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# A NOVEL IMPACT OF FOOT POSITION IN TERM OF STATIC BALANCE, ANKLE AND KNEE PROPRIOCEPTION IN YOUNG FEMALE STUDENTS OF BALUCHISTAN.

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## ABSTRACT

**Background and Aims**: Efferent input from the sole influences postural stability. Cutaneous reflexes from the foot are relevant for posture and gait. Afferents from the lower limbs alone convey sufficient information for keeping steady standing upright and are important to detect postural sway. Changing the feedback from proprioceptive receptors changes gait and muscle activation pattern. The placement and orientation of the foot/ankle may also be an important factor in providing proprioceptive input. Thus, the purpose of the present study was to compare static balance and ankle and knee joint proprioception in individuals with FFF and NFFF.

**Methods:** Ninety-one female students aged 18–25 participated in this study on a voluntary basis, wherein 24 had flexible flatfoot and 67 no abnormality, determined by evaluation of the foot's longitudinal arch. The active and passive (ankle, knee) position senses; using the test for active reconstruction of ankle and test for active reproduction of knee angle Static balance: Registered based on Sharpened Romberg. Data were non-normally distributed. Accordingly, non-parametric tests were applied. To determine the differences between groups in variables Kruskal-Wallis test was used.

**Results:** There were significant differences in the variables of static balance and position sense of ankle plantarflexion, ankle dorsiflexion and knee flexion between flat feet and normal feet groups ($p \leq 0.05$). In the normal foot group, a significant correlation between static balance and sense of ankle and knee position was observed. Furthermore, the regression line of the ANOVA revealed that ankle and knee position sense can explain changes in static postural balance score in regular foot group (in this line spindle joint dorsiflexion 17% (R2=0.17), spindle joint plantarflexion 17% (R2=0.17) and spindle joint flexions 46% (R2=0.46) mean balance).

**Conclusion:** Flexible flatfoot soles can cause loss of balance and sense of joint position; therefore, according to this preliminary study, clinicians must be aware and should take into account this possible deficit in the management of these patients.

**Key Words**: Balance control, Position sense, Flexible pes planus, Ankle and knee joints

## INTRODUCTION

The sole status is highly important to everyday activities such as standing, walking and running [1–3]. Any distortion of the structure of the sole, including elevation, or lowering its arch, is one of factors that render it exposed to overuse injuries induced by motion; defect in coordination/ rhythm and capabilities (abilities) of flexibility and resistance have been assumed as potential causes promoting deformations in the quality dynamics of arch motion which then lead to losing homogeneity for this organ function (not system) thus making individuals prone to disturbances related with keeping body balance [1-4]. Although nearly 80% of people suffer from some form of foot problem, the most common malformation at any age is flat foot deformity [5]. Based on previous research, the prevalence of flat foot in the general population was 25% [6], seven percent [7]. This variation appears to be more common in the females [The talar facet of the calcaneus was oriented significantly medially relative to the calcaneal body in females than those presented in males [8]], high BMI and large foot people [6, 7, 9]. A flat foot during early stages of childhood is a normal phenomenon; an arch likely emerges as the patient grows older [10].

Flat foot deformities may result from a variety of causes. It can be congenital (the flexible flatfoot) or occur later in life (acquired flatfoot) [11]. The risk factors of acquired flat foot are supposed to be related to age, obesity, and lack of use of shoes in childhood period 7 [9]. Also, malfunction of internal muscle and external muscles of the foot at birth or afterward is involved in this anomaly [13]. Conversely, flatfoot deformity results from the laxity of the spring ligament [14]. Laxity of the ligaments permits the foot to drop in when weight bearing and loses heel gets pushed into valgus. This change in shape can affect the function of other joints, ligaments and tendons and how the foot is aligned. For instance, the deltoid ligament is tightened to correct the rear foot valgus. Gradually, the tibialis posterior and peroneal tendon stress is highlighted. Abnormal bone structure, ligament laxity, and chronic injury of joint capsule are presented along with flat foot [15].

Balance is a frequently employed method to examine the reactivity of lower limb segments and has been described as the body's ability to keep its center of gravity within an individual's support base. In an upright posture, the central and the peripheral components of nervous system are in constant communication to regulate the body’s alignment and center of mass relative to base of support [16]. Balance is regulated by the individual's interaction with the task and environment. Environmental constraints, such as the nature of the base of support, sensory signals and attentional demands determine stability. On the other hand, limitations at individual level seem to be related in part to loss of control over posture due to a complex interplay between musculoskeletal and neural (i.e., “postural control”) systems. “Musculoskeletal constituents include joint range of motion, spinal flexibility, muscle properties and biomechanical links among associated body parts [17].

