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Could Mini-Trampoline Training Be Considered as a New Strategy to Reduce Asymmetries?

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Abstract: Inter-limb asymmetry is defined as the performance imbalance of a limb with respect to the other one. Studies demonstrated how plyometric training could minimize inter-limb imbalance by reducing asymmetries and the relative risk of musculoskeletal injuries. Among the different plyometric training modalities, SuperJump® represented a reliable method. This study aimed to evaluate the acute effects of SuperJump® training on dynamic balance Unilateral Asymmetry and Bilateral Asymmetry Indexes. Thirty-seven subjects were randomly allocated in two groups: SuperJump® (N = 20) and Control (N = 17). The SuperJump® group participated in the SuperJump® session, whereas the Control group did not receive any workout session. Before (PRE) and after (POST) the SuperJump® session, both groups performed the Wobble Board balance test. A significant difference ($p < 0.003$) between the SuperJump® in POST and Control groups in PRE intervention for dominant leg was found. No significant differences ($p > 0.05$) emerged between groups in testing time on Bilateral Asymmetry Index. Significant differences ($p = 0.005$) between PRE and POST in the SuperJump® group and an 18.9% Unilateral Asymmetry Index threshold reduction for the subjects were found. A strong relationship ($R^2 = 0.79$) between delta (Δ) change Unilateral Asymmetry Index and Unilateral Asymmetry Index baseline parameters was tested. Lastly, no significant differences ($p > 0.05$) in Unilateral Asymmetry Indexes between the Bilateral Asymmetry equal and change categories in the SuperJump® group was found. In conclusion, SuperJump® training played a key role in reducing Unilateral Asymmetry Index.

Keywords: plyometrics; musculoskeletal equilibrium; postural control; motor skills; college students

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1. Introduction

The inter-limb asymmetry or inter-limb imbalance describes the concept of comparing the function (i.e., strength, balance) of a limb respect to the other [1]. Recently, the inter-limb asymmetry concept has been fully investigated, with inconsistent findings, particularly related to physical health and sporting performances [1]. Asymmetries between legs are influenced by several factors such as lateral dominance (left vs. right), injuries and sport specificity [2–4]. In particular, leg dominance is an important factor both in sports and in everyday tasks [5]. It leads to an increase in asymmetry magnitude and can contribute to the development of injuries, thus influencing sport and everyday tasks [6]. The type of activity in which the athlete is engaged and the training volume of sport exposure influence the magnitude of asymmetry [3,7]. In fact, team-sport athletes exhibit significantly greater inter-limb asymmetries values with respect to non-athlete, due to the large number of unilateral actions such as jumping and changes in direction [2,7].

In this context, training programs should be structured aiming to eliminate or limit the asymmetries in order to avoid negative effects on health and performances of athletes and non-athletes on the long-term. Previous research demonstrated how training strategies, such as balance training, resistance training and warm-up programs, could minimize inter-limb asymmetries and the relative risk of injuries [4,8,9]. Furthermore, studies show that plyometric training could contribute to improve several sports/physical domains as vertical jump performance, acceleration, leg strength, muscular power and postural control [10,11]. Among the different plyometric training modalities, an effective method is represented by mini-trampoline training as it has been shown to increase lower body strength, bipodalic static and dynamic balance, and coordination in young subjects [12–14]. Among the mini-trampoline activities, in 2009, the American fitness teacher Jill Cooper developed the SuperJump® training (SJ) comprising aerobic and anaerobic exercises alternating upper and lower limbs performed to the rhythm of music. SJ training facilitates the reduction in body mass (−5%) and fat mass (−7%), the improvement of the lipid profile with the reduction in low-density lipoprotein (−28%), and the reduction in bone resorption (+34%) and parathyroid hormone (−23%) [15,16]. Despite the beneficial acute and chronic effects of SJ on several physical outcomes, no study has yet investigated its acute effects on dynamic balance performances and balance inter-limb asymmetries in young subjects. Therefore, this study aimed to evaluate the acute effects of SJ training on dynamic balance performance and Bilateral Asymmetry (BA) and Unilateral Asymmetry (UA) Indexes in healthy young adults. Based on the positive effects of SJ on health-related domains, it could be hypothesized that SJ training might represent a good strategy in reducing dynamic BA and UA Indexes, providing an enjoyable and alternative training modality for both subjects and health specialists and/or coaches.

