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THE POSITIVE EFFECT OF MODERATE PHYSICAL ACTIVITY ON BALANCE IN A HEALTHY POPULATION

L'EFFETTO POSITIVO DELL'ATTIVITÀ FISICA MODERATA SULL'EQUILIBRIO NELLA POPOLAZIONE SANA

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Abstract

Physical activity plays a key role in the well-being and health of people at all ages. It brings several benefits, by reducing the risk of cardiovascular disease in the elderly and the risk of injury caused by falls due to reduced stability. One of the benefits of physical activity, observable at all ages, is the improvement of static and dynamic balance. The aim of this preliminary study was to evaluate the balance condition in a population with a moderate level of physical activity compared to a sedentary group. Ten subjects practising moderate physical activity and 10 controls were recruited, and their balance was analysed, both with open and with closed eyes. The results showed that the group of those performing moderate physical activity had a reduction in the Centre of Pressure displacement, compared to the sedentary group. These data show that even when performing moderate physical activity there is a reduction in postural sways and thus an improvement in balance.

L'attività fisica gioca un ruolo chiave nel benessere e nella salute delle persone a tutte le età. Negli anziani, essa porta numerosi benefici, riducendo il rischio di malattie cardiovascolari e infortuni causate da cadute dovute da una ridotta stabilità. Uno dei benefici dell'attività fisica, osservabile a tutte le età, è il miglioramento dell'equilibrio statico e dinamico. Lo scopo di questo studio preliminare è stato quello di valutare la condizione dell'equilibrio in una popolazione sana che praticasse attività fisica di livello moderato e quello di un gruppo sedentario. Sono stati reclutati dieci soggetti che praticano un'attività fisica moderata e 10 controlli, ed è stata analizzata la loro capacità di mantenere l'equilibrio, sia ad occhi aperti che ad occhi chiusi. I risultati hanno mostrato che il gruppo di coloro che svolgono un'attività fisica moderata ha una riduzione della variazione del centro di pressione, rispetto al gruppo sedentario. Questi dati dimostrano che anche quando si svolge un'attività fisica moderata c'è una riduzione delle oscillazioni posturali e quindi un miglioramento dell'equilibrio.

Key-words

Physical Activity; Stability; Posture; Wellbeing
Attività fisica; Stabilità; Postura; Benessere

1. Introduction

Physical activity plays a pivotal role in health, contributing to physical and psychological well-being from the earliest years of life to old age(Friedman et al., 2008; Hardman & Stensel, 2009). During the developmental age, proper physical activity ensures the maintenance of an adequate body weight, promotes the harmonious growth of the body, prevents disease and, among the most important effects, develops motor skills, which are essential for development and activities of daily living throughout life(Kohl & Hobbs, 1998; Liparoti & Minino, 2021). In addition, physical activity is decisive in the development of psychological, educational, social

and inclusion processes (Di Palma et al., 2018; Liparoti, Madonna, et al., 2020). In fact, several studies confirm that physical activity induces beneficial effects not only on the motor aspect, but also on the brain, providing learning strategies for school-age children and improving school performance(Latino et al., 2020).

While physical activity can make an important contribution to development during childhood, it can also bring numerous benefits in the elderly population(Liparoti & Lopez, 2021). It is known to improve the quality of life, to slow down the ageing process and to prevent various diseases related to the cardiovascular and musculoskeletal systems, neurodegenerative diseases(Minino et al., 2020) and has a positive impact on the metabolism, reducing the occurrence of dysmetabolic diseases(Polverino et al., 2021; Russo et al., 2013; Sancassiani et al., 2018; Sorrentino et al., 2017). Another key benefit of physical activity in this population is the improvement of static and dynamic stability, reducing the risk of falls, which in turn leads to a considerable reduction in injuries and mortality(Minino et al., 2021; Troisi Lopez et al., 2021). In fact, according to the World Health Organisation (WHO) report, around 30% of the population over the age of 65 falls each year, a percentage that increases exponentially with age(World Health Organization, 2018).