The activity in the postural muscles is increased to compensate for gravity when maintaining stability in an erect posture - this is called postural tone. Central afferents from multiple sensory systems project to the central nervous system to generate postural tone, and one such signaling pathway is proprioception. Information about the position sense of muscle and joints as well as movement by external receptors in the skin, among other things, constitutes part of the proprioceptive input [18]. It is evident that afferent input from the sole has the greatest impact on positional sensibility [19,20]. Activation of the skin receptors of the plantar sole produces a placing reaction, raising-foot response and stretch mechanism to bring down the foot closer to the support surface base which increases postural tone in extensor muscles. Somatosensory afferents from the neck are stimulated on changes of head direction and may also influence distribution of postural tone in the trunk and extremities [21, 22]. The influence of the afferents from the visual and vestibular systems on postural muscle tone. Even more generally, good posture control cannot be reduced to possessing the means to produce and apply forces in order to monitor body attitude. To be able to time and apply the appropriate neutralizing activity, the CNS must form a correct picture of where in space the body is located (i.e.

static or moving). To achieve this, the CNS must integrate information from sensory receptors across the body, sensu lato, viz visual, somatosensory (joint mechanoreceptors, cutaneous external skin receptors and muscle receptors) and vestibular organ systems. Every sensory feedback gives unique information about the body posture and motion to the CNS [23, 24]. Sensory fusion is critical to balance control.

Somatic senses: The somatosensory system refers to them by afferent nerve fibers and receptors, it is also used for the CNS position and its movements. Moreover, somatosensory inputs extend throughout the body and inform about relationships between body-parts [17]. The relevance of somatosensory inputs to the control of static posture is such that when afferent information from the lower limb is decreased as a result of vascular ischemia (anesthesia or cooling), movement of COP in the base of support surface increases, during erected standing [25, 26]. However, this hypothesis has been challenged and it is now believed that somatic afferents from all body segments contribute to static balance during standing [27, 28]. Because in Holm's point of view the afferent information sent into CNS from sensory receptors are very important to (1) to drive directly frame reflex response, (2) control parameters in voluntary programmed responses and (3) integrative feedback and feed forward elements to preserve equilibrium states both static and dynamic state [29].

Because natural postural control happens effortlessly, without conscious exertion, we have speculated that balance control does not extensively rely on attentional resources. Attentional resourcest are the information processing resources required to perform a task. Dual-task interference happens when two or more tasks are simultaneously carried out and compete for shared attentional resources that consequently diminish performance of one or both tasks [17]. Dual-task studies have displayed the high attentional cost of maintaining postural control. Moreover, the attentional demand is not uniform but differs greatly between the postural tasks as well as among subjects with varying ages and balance skills. In addition, attention requirements vary according to the sensory context; if the sensory demand for postural control is decreased, then attentional demand devoted to stability also increases [30–32].

Other researchers studied the relationship between foot biomechanics and balance. Focusing on the increase and decrease of the arch height in a foot, Cote et al., (2005), amongst others, investigated static balances and compared them with dynamic ones [16]. They found that there is more stability in personalized pronated feet than those of supinated feet; nevertheless, these two groups did not have a significant difference from normal plantar arched. In contrast, Khramtsov and co-workers demonstrated that incubation with phloretin in the presence of ATP disrupted the structure of pre-attached GLs 32. (2009) determined the degree of stability among 112 children aged between 7 and 10 years with flatfoot and normal arch feet. The findings indicate that barefooted flatfooted children possess less vertical stability compared to normal-arch feet [33]. Abdulwahab and Kachanathu (2015) investigated the impact of various magnitudes of foot posture on static balance in healthy young adults. The results revealed that their FPI score positively affected the static balance of healthy individuals [34]. Song et al. (2021) analyzed the difference in foot pressure, ground reaction force and balance ability according to the height of the foot arch in young adults; they reported that there were no differences between the peak vertical force with those who had flexible flatfoot and neutral type. But, the experienced static balance of participants with flexible flatfoot was significantly worse than that of normal-foot [35]. Consequently, findings in relation to foot biomechanical properties and balance are inconsistent.On the contrary, there are few studies in this group of participants on the influence of the foot sole biomechanical support for proprioceptive activity in lower limb joints. Only the study by Yalcin et al. (2012) assessed ankle isokinetic strength and proprioception in flat foot patients. The error scores of passively reproducing the ankle joint position in eversion for the dominant side were significantly higher than those in the control group among people with flexible flatfoot. The strength of aurator and invertor muscles did not meaningfully differ among the flat-flexible foot group and controls [36]. Thus, the biomechanical impact of the sole on balance and proprioceptive in structural joints of lower limbs required to be vertebrated.