2. Materials and Methods

2.1. Study Design

Following the Declaration of Helsinki, the study was approved on 4 December 2019 from the Institutional Review Board of the Department of Human Sciences, Society, and Health of the University of Cassino and Lazio Meridionale (approval Number 26898) to examine the effects of the SJ training on subjects' balance performance, BA and UA. All participants were asked to read and sign the consent form. Subjects were able to withdraw from the study at any time for any reason, without any consequences.

BA and UA Index are commonly used in strength and conditioning investigations, particularly when performing countermovement, vertical, repetitive and unilateral jumps. These methodologies are the most used in laboratory and field settings, due to their being easily exposed to several populations, effectiveness and low costs. Since they only focused on strength, a new methodological approach, represented by the SJ training, was preferred in this study to fill the lack of scientific evidence in evaluating dynamic BA and UA Indexes. Considering that mini-trampoline training includes both the characteristics of the stretching–shortening cycle and the displacements of the center of gravity due the elastic material of the surface, which characterize any type of plyometric training, it could provide more information with respect to countermovement, vertical, repetitive or unilateral jumps. Thus, to establish whether dynamic BA and UA Indexes could be modified by SJ training, the assessment of dynamic balance was performed before (PRE) and after (POST) SJ training.

2.2. Participants and Procedures

A total of sixty apparently healthy college students voluntarily participated in this study and received all information about the procedures and the aim of the study. Subjects were excluded if they reported pre-existing condition such as neurological condition, cardiovascular, respiratory, and/or metabolic diseases, hypertension previously diagnosed, osteoporosis, musculoskeletal injury of the back or lower extremities occurred during the past year, visual and vestibular disorders that could influence their balance ability, left-handed subjects and previous experience in SJ. Subjects were included if reporting to be minimally active according to International Physical Activity Questionnaire (IPAQ).

Before starting the testing session, subjects' anthropometric characteristics were collected. Height and body mass were measured to the nearest 0.1 cm and 0.1 kg, respectively, by using a scale with an integrated stadiometer (Seca 709, Vogel & Halke, Hamburg, Germany). Body mass index (BMI) was subsequently calculated and reported as weight (kg)/height (m^2). Subjectively preferred dominant leg was also defined as the leg preferred when stepping on a platform [17]. The Italian version (7 items) of the IPAQ was also administered to determine the individual level of physical activity (PA) [18]. In the present study, physically active subjects were included. As proposed by the IPAQ Scoring Protocol, subjects had to meet at least one of the following criteria to be classified as minimally active: 3 or more days of vigorous activity of at least 20 min per day; 5 or more days of moderate-intensity activity or walking of at least 30 min per day; or 5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 600 metabolic equivalent task (MET) min/week.

From a total of sixty subjects, twenty were excluded due to not meeting the inclusion criteria. Subsequently, the forty subjects were randomly allocated in two groups: twenty in SJ group (SJG) and twenty in the Control group (CON). Three subjects in CON discontinued the study without any specific reason. Twenty subjects in the SJG and seventeen subjects in the CON were finally analyzed (Figure 1). SJG participated in the SJ training session, whereas CON did not receive any training session. Before (PRE) and after (POST) SJ training session (intervention), both groups performed balance test (described in Section 2.4).

