Comparison of Static and Dynamic Balance between Male and Female: A Literature Review

Hannan Azkiya[1], Lucky Prasetiowati[2], Indrayuni Lukitra Wardhani[3]

[1]*Hannan.azkiya.alfan-2020@fk.unair.ac.id*
[1]*Faculty of Medicine, Universitas Airlangga, Surabaya 60132, Indonesia*
[2]*Department of Anatomy Histology and Pharmacology, Faculty of Medicine, Universitas Airlangga*
[3]*Department of IKF And Rehabilitation Faculty of Medicine Faculty of Medicine, Universitas Airlangga*

Abstract

Falling is part of various factors that affect health, and falling incidents can have a significant impact on one's quality of life by causing functional, psychological, or social limitations. One way to avoid falling incidents is by maintaining balance. The ability to maintain body balance is a crucial aspect in performing daily activities. Balance can be categorized into two types: static balance and dynamic balance. The variations in findings among these studies create a need to better understand individual variability and contexts that may influence the balance of males and females. The purpose of this research is to identify the comparison of static and dynamic balance between males and females. The study's design is a literature review. The process of data collection involved sourcing articles from three databases, namely Web of Science, PubMed, and Google Scholar. The search utilized the keywords comparisons, balance, and genders. The inclusion criteria for the articles encompassed those published between 2000 and 2023. The results indicate that some studies suggest differences in balance between males and females, while others show contrasting result. The commonality found in some studies is that gender does not directly affect balance but through other factors such as muscle strength and maturational development. Maintaining these factors is crucial to produce better balance for an individual.

Keywords : *comparisons, balance, and genders*

1. Introduction

Falling is part of various factors that affect health, and falling incidents can have a significant impact on one's quality of life by causing functional, psychological, or social limitations. Globally, falling has become a major issue and is the second leading cause of death due to unintentional injuries (Nagrale, O. 2020). One way to avoid falling incidents is by maintaining balance. The ability to maintain body balance is a crucial aspect in performing daily activities. Balance refers to the capacity to control or sustain the center of gravity in relation to the base of support with minimal postural sway (Kim, Shin, and Cho, 2022). Balance can be categorized into two types: static balance and dynamic balance. Static balance demonstrates the ability to maintain posture on a stationary surface, while dynamic balance is associated with the ability to sustain posture during movement (Kim et al., 2018).

Several studies indicate that falls are still a common occurrence in daily life. In the adult population, approximately 13% report imbalance within the age range of 65-69 years, and this figure increases to 46% in the group aged 85 years and older. Meanwhile, the prevalence of falling incidents due to imbalance in adults reaches 28% (Osoba et al., 2019). In a study by Xing *et al* (2023), it was found that approximately 27,000 elderly individuals died due to falls each year. About 28-35% of individuals aged 65 experience falls annually, while in those over 70, the incidence of falls increases to 32-42%. Injuries ranging from mild to severe occur at a rate of 20-30% due to falls, with over 50% of them requiring hospitalization for treatment. Among this group, 35% of individuals aged over 70 and 61% of those aged over 80 have balance disorders.

To maintain balance, several components are required to function optimally, and some of these components tend to decline in function as age increases. The components influencing balance include motor ability (muscles), the nervous system, and sensory systems (vestibular, visual, somatosensory/proprioceptive), which are interconnected through efferent and afferent signal pathways (Pasma et al., 2014). Other factors

that also influence an individual's balance include the base of support, the center of gravity, and the line of gravity (Aulia, 2018).

Some studies suggest that there are differences in the level of balance between male and female. Bryant et al.'s research (2005) found a significant difference in the balance between male and female, indicating that male have a greater imbalance than female. Similarly, Cabedo *et al* (2008) stated that both static and dynamic balance were better in male compared to female. On the other hand, a study by Morrone, B. F., & Spaccarotella, K. (2018) reported no significant difference in the level of balance between male and female.

The differences in findings among these studies create a need to better understand individual variability and contexts that may influence the balance of male and female. A profound understanding of these factors can assist in designing interventions and exercise programs that are more specific and effective, ultimately enhancing balance and reducing the risk of falls, especially in vulnerable populations such as the elderly and aids in improving balance to prevent falling incidents that can have fatal consequences in daily life. Considering this background, further research on the differences in balance between male and female becomes relevant to contribute to scientific understanding and the development of targeted health interventions. Therefore, this study aimed to identify the comparison of static and dynamic balance between males and females.

2. Methods and Materials

In this research, a literature review approach is utilized. The data collection process consists of obtaining articles from three databases: Web of Science, PubMed, and Google Scholar. The search involves the use of keywords such as "comparisons," "balance," and "genders," The articles included in the study must meet certain criteria, including being published between 2000 and 2023, presented as original articles, complete in text, and openly accessible, using quantitative research methods. The collected data will be subjected to analysis, leading to the development of conclusions based on the research findings.