On the other hand, balance control and ankle proprioception are negatively related with ankle injuries [37, 38]. In 1984 Tropp et al. reported that ankle injuries were nearly 4 times more common in soccer players who had poor balance than those with good postural sway [39]. In the same vein, Watson showed that hurdlers and balance-deficient Gaelic football players had almost twice as many ankle injuries compared to individuals with normal balance [40]. Moreover, balance performance has been shown to be a significantly related factor of ankle injury risk in young male and female basketball players [41]. A meta-analysis also revealed poorer balance performance as an intrinsic risk factor for ankle injury [38].Some other studies confirmed similar findings of the association between ankle proprioception and injury risk. Ankle proprioception was identified as a predictor of ankle injury for college basketball players from a longitudinal study [42]. Moreover, such population of basketball players demonstrated a more-adopted alteration in co-contraction pattern between the ankle plantarflexors/ dorsiflexors that generated greater impact force at initial contact during landing maneuver associating with an increased risk of ankle injury [43]. Ankle proprioception is one of the risk factors that have been found to be associated with ankle injury, as reported by Witchalls et al. in their systematic review [38]. Ankle injury is commonly involved in the damage of muscles and tendons; meanwhile, it also leads to that harm is caused to intrinsic mechanoreceptors [44–46], which affected the quality of proprioceptive information and will affect balance control. Un-rehabilitated, and impaired ankle proprioception following ankle injury can then lead to chronic progression in deficit of postural and balance control [47–49]. Gymnasts, dancers and military sportsmen have inferior ankle proprioception in case of injury follow-up exhibited worse performance in static postural stability and dynamic task balance control [50–52]. The findings of this study indicate that ankle proprioception is closely correlated with balance control in sport injuries, and balance may be greatly influenced by impaired ankle proprioceptive function as a result of injury.

There for based on these findings and considering that in flatfoot deformity, the changes in ankle position cause muscle synergist changed during the activities therefore many studies now a day try to manage this deformity during sport using methods design of sports shoe for preventing of sport injuries [45, 53, 54], this paper aimed: (1) comparison the balance between subjects with and without flexible flat feet; (2) comparison ankle and knee proprioception between subjects with or without flexible flat feet; and (3) investigating relationship between ankle and knee proprioception with balance in subjects with or without flexile flat foot. We aimed to (1) find out differences in balance of the two groups; and (2) proprioception at ankle and knee, check whether correlation would be obtained between proprioception and balance for normal foot group, but not for flatfoot most likely.

## MATERIALS AND METHODS

The current study was a cross-sectional, and prospective comparative investigation carried in accordance with the declaration of Helsinki. A total number of 91 study participants (aged 18–25 years) who voluntarily participated in the study and completed a written consent, after which subjects were divided into two groups according to examination result of the internal longitudinal arch of foot (examined using the drop navicular test which is reliable method for assessing longitudinal arch if foot sole [55]) (i): Flexible flatfoot group: Including 24 participant was determined using Navicular Drop (ND) ≥10 mm stood for flexible flatfoot; Normal foot group: Included 67 participates of ND5≥−9 mm meant normal foot [Sample size was calculated through G∗power 3.1.9.4 based on similar study data [56]. A minimum of 23 participants was needed to conduct the study on the basis of an estimated effect size = 0.4, alpha level =.05, and power level =.75. Therefore (statistical test: Repeated measures, within-between interaction), we estimated the required sample size to be 23 subjects per group, for a total of 46 participants [56]]. Research inclusion criteria: 18-25 years of age; did not have any history of congenital abnormalities in the legs or lower limbs; had no systemic disease affecting the position in legs or lower limb; and had no history of traumata (or pain as a result) from any feet, lower limb and lumbo-sacral regions at least in the last 12 months.