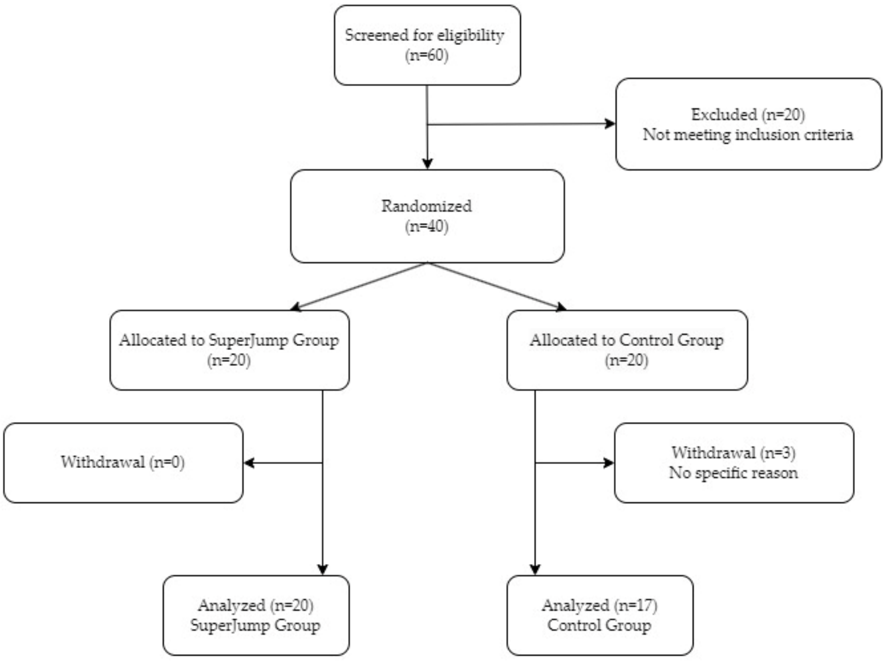

Figure 1. Flow chart of the recruitment and selection process of the subjects included in the study.

During testing and training sessions, to ensure the safety of each individual, physical exercise experts took care of the subjects' due precautions, such as soft surfaces and various aids (i.e., mats).

2.3. SuperJump® Training

SJ was performed on a mini-trampoline (CoalSport, Rome, Italy) with the diameter of the elastic surface of 122 cm. The SJ training session included a session of free practice on the mini-trampoline and 30 min of workout. During the warm-up (5 min) and cool down (5 min) phases, subjects were required to continuously jump on the mini-trampoline while performing breathing and mobility exercises. During the central phase (20 min), consisting of jumping exercises and movements of the upper body, they performed the following exercises: double leg hops, single leg hops, alternated double leg hops on sagittal and frontal plan; single leg and double leg lateral hops, jumping jack, double leg hops with wide and close stance; wide to close-stance double leg hops. Subjects also performed hops alternating upper limb movements, such as hops with shoulder front and lateral raises, straight-arm push down, lateral elbow extension and flexion and alternating arms swing. The video workout was displayed on a computer screen, placed in front of the mini-trampoline, and the subjects had to follow the instructions. To monitor exercise intensity, rating of perceived exertion (RPE) was assessed by means of the Category-Ratio 10 (CR-10) scale 30 min after the end of the training session, in line with similar studies [19,20].

2.4. Wobble Board Balance Test

A Computerized Wobble Board (WB) (Well Sport Project, G.S.J. Services S.r.l., Rome, Italy) was used in the present study to collect WB balance performance data. WB consists of a circular wooden surface with a diameter of 40 cm placed on a plastic semispherical support with a diameter of 12 cm and a height of 6 cm, containing a tri-axis accelerometer (Phidget Spatial 0/0/3 Basic 1041, Phidgets Inc. 2016, Calgary, AB, Canada) to measure tilt angles (maximal tilt angle = 20°). A USB cable connected to a computer facilitated data collection (sampling frequency: 200 Hz) and real-time display of the WB tilt angle. Real-time performance was displayed on a monitor (resolution = 1920 × 1080) and was represented by a yellow motion marker (MM). The WB software (W.S.P. version 1.0.0.1; G.S.J. Service S.r.l., Rome, Italy) user interface also displayed a target zone (TZ) representing the stability area (tilt angle = 0°), and a countdown. The balance performance counter becomes active when the MM is into the TZ for at least one second (integer is the only number recorded, not second fractions). The software allows the user to calibrate the platform on 5 different levels: easy, medium, sportive, agonist and elite agonist. For the testing procedures, software level was set on easy mode (diameter = 6.5 cm), following the validated protocols [21–24].

The WB test included 3 min of free familiarization with the platform and 1 min of rest in sitting position followed by one attempt of thirty seconds per lower limb with 1 min of rest in seated position in-between. Subjects were required to stay barefoot on the unstable platform, in a single leg stance, by adopting a comfortable and central position of foot, knee slightly bent and hands on their hips. The subjects were asked to focus on the MM and try to minimize its displacement with the aim of keeping it inside the TZ as long as they could. Starting limb chosen was completely random.

The test trial was interrupted and repeated if the subjects: (1) touched the floor with the raised leg; (2) used the arms as support; (3) braced the raised leg against the contralateral leg; and (4) dropped off the WB. WB balance performance was defined as the time (s) the MM was maintained into the TZ over the recording period.