3. Results and Discussions

Based from the gathered and analyzed articles, the findings are presented as follows

Table 1. List of Articles

No.	Authors	Title	Method	Result
1.	(Bryant *et al* 2005)	Gender differences in balance performance at the time of retirement	experimental research design	for several of the balance tasks the men exhibited a statistically significant larger range of centre of pressure displacement than the women ($P < 0.01$).
2.	(Cabedo *et al* 2008)	Differences Between Males And Females In Static And Dynamic Balance From 4 To 74 Years Of Age 1970	experimental research design	These were only 3 significant ($p<0.05$) gender differences for static balance, 39-43 y (male: 153.74 ± 32.35s vs female: 124.51 ± 47.38s, mean± SD), 49-53 y (male: 127.00 ± 46.00s vs female: 102.18 ± 49.38s), 64-74 y (male: 35.77 ± 17.65s vs female: 27.77 ± 18.19s) these were only 4 significant ($p<0.05$) gender difference for dynamic balance, 14-18 y (male: 2.32 ± 0.95s vs female: 2.76 ± 1.12s), 19-23 y (male: 1.45 ± 0.44s vs female: 1.82 ± 0.59s), 24-28 y (male: 2.17 ± 0.80s vs female: 3.69 ± 2.25s), 29-33 y (male: 2.84 ± 1.18s vs female 3.76 ± 1.32s).

No.	Authors	Title	Method	Result
3.	(Morrone, B. F., & Spaccarotella, K. 2018)	Comparison of Balance between Genders of CrossFit Athletes	experimental research design	There was no significant difference in individual reach directions, but significantly more men (p=0.02) had a normalized composite right reach score less than 89.6% compared with women
4.	(Sabin MJ, *et al.* 2010)	Balance Performance in Male and Female Collegiate Basketball Athletes: Influence of Testing Surface	experimental research design	A significant main effect for gender (collapsed across group and limb) was present in the posterior direction (p = 0.02)
5.	(Olchowik, G *et al,* 2015)	The human balance system and gender	experimental research design	The study showed a significant correlation between gender and the ES (Equilibrium Score) results for SOT1 (Sensory Organization Test) and MS (Motor Strategy) for SOT5. Significantly higher ES1 values for men are evidence of smaller displacements of the centre of gravity in the forward–backward direction with the proper information from the eyes and the sensory system. However, for women, higher MS5 values were observed. In the absence of information from the eyes, women show a greater ankle-muscle activity and lesser hip-muscle activity in comparison to men. Postural response amplitude in both left and right lower limbs was also significantly dependent on gender
6.	(Steinberg, N *et al,* 2017)	Is There a Correlation Between Static and Dynamic Postural Balance Among Young Male and Female Dancers?	experimental research design	Female dancers static PB ability is correlated with their dynamic ability, whereas among male dancers, no relationship between the static and dynamic PB in the AP direction exists
7.	(Akinoğlu, B et al 2023)	Comparison of static and dynamic balance ability according to gender in athletes- a cross sectional study	experimental research design	Static balance ability of female athletes was significantly better than male athletes, and female athletes interpreted visual inputs better than male athletes in static balance ability
8.	(Menegoni, F., *et al* 2009)	Gender-specific Effect of Obesity on Balance	experimental research design	Body weight was found to correlate with AP (anteroposterior) parameters (r = 0.36–0.74), but not with ML (mediolateral) displacements. The increased body mass seems to produce AP instability in both genders and ML destabilization only in males.
9.	(Razmi, R. R *et al.* 2018)	The Comparison of Balancing between Male and Female Student at Faculty of Sports Science in Chulalongkorn University	experimental research design	There is an equal score for both gender; male and female in overall stability index. For normal score, both male and female get 6 out of 17 while 11 out of 17 of both genders obtained a good score which is better than the norms.
10.	(Patrícia *et al.* 2013)	Comparison of balance in adolescents	experimental research design	Female adolescents showed a significantly lower COP (center of pressure) ap (p=0.011) and COPml (p=0.003) ranges of displacement with open eyes when compared to male adolescents. With closed eyes, females had lower COPap (p=0.001), COPml (p=0.001) and COPvel (p=0.004)

No.	Authors	Title	Method	Result
11.	(Bonis, M. & Tillery, K 2021)	Gender Differences in Static and Dynamic Balance Testing	experimental research design	Non-parametric Mann-Whitney results indicated significant superior static balance of males in both the dominant and non-dominant leg of the Stork test; and significant superior dynamic balance of males for the 5 Times Sit-to-Stand test
12	(Carter, E., & Bartlome, B. 2020)	A Comparison of Dynamic Balance in Male and Female Collegiate Soccer and Lacrosse Athletes	experimental research design	Male participants demonstrated a significantly greater posteromedial reach than female participants (male: 100.2 (+ 10.6), female: 94.0 (+9.03), p=0.03). No significant differences in posterolateral or anterior directions noted