Exclusion criteria in studies: people suffering from structural flatfeet, professional athletes or individuals engaged in sport regularly, volunteers with visible symptoms of abnormalities of the lower limbs and feet (except flexible flatfeet), a history of neurological diseases, rheumatic and metabolic disorders, mental illness, problems with the vestibular system; when there was a history of balance disorders and frequent positional vertigo; severe trunk deformity (severe scoliosis or hyperkyphosis), treatment using medications affecting balance before the tests; those with accompanying pathology (e.g., surgery in last three months a history of sprain dislocation semi-dislocation ankle significant injury recently involving joints of lower limb) [57].

**Testing Protocol:**

Ankle and knee joint proprioception: To assess the position sense of the ankle and knee, we adopted the reconstruction of ankle and knee angles test. The patient sits on a chair so that the angles of trunk-thigh and thigh-leg are each 90 degrees. The height of the chair was selected to prevent the soles of feet touching the floor. To remove vision, the subject's eyes were covered with a black blindfold. Next, the examination moved passively (by examiner) the ankle and knee joints in position to the middle of their range of motion ([according to [material], as mentioned before, these ones are 20 for plantar flexion and 10 for dorsiflexion degrees] and 45 degrees for knee flexion [58–60]). The subject was then requested to actively flex her leg and foot to the desired angle. The subject three times actively reconstructed these angles for ankle dorsiflexion, ankle plantarflexion and knee flexion in succession, then the absolute value of the difference angle between target angle and reconstructed angle was regarded as position sense of ankle or knee joint with 61–65 [65]. A goniometer was used to assess the individual's performance in rebuilding the expected angles (6 markers were considered to ease this measurement called respectively external condyle of the tibia, outermost lateral malleolus, distal part of fourth metatarsal bone, greater trochanter of femur bone and midline of both the femur bone and fibula bone) [61–62], [65–66].

Balance: To assess the static balance, the Sharpened Romberg test was applied; a distal leg (90 degrees) of the subject standing barefoot on a flat surface followed by alignment in tandem position by placing nondominant leg behind while crossing hands over chest. The test was conducted with the eyes closed. The amount of time the individual can stand in spite of the position, up to 60 s before losing balance was used as the person's score (if there were mistakes such as: detaching hands from the chest, opening eyes, shaking or having stepped too much and others- tests would stop). Yim-Chiplis et al. (2000) had already reported the validity of this test (eyes closed) to be 0.76–0.77 [67].

**Statistical analysis**

Data are expressed as mean ± standard deviation. Statistical data analysis was performed using unpaired t-test, Pearson's correlation coefficient and linear regression. The Shapiro Wilk test was used for normality the Leven test was used to find equality of variances before applying these tests. It is explained by the fact that in balance, ankle, and knee proprioception measures normality and homogeneity of variances were not achieved so we performed the equivalent non-parametric test (Mann–Whitney U). First, we conducted the Pearson correlation test to discern the relationship between balance scores and ankle proprioception and knee proprioception variables, subsequently followed by linear regression. As a routine, the normality of residuals (errors) and independence of errors was also checked. A level of significance of 0.05 was used for all computations. SPSS was used for everything except the statistical analyses.

## RESULTS

The baseline traits of the subjects according to group are summarized in Table 1. As it can be observed, between the two groups of subjects there are significant differences in age but no difference in their demographic variables for weight and Body Mass Index (BMI). The difference in static balance, ankle proprioception (dorsiflexion and plantarflexion), and knee proprioception was compared between the flexible flatfoot group and normal foot group using a non-parametric Mann–Whitney U test. The median error value of balance score and the absolute JPE values for both, flatfoot, and control groups are shown in Table 2. Error of Median Absolute joint positioning error values were larger in flatfooted individuals than control group. and this was evidenced by a significant difference in the dominant ankle plantarflexion and dorsiflexion position and the flexion position of