2.5. Bilateral Asymmetry Index and Unilateral Asymmetry Index

To evaluate the magnitude of balance BA between dominant and non-dominant leg, the BA Index was calculated as follows [1]:

$$(\mathrm{dl} - \mathrm{ndl})/(\mathrm{dl} + \mathrm{ndl}) \cdot 100 \tag{1}$$

where dl represents the dominant leg, and ndl indicates the non-dominant leg.

The outcome extrapolated from the formula is represented as a vectorized percentage with positive values indicating that the dominant limb is preferred, whereas negative values favor the non-dominant limb.

Furthermore, to analyze the UA Index the following formula was used [1]:

$$[(100/\mathrm{high} \cdot \mathrm{low}) \cdot -1] + 100 \tag{2}$$

where high and low correspond to the greater and lower values of the WB balance performance, respectively.

2.6. Statistical Analysis

Normal distribution was verified by Shapiro–Francia test, showing normal distribution. Means, standard deviations (SD) and 95% confidence intervals (95% CI) were calculated for all variables. Statistical analyses were performed using STATA (Version 14.2; StataCorp LLC, College Station, TX, USA). Linear repeated-measures mixed model analyses were performed to examine the effects of the SJ training on subject's WB performance, BA and UA Indexes. In the model, subjects were considered as random effect, whereas the intervention (SJG vs. CON) and testing time (PRE vs. POST) were treated as fixed effect. The models were fitted using the residual maximum likelihood to account for the small sample. The repeated-measures Analysis of Variance (ANOVA) was used for computing the degrees of freedom of at distribution, as the subjects were tested PRE and POST intervention. Subsequently, the contrast method was used to test whether the dependent variable means of SJ, CON and testing time (PRE and POST) were identical. When significant main effects and interactions were found, post hoc analysis was applied using Bonferroni correction. In order to avoid type 1 error, after Bonferroni correction, for the linear repeated-measures mixed model, significance was set at $p < 0.05$ for the main effects and at $p < 0.008$ for post hoc pairwise comparisons.

The magnitude of the difference was also determined using Cohen's d effect sizes (ES). In line with similar research, an ES value less than <0.20 = trivial; 0.20–0.60 = small; 0.61–1.20 = moderate; 1.21–2.0 = large and >2.0 = very large [25].

Subsequently, only for the SJG, linear regression analysis was used to test the relationship between PRE UA Index values and UA delta (Δ) change to determine if UA asymmetry changes were related to baseline parameters. The Δ change were calculated as the difference between PRE exercise and POST exercise UA index values. Lastly, for analyzing a possible influence of the SJ training on the BA index, the relative changes in the BA index between PRE and POST were classified into two categories: (1) no change from PRE to POST (equal); (2) change from PRE to POST (change). Subsequently, one-way ANOVA was used to assess difference in the UA index Δ change between the two BA categories. For these analyses the level of significance was set at $p < 0.05$.

3. Results

Anthropometric characteristics of subjects are presented in Table 1.

Table 1. Means and standard deviations of the subjects' characteristics.

	SJG			CON		
	Female	**Male**	**Total**	**Female**	**Male**	**Total**
N	10	10	20	6	11	17
Age (years)	24.1 ± 0.9	27.1 ± 2.8	25.6 ± 2.6	23.2 ± 1.6	23.5 ± 1.8	23.4 ± 1.7
Body height (m)	1.6 ± 0.1	1.7 ± 0.1	1.7 ± 0.1	1.6 ± 0.1	1.8 ± 0.1	1.7 ± 0.1
Body weight (kg)	57.2 ± 6.9	72.4 ± 11.4	64.8 ± 12.0	53.5 ± 7.8	72.7 ± 8.3	65.9 ± 12.3
BMI ($kg \cdot m^{-2}$)	22.5 ± 2.3	24.3 ± 2.7	23.5 ± 2.6	20.9 ± 2.8	23.6 ± 2.7	22.6 ± 2.9

SJG = SuperJump® group; CON = Control group; N = number; BMI = body mass index.

Subject rated the SJ session as 'somewhat hard' (mean RPE = 3.5) to the (CR-10) scale, corresponding to 12–13 on the 6–20 RPE scale [26], indicating a moderate intensity exercise [27].

The linear repeated-measures mixed model analysis showed a significant main effect ($F_{(3,35)} = 3.50$; $p < 0.044$; 95% CI = 0.11–7.28) between PRE and POST intervention for the WB balance performance on the dominant leg (Table 2), independently from the group (ES = 0.34). After Bonferroni correction, significant differences ($p < 0.003$; 95% CI = 2.30–11.04) were found between the SJG in POST and CON in PRE intervention. No significant differences ($F_{(3,35)} = 2.35$; $p > 0.05$) between groups during PRE and POST evaluation for the WB balance performance on the non-dominant leg were found.