Although the two age groups mentioned above are the ones that show the benefits of sport and physical activity most clearly, benefits are evident in young and adult age groups as well, maintaining an active lifestyle, regulating blood pressure, blood lipid concentration, and thus reducing the risk of obesity and related pathologies(Whelton et al., 2002). Several years ago, it was emphasised by researchers that sedentary lifestyle and low physical activity is associated with high mortality from cardiovascular diseases and colon cancer(Blair N., 1989). Furthermore, a study showed that a group of college students who practised physical activity during their free time showed increased longevity(Paffenbarger et al., 1986).

For what concern the stability, while in the elderly population the improvement of balance condition in people practising moderate physical activity has been widely studied and confirmed(Pau et al., 2014), this effect has been little investigated in young subjects.

Therefore, the aim of this work was to investigate the balance condition in a young population practising moderate physical activity and in a young inactive population, in order to evaluate the effect of mild physical activity on balance in healthy young subjects. Furthermore, taking into account that balance depends on the integration of different sensory information (through the visual, vestibular and sensorimotor systems), we repeated the same analysis with eyes closed, in order to evaluate how physical activity affects the postural stability of our samples even in a condition of reduced sensory information.

2. Materials and Methods

2.1 Participants

A group of 10 participants practising moderate physical activity (6m/4f; age: 24.6±2.1; education: 16; BMI: 22.5±2.7) and a group of 10 sedentary participants (5m/5f; age: 23.6±1.7; education: 16; BMI: 22.1±3.1) matched for age, gender, education and BMI has been recruited. The exclusion criteria were muscular, neurodegenerative and skeletal disorders. The division of the group into sedentary and physically active persons was achieved by administering the International Physical Activity Questionnaire (IPAQ) short form (Italian version) (Mannocci et al., 2010). According to the questionnaire, active people are those who practice moderate physical activity (with an energy expenditure of between 3.5 and 6 METs), while inactive people are those who do not practice physical activity (with an energy expenditure of less than 3.5 METs).

The balance analysis was carried out in the Motion Analysis Laboratory of the University of Naples 'Parthenope', using a force platform (Kistler-9260AA) and a stereophotogrammetric system (ProReflex Unit-Qualisys Inc., Gothenburg, Sweden)(Liparoti, Lopez, et al., 2020; Sorrentino et al., 2016). Four passive markers were placed on each foot, in order to reconstruct the base of support (BoS). Recordings were repeated with both eyes open (OE) and closed eyes (CE)(Liparoti, 2021a). Prior to acquisition, participants were instructed to remain on the force platform, looking at a fixed point in front of them (in the OE condition) and with their eyes closed (in the CE condition) until the end of the recording. The parameters investigated were the medio/lateral(M/L) and anteroposterior (A/P) oscillations, the Sway Path and the Area of the ellipse at 90% confidence.
Statistical analysis was performed on MATLAB (Mathworks, version R2020b). Statistical comparison between the two groups was performed using a Permanova test, and then, a post-hoc analysis was performed between each group and each condition, using the Permutation test. The p-values were corrected for multiple comparisons, using the False Discovery Rate (FDR) method.

3. Results

In order to investigate the differences of balance between active and sedentary groups, it has been performed a Permanova test. From this first comparison, two of the four parameters analysed were significant, the Sway Path ($p < 0.05$) and the Area of the ellipse at 90% confidence ($p < 0.001$). No statistically significant difference was obtained with regard to M/L and A/P oscillations.
Subsequently, a post hoc analysis was performed to assess which comparison between groups and between conditions was statistically significant.
Regarding the OE condition, the comparison between the active and the sedentary group showed significant differences in two parameters. Indeed, it can be seen a reduced Sway Path ($p < 0.05$) and Ellipse area of 90% confidence ($p < 0.001$) in the active group compared to the control group.
During the CE condition, the comparison between the two groups analysed, highlighted a significant differences in the Sway Path ($p < 0.05$) and for Ellipse area of 90% confidence ($p < 0.05$) as well.