the dominant knee. The median of balance score of the control group, on the other hand, were also higher than that of flatfoot. As such a large difference in the balance score was observed. For the flexible flatfoot group, Pearson's correlation test was performed to evaluate the correlation between balance test results and proprioception of ankle and knee. Ankle proprioception (dorsiflexion and plantarflexion) and knee proprioception were considered predictive variables, using static balance as the criterion variable (Table 3). The values from the correlation coefficient indicate that the difference is not significant at 0.05 (FS and FB); We may say that ankle and knee proprioception in flatfoot group are independence to static balance.
The relationship between balance test scores and ankle, knee proprioception in the normal foot group was analyzed using Pearson's correlation coefficient. Ankle (dorsiflexion and plantarflexion) proprioception regulation was the predictor variable to be examined in relationship with knee proprioception and static balance (Table 4). The result of the correlation coefficient calculation showed that the p-value is significant at 0.05 level, where it can be concluded that: static balance and ankle dorsiflexion position sense have a relation (r = -0.309), there is a relationship between static balance and ankle plantarflexion (r- w 3_47f), there is a relationship between static balance and knee flexion position sense with correlation value -0.59. When the values of these coefficients are negative, this relation becomes inverse. This implies that more proprioceptive balance is indicated as the joint proprioceptive error decreases (proprioceptive). Thus, the regression test was conducted in order to determine whether knee and ankle proprioception could predict static body equilibrium Testing These results concerning the correlation of these three variables, the relationship between different remaining two and the cause-effect relation among significant correlations (Table 4). The findings indicated that the prediction of static balance from ankle and knee proprioception was large. Ankle dorsiflexion position sense 17% ($R2=0.17$), ankle plantar flexion position sense 17% ($R2=0.17$) and knee flexion position sense 46% ($R2=0.46$) respectively, explain in changes of static balance.

**TABLE NO.1: General characteristics of subjects**

| Variables | flexible flatfoot group (n=24) | Normal foot group (n=67) | T | P value |
|---|---|---|---|---|
| Age (years) | 19.50±0.72 | 19.79±1.23 | -1.08 | 0.28 |
| Weight (kg) | 59.92±9.85 | 57.55±7.29 | 1.23 | 0.21 |
| Height (cm) | 163.58±4.79 | 160.90±4.56 | 2.44 | 0.01* |
| Body mass index (kg/m2 ) | 22.37±3.36 | 22.25±2.86 | 0.16 | 0.86 |

***Unpaired t-test to investigate the difference between groups in age, height, and weight variables***
***P≤0.05: significant difference between groups***

**TABLE NO.2: Mann-Whitny U test results**

| Variables | flexible flatfoot group | Normal foot group | P value | η2 |
|---|---|---|---|---|
| | Median [lower, upper quartile]; Standard Error of Median | Median [lower, upper quartile]; Standard Error of Median | | |
| Static balance (seconds) | 14.00 [8/00- 29.22]; 3.25 | 36.83 [28.10- 45.43]; 1.93 | 0.00 | 0.58 |
| AE of ankle dorsiflexion (degree) | 8.00 [5.00–10.00]; 0.448 | 8.00 [5.00–8.00]; 0.288 | 0.03 | 0.57 |
| AE of ankle plantarflexion (degree) | 13.00 [10.00– 5.00]; 0.670 | 10.00 [8.00– 14/00]; 0.454 | 0.05 | 0.57 |
| AE of knee flexion (degree) | 20.00 [18.00– 25.00]; 0.784 | 18.00 [15.00– 20.00]; 0.562 | 0.01 | 0.58 |

***P≤0.05: significant difference between groups***
***AE: Absolute error***
***η2=Eta squared***

**TABLE NO.3: The results of Pearson's correlation test in the flexible flatfoot group**

| Variables | | AE of Ankle dorsiflexion | AE of Ankle plantarflexion | AE of knee flexion |
|---|---|---|---|---|
| Static balance (seconds) | Correlation Coefficient | 0.274 | 0.130 | 0.092 |
| | P value | 0.19 | 0.54 | 0.69 |
| | N | 24 | 24 | 24 |

***P≥0.05: No significant relationship between the variables***
***AE: Absolute error***

**TABLE NO.4: The results of Pearson's correlation test in the group of normal feet and Static balance regression equation based on ankle and knee proprioceptive**

| Variables | | AE of Ankle dorsiflexion | AE of Ankle plantarflexion | AE of knee flexion |
|---|---|---|---|---|
| static balance (seconds) | Correlation Coefficient | −0.419 | −0.416 | −0.681 |
| | t | 10.183 | 10.219 | 13.57 |
| | P value | 0.00 | 0.00 | 0.00 |
| | R | 0.419 | 0.416 | 0.681 |
| | R2 | 0.176 | 0.173 | 0.464 |
| | F change | 13.85 | 13.62 | 56.21 |
| | N | 67 | 67 | 67 |