Table 2. Means and standard deviations of Wobble Board performances for dominant and non-dominant leg and SuperJump® training on the Bilateral Asymmetry Index between testing time by group.

	SJG (N = 20)		CON (N = 17)	
	PRE	POST	PRE	POST
Dominant leg (s)	18.5 ± 6.4	22.2 ± 6.8 *	15.5 ± 7.1	16.3 ± 6.8
Non-Dominant leg (s)	18.0 ± 8.3	20.5 ± 5.9	15.5 ± 5.3	18.7 ± 6.1
BA Index (%)	6.11 ± 36.43	3.39 ± 13.57	−2.50 ± 26.47	−7.93 ± 21.18

SJG = SuperJump® group; CON = Control group; N = number; s = second; BA = Bilateral Asymmetry; % = percentage. * significantly different from PRE values of the CON group.

No significant differences ($F_{(3,35)} = 1.07$; $p > 0.05$) were found between SJG (ES = 0.09) and CON (ES = 0.22) groups in testing time (PRE and POST) on BA Indexes (Table 2).

The linear repeated-measures mixed model analysis also showed significant differences ($F_{(3,35)} = 3.29$; $p = 0.005$; ES = 0.87) for UA Index between PRE and POST in the SJG (Figure 2). Furthermore, the model identified an 18.9% UA threshold reduction for the subjects.

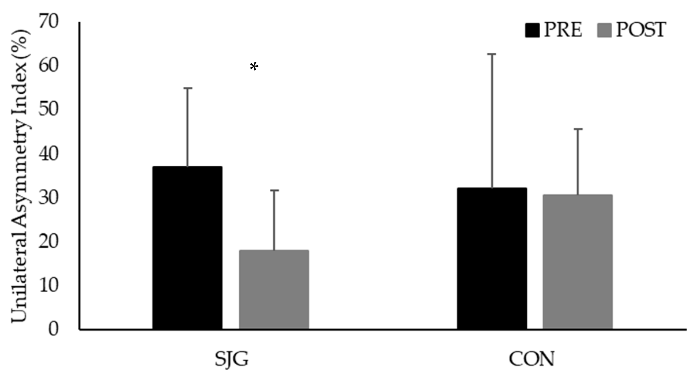

Figure 2. Means and standard deviations of Unilateral Asymmetry Index between SuperJump® (SJG) and Control (CON) groups before (PRE) and after (POST) the training session. * significantly differences for SuperJump® group between testing time.

Linear regression analysis ($R^2 = 0.79$, $p < 0.0001$) was performed to test the relationship between Δ change UA Index and UA Index baseline parameters (Figure 3). Findings indicated that subjects with higher baseline values of lower-limb asymmetry had higher Δ change for UA Index after the SJ training.

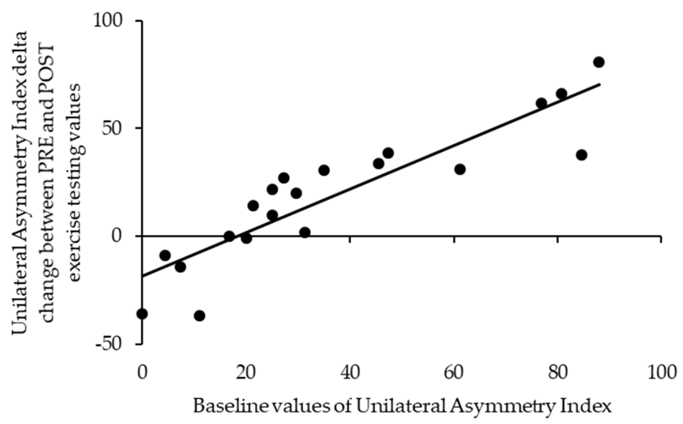

Figure 3. Delta change between before (PRE) and after (POST) the exercise testing values for Unilateral Asymmetry Index ($R^2 = 0.79$, $p < 0.0001$).

One-way ANOVA analysis showed no significant differences ($p > 0.05$; ES = 0.22) in UA Indexes between the BA equal category and the BA change category in the SJG (Figure 4).