Based on the table above, it can be seen that there is a difference between the balance that male and female have both static and dynamic:

3.1 Comparison of static balance between male and female.

Several studies explain that there are differences in static balance levels between male and female. The study by Bryant et al. (2005) found significant differences between the sexes in absolute data for several balance tasks, with male showing a greater amplitude of CoP displacement, signifying greater instability in male. This may have occurred because the male in this study had greater height than the female, which could be a contributing factor to the tendency that male had a greater range of CoP displacement than female when performing balance tasks with both feet together.

Another study by Cabedo et al. (2008) explained that male had better static balance than female, which may be attributed to a preferential decline in muscle strength in female due to age. Similarly, a research by Olchowik, G et al. (2015) explained that greater body weight and greater muscle mass in male allows for a more effective postural amplitude response compared to female. They also noted that female had lower response amplitudes to large forward platform translations and shorter response latency times to large platform translations in both forward and backward directions. This may be a factor explaining why female tend to fall more often, due to a lower ability to generate enough muscle power to correct for shifts in body silhouette.

Research by Morrone, B. F., & Spaccarotella, K. (2018) stated that there is no significant difference in individual reach direction between male and female. However, there was a significant difference between the legs in male, with more male having a normalized right reach score of less than 89.6% compared to female. This finding suggests poor balance and potential injury on the right side, while male tend to have better balance and lower risk of injury on the left side of their body compared to the right side.

The study by Sabin MJ et al. (2010) showed different results. The results showed that there was no difference between limbs in performing the SEBT, regardless of group or testing surface. This similarity confirms that healthy limbs will perform similarly during SEBT, regardless of group or testing surface conditions. Symmetry in healthy limbs was also seen in the unilateral postural control task on the force platform, where sway area and sway path length showed non-significant differences between functionally dominant and non-dominant limbs. A non-significant difference between limbs was expected in this study as it was assumed that in a healthy population, the reach distances of both limbs would be the same in the absence of pathology.

3.2 Comparison of dynamic balance between male and female.

In the comparison of dynamic balance, some studies suggest that male may have better balance than female. The study by Cabedo et al (2008) explained that all values for dynamic balance were greater in male compared to female, regardless of age group. It is possible to speculate that the greater increase in strength seen in male compared to female after puberty may be responsible for the statistically better dynamic balance seen in male aged 14-33 years. Similarly, Bonis, M and Tillery, K (2021) also found

that males in this study showed significantly superior dynamic balance in the five sit and stand tests and significantly superior static balance in the crane test in both dominant and non-dominant legs compared to females.

Research by Carter, E., & Bartlome, B. (2020) showed that male had better dynamic balance in the posteromedial direction than female, but no significant differences were found in the anterior and posterolateral directions. As previously described, dynamic balance is a strong predictor of injury in the lower limbs. The better a person's dynamic balance, the less likely they are to be injured in the inferior extremities.

However, a study conducted by Patrícia et al. (2013) reported that female adolescents showed better postural balance than males due to different anthropometric characteristics. Another hypothesis is the developmental rhythm of maturation, which usually occurs earlier in females. The findings in this study point to the important clinical importance of postural balance for rehabilitation, as deficits found in adolescent boys' balance may lead to changes in other motor skills, which depend on postural control, such as gait, and also make the musculoskeletal rehabilitation process more difficult in case of lesions.

Similarly, Akinoğlu, B et al (2023) conducted a study on balance in male and female elite athletes and showed that female athletes had better balance abilities than male athletes. In addition, female athletes tend to rely more on visual input to maintain balance. Nonetheless, the study also showed that the rate of body weight transfer from male and female athletes to the right and left sides was similar, but male athletes had a more functional reach to the right side. The results of this study suggest that the fact male athletes have a greater functional reach to the right side, which is the dominant side, may be due to greater muscle strength in male athletes.

4. Conclusion

In summary, a review of various studies has identified differences in both static and dynamic balance between males and females. Some studies suggest that male may have greater instability in static balance than female, while others indicate that male may have better static balance. In terms of dynamic balance, some studies suggest that male may have better balance than female, while others state contrasting result. The divergent findings can be attributed to the diverse methods employed to measure static and dynamic balance in males and females. The commonality of some of the studies found is that gender does not directly affect balance but through various other factors such as muscle strength and maturational development. It is crucial to maintain these factors to enhance balance for individuals.

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