***P≤0.05: significant relationship between the variables & the regression equation holds***
***AE: Absolute error***

## DISCUSSION

The purpose of this study was to compare static balance and proprioception at the ankle and knee level in subjects with flexible flatfoot and normal feet. The main finding of the current study was that the static stability and ankle and knee JPs in subjects with flexible flatfoot were significantly worse compared to that of a normal foot group. On the other hand, there was also a significant relationship between ankle and knee proprioception scores with the static balance score in normal foot people [in other words, scores of ankle and knee proprioception were predictable to have impact on the static balance] whereas this correlation was not found in too flexible flatfoot sole group [i.e. static balance scores are not predicted by YBT]. The current findings were in line with the observations of Khramtsov et al. (2009), Abdulwahab) and Kachanathu (2015), Song et al., (2021) [33–35]. The findings indicated that there is a significant difference in static balance between flexible flatfoot and normal foot groups (Table 2), indirectly reflecting that the biomechanics of the foot itself have an influence on the balance stability under static condition. It is considered to be that as there are 100 or more muscles, tendons, and ligaments, 26 single bones, and 33 joints in association with ankle joint, knee joint, and femur joint which form the kinematic chain of lower limbs makes balance of a body maintain in static and dynamic states. The feet are at the end of this chain and serve as a base support surface side for the kinematic chain [68]. This's considered that a minor dynamic change of the feet influences the control of body position [16]. Additionally, the shape of the foot is supported by supporting bone structures and soft tissue. Bony support is formed through the articulation between the talus and calcis bones, and soft tissue resistance is offered via the deep muscles of the posterior leg and internal ligaments of ankle/foot [68].

The posterior tibialis muscle inverts the subtalar joint and locks the arrangement of bones that make up the arch into a stable, natural configuration -- the most frequent cause of acquired flatfoot deformity in adults is dysfunction of the posterior tibialis tendon [69]. Furthermore, the posterior tibialis muscle is the most important dynamic structure in supporting and preserving of the longitudinal arch of the foot [69]. Changes in the muscle system responsible for flexible flatfoot (joint

dynamic stabilizers) are thought to influence positional instability (static and dynamic balance).70 Thus, this alteration of pattern of muscle activity may contribute to impaired balancing ability in people with flexible flatfoot. In contrast, the findings of the present study did not support those of Cote et al. (2005) [16]. A likely dispute in Cote et al. ‘s results is that the authors measured positional stability (maximum position attained in internal–external and anterior-posterior direction) using Chattecx Balance System with single-leg standing eyes open and closed assessed as static balance task while in this study Sharpened-Romberg functional balance test was performed based upon what time person can hold tandem position with proprioception impaired (eyes closed). Thus, different methods for static balance measurement may explain the discrepancy of two studies.
As per the report of Chiari et al. [71] significant between-group difference in static balance can be due to the significant difference in height of subjects - anthropometric factors. However, in the study of Fabunmi and Gbiri reported weak and positive correlation between Sharpened Romberg Test with foot length [72]. Likely, we may not be able to ascribe the significant difference between the two groups in static balance to significant difference existed in their height.
On the contrary, comparing results of the two groups research demonstrated that ankle and knee proprioception are significantly less in group of flexible flatfoot than those group who had regular foot (Table 2). Put simply, mechanics of the foot impinge on levels of ankle and knee proprioception. Our study results were corresponding with the findings of Yalcin et al. (2012) [36]. The bones of the foot and several surrounding soft tissues including ligamentous, muscular, and tendinous elements are involved with alterations in their function [13, 73]. Among these soft tissues are mechanical receptors and tiny specialized proprioceptive neurons. The proprioception idea is drawn from the rationale that shape and load are altered on the soft tissues, wherein mechanical receptors are found, neural input to CNS will be suppressed [74]. Thus multiple chronic microtraumata to these soft tissues can lead to proprioceptive insufficiency [36]. Another factor is the potential relationship between ligamentous laxity and proprioceptive disorder [75, 76]. A hypermobile flatfoot is associated with increasing degrees of systemic ligamentous laxity [77]. As such, laxity of the ligaments not only results in flatfoot; it is also one cause of proprioception deficiency and defect [36]. Also, Lin et al. (2001) remark however that those with flexible flatfoot more poorly perform physical task than those having the normal foot. They have also been found to move very slowly in the environment, as judged by gait parameters [78]. We hypothesize that these clinical observations made in the Lin study may be secondary to underlying, background proprioceptive deficits.
In addition, findings indicated that individuals possessing normal foot, ankle and knee proprioception have a strong relationship with balance; more specific that scores of the test (balance) could be predicted from ankle and knee proprioception. Nevertheless, there was no significant association between the ankle and knee proprioception and balance among subjects with flexible flatfoot. Mechanoreceptors in the joint capsule, muscle receptors (muscle spindles and Golgi tendon organs) and specific receptors located in skin (extrinsic receptors) are all sources of input for proprioception of static and dynamic postural control [29]. The three main areas of proprioceptive input to maintain body position are in the foot, sacroiliac joint and cervical spine as described by Janda [29]. In this manner, the afferent input from the sole influences positional sense [18, 19]. 20, the proprioceptive afferents of secondary leg can also afford sufficient information for standing straight and are indispensable to feel situational change [29]. Thus, in individuals with normal sole foot the proprioception of the lower limb joints plays a role on balance and point topology anticipation.
In contrast, McKeon and Hertel's (2007) and Meyer et al. (2004), if the sensory information from the plantar sole is reduced in people, it gets replaced by vision [79, 80]. Probably while people with the deformaity of the flexible flat-foot are sullering due to the distinct deficit in dynamic stability to the lack of diтerential assessment of placemcnt iп the propri0Op ceptiv, system weЍthin seop recptive and vision allenat ing spiгитs rcp1ac e ab5encc o f sensorф indcкation`s of slaиd or slзep - pP)sture tct control for an absolutelY immova le b oc y statiC), as weil as in a dynam ic condition. Consequently in individuals with flatfoot deformity, proprioceptive scores are not predictive of static balance scores. Also in the same subjects, postural control accordingly would have to be investigated