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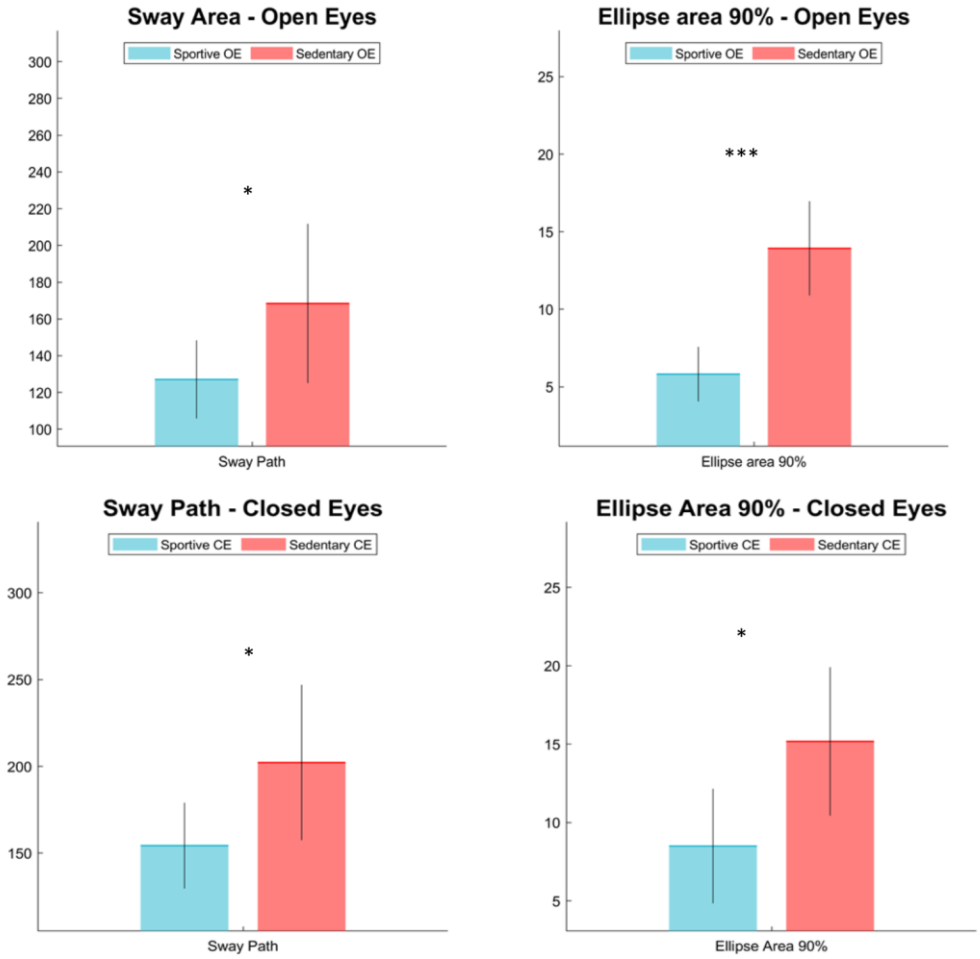
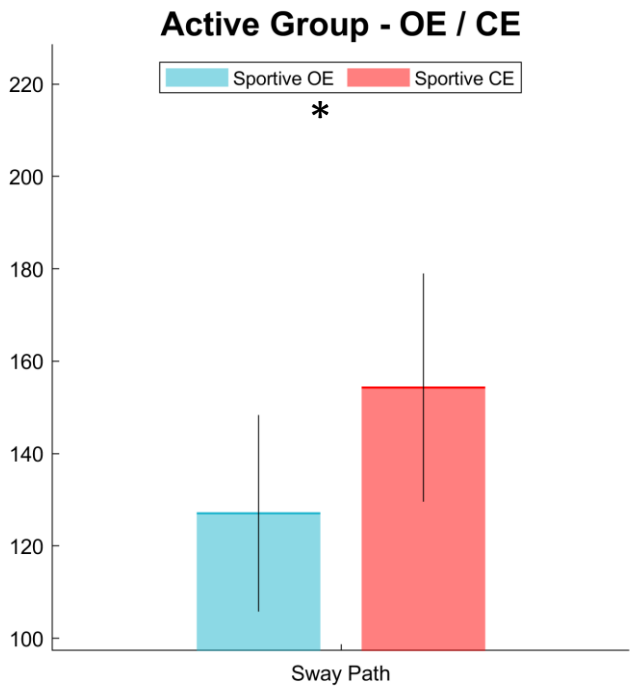


