treat each item separately from every other item.

MAAS Scoring

To score the scale, simply compute a mean (average) of the 15 items. Higher scores reflect higher levels of dispositional mindfulness.

8.4 APPENDIX- 4

ASSESSMENT TOOLS

FIG 8.4.1 LASER POINTER.

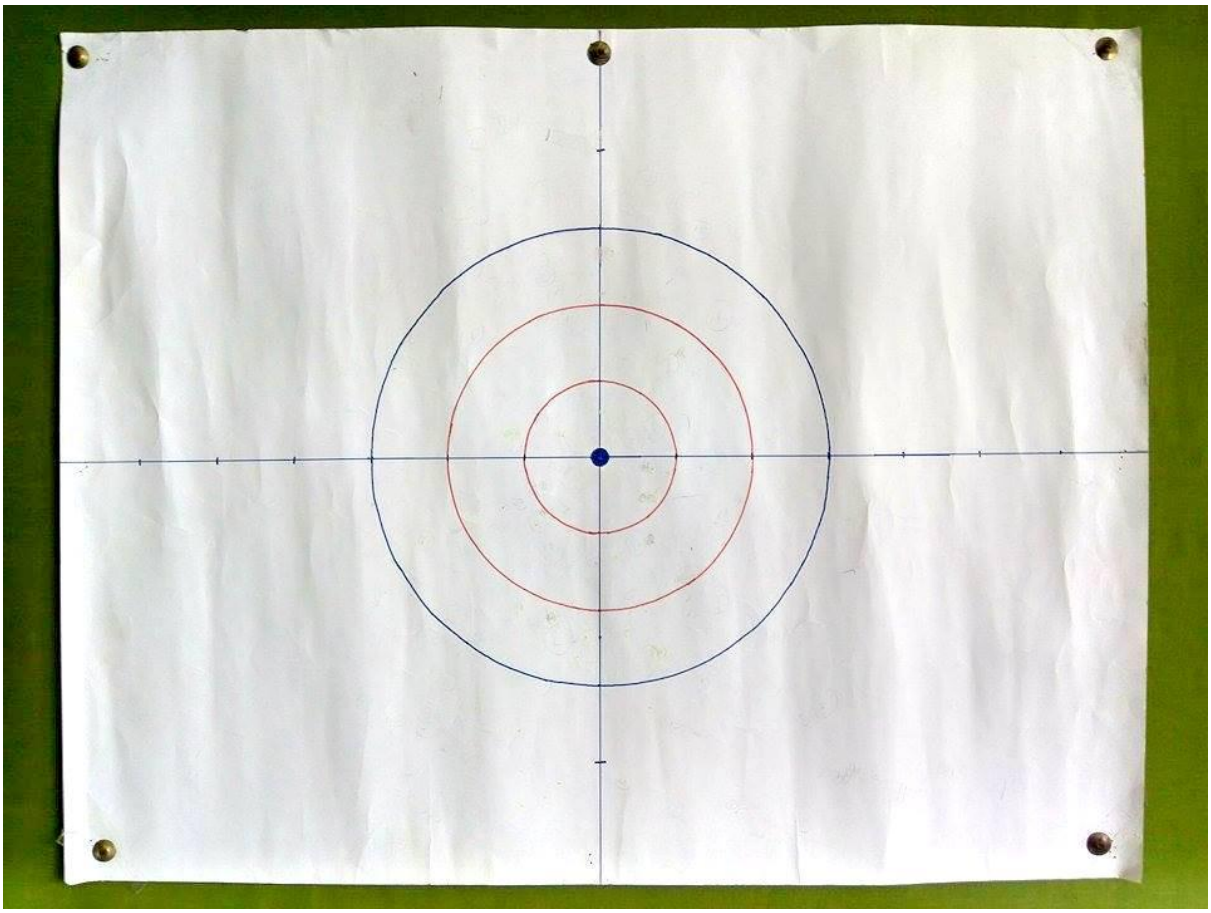

FIG 8.4.2: Tracker Chart

8.4.3 Win-Track Force Platform (Medicapteurs technology, France)

8.4.4 Ruler – To measure the foot size

8.4.5 Weighing Machine to measure weight

8.4.4.6 Inch Tape – to measure height and distance in centimeters