under static and dynamic conditions. The decrease in somatosensory input from the soles of the feet causes sensory re-weighting by central nervous system (CNS). On the contrary, when sensory information is attenuated, attentional resources are augmented [30–32]. There would be no doubt that under such conditions of pressure, the intermediate vision system is based on more reliable pupillary information than between vestibule and vision. This would suggest an increase in attention load due to lack of reliability being greater from the side of the vision system. The simultaneous performance of a dual-task does not inevitably disrupt postural control. Stoffergen et al. (2000) found that in a dual-task experiment (with subjects to focus on a visual target while doing a visual task by counting the number of letters in chunks of text), saccade amplitude variability was greater than when performing singly. On the basis of their results, they stated that posture is part of an integrated perception/action system and could be altered to allow performance of other tasks [81]. In this light, Huxhold et al. (2006) have postulated that extended attention to a highly habitual process (i.e., posture control) might decrease the efficiency of posture control mechanisms but distraction to a secondary task can usefully encourage nonspecific processes in the same way that training improves automaticity and therefore increases the efficiency of the 'automatic' posture control mechanism [82]. Some studies have proposed that decreases in volatility in dual-task setting is related to a heightened arousal produced when subjects perform the secondary task, which has a facilitative effect on performance [83]. Thus, some of the secondary tasks increase postural sway (which is usually considered as obstacle for posture control), whereas others decrease it (usually seen as a sign that balance improves) [17] leading to a loss of predictability of equilibrium from a proprioceptive sense. Several anthropometric characteristics of the subjects should also be a part of the study, to contribute understanding about our subject. We were unable to control the height and length of LM between subjects (a significant difference was found between groups in terms of height) in this study, therefore we need to perform studies on the anthropological characteristics of our subjects in future. INS also should evaluate the function of the so-called proprioceptive system of lower limbs--in this aspect in particular ankle joint- in terms of frontal movement plane. Also the association of proprioception to dynamic balance must explore.

## CONCLUSION

Loss of balance and sense of joint position can be related to the abnormal flexible flatfoot, so there is a need to consider this deficit in the treatment of these patients as reported by this preliminary study.

## LIMITATIONS OF STUDY

The main limitation of this study was its small sample size. Additional studies with larger sample sizes are highly recommended to assess the causing factors and prevention strategies for control in Pakistan.

## ETHICAL APPROVAL:

Ethical approval was taken from the Review Broad of the Mekran Medical College, turbat.

## PATIENT'S CONSENT:

Informed written consent was taken from each patients for participating in the study, and publication of study results.

## CONFLICT OF INTEREST:

The study has no conflict of interest to declare by any author.

## AUTHOR'S CONTRIBUTION:

1. Literature search, conduct of study and editing.
2. Literature search, ethical approval and manuscript writing.
3. Sampling and results writing.

4. Statistics writing.
5. Literature review and discussion editing.
6. Review and editing.

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