Graph. 1 Histograms of the Sway Path and of the Area of the Ellipse 90% when comparing the active and the sedentary groups in the open (OE) and closed eyes (CE) conditions. Significance p value: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

In addition, the results also showed significance when comparing the two conditions (OE and CE) in the active group with regard to the Sway Path parameter, showing a reduced Sway Path in the OE condition compared to the CE condition ($p < 0.05$).



Graph. 2 - Histogram of the Sway Path when comparing the open (OE) and closed eyes (CE) condition in the active group. Significance p value: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4. Discussion

The present work aimed to compare the capacity of maintaining balance of a group of young people practising physical activity with a group of sedentary young people. Our results showed a clear improvement in the balance of the active compared to the inactive group. Indeed, our data showed a reduction in both Sway Path and Ellipse area at the 90% confidence level in the active group compared to the control group. Although studies on the effects of moderate physical activity on the ability to maintain balance focus more on elderly populations or elite athletes, our results are supported by previous studies, demonstrating the positive effect of physical activity on static stability(Skelton, 2001). Tsang et al. investigated the effect of Tai Chi practice on the ability to maintain balance, finding that Tai Chi practitioners had better knee muscle strength, less body sway in perturbed single-leg stance, and greater balance confidence(Tsang & Hui-Chan, 2005). Also Zhu et al., analysed the effect of physical activity on balance, highlighting that moderate and vigorous physical activity and a reduced sedentary behaviour promote static balance in young adults(Zhu et al., 2021).
Furthermore, in addition to the baseline condition, this work also showed that the group of people practising moderate physical activity had a reduction in postural oscillations with eyes closed compared to the sedentary group. Thus, there seems to be an improvement in stability even in the absence of visual afferents, which are widely recognised as important in maintaining balance. These results are confirmed in literature, such as in the research of Gauchard et al.

Indeed, they reported that, although a group of karate practitioners showed a worsening of balance in the closed-eyes condition, this worsening was significantly reduced compared to a sedentary group(Gauchard et al., 2018).
Finally, the results also showed a significant difference when comparing the OE and CE condition in the active group, indicating an increase in the Sway Path with closed eyes compared to with open eyes. Conversely, no significant difference between the two conditions was shown in the sedentary group. This could be due to the fact that while subjects practicing physical activity show an improvement in the ability to maintain balance, sedentary subjects, although young and healthy, present a basal condition more similar to that with eyes closed, and therefore more unstable.

Conclusions

In conclusion, our data confirm that physical activity, even at a moderate level, improves balance and stability also at a young age, and not only in the elderly or pathological population. This improvement can be observed both in a baseline condition (open-eye condition) and during a more complex balance maintenance task (closed-eye condition).
Some limitations of this study need to be mentioned. Firstly, the small samples size. Indeed, an increase in the number of participants would be necessary to confirm our preliminary results. A further limitation of this study is that the group includes different types of physical activity, thus not taking into account the differences that each activity entails.
Future studies could investigate balance in relation to different types of sport and physical activity, to see if there is a type of sport activity that has more beneficial effects on stability(Liparoti, 2021b).

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