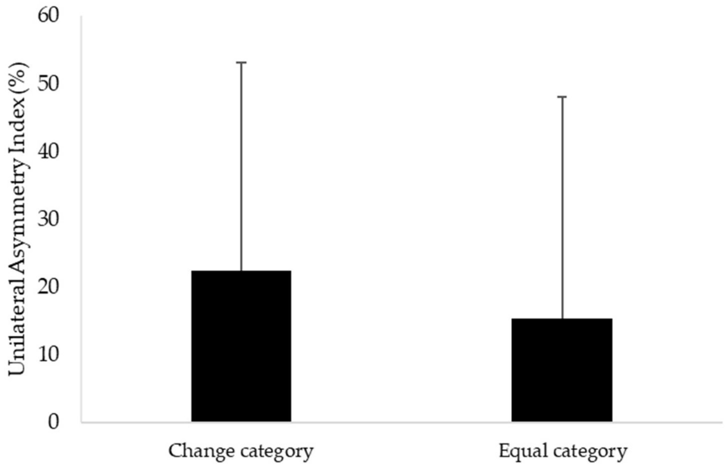

Figure 4. Means and standard deviations of Unilateral Asymmetry Index between the Bilateral Asymmetry equal and change categories.

4. Discussion

This study aimed to investigate the effects of the SJ training on subject's dynamic balance performance and to observe BA and UA Indexes acute changes after the SJ training intervention in healthy young adults.

The relevant findings of the present study suggested that SJ training positively affected the UA Index for the SJG, by significantly reducing the lower limb balance asymmetry. Furthermore, considering the relationship between the UA Index Δ change and UA Index baseline values, results showed that subjects with higher UA Index baseline values had higher UA Index Δ change after the SJ intervention. On the other hand, a marginal and not significant effect of the SJ on BA Index was found.

Plyometric training, such as repetitive jumps, represents a dynamic form of resistance training that involves displacements of the center of gravity resulting in improved dynamic postural control [28,29]. Thus, SJ training preserves both the characteristics of the stretching–shortening cycle and the displacements of the center of gravity, which characterize any type of plyometric training. It has been shown that plyometric training had chronic effects on the dynamic balance of young athletes in basketball [30,31] soccer [32], and rhythmic gymnastics [33]. Alongside this, few studies have investigated the acute effects of plyometric training on the balance performance of young athletes in weightlifting [34], volleyball [35] and football [36] or in recreationally trained individuals [37]. Although dynamic balance is considered a physical ability that requires long-term intervention training protocols in order to be improved, different studies have indicated that a single plyometric intervention has the potential to improve balance performance [34]. In line with these previous studies, findings from the present study confirmed that SJ training acutely improved WB performances. In fact, the main difference was observed between the SJG in POST (22.2 ± 6.8 s) and CON in PRE (15.5 ± 7.1 s) intervention for the WB balance performance on the dominant limb with respect to the non-dominant one. Recently, Fusco and colleagues [21] have fully investigated the minimal detectable change values to determine significant changes in dynamic performance on the WB. Accordingly, the emerged mean difference of 6.7 s between the POST intervention of the SJG and PRE intervention of the CON might be considered a real change in WB dynamic balance performance. Therefore, these results suggested that SJ training could be considered in training programs to acutely enhance dynamic balance. However, further research to evaluate the acute effect of SJ on the dynamic performance assessed by WB in several populations is needed.

Repeated jumps training may also cause fatigue and joint instability by negatively affecting postural control and increasing the BA Index [38]. In line with this assumption, a previous study showed that excessive jumps training cause muscle fatigue, decrease the concentric peak power and the stretching reflex and increase the magnitude of the BA Index in young athletes [39]. On the contrary, despite the 30 min of SJ workout performed in our study, no significant differences in BA Index between SJG and CON groups in PRE and POST evaluation were found. These results might be due to the selected workout. In fact, although the selected workout was standardized in terms of execution, performing repetitive jumps on a mini-trampoline may not have influenced the magnitude of BA Index. Thus, accurately selecting the type of plyometric training and type of surface where the jumps are executed might decrease the effects of fatigue on BA and consequently reduce the performance loss during balance dynamic performances.

The literature identified that a UA threshold of >15% is considered as the real UA [1,40]. Previous research has also highlighted that both athlete and non-athlete populations who exhibit values in the asymmetry threshold >15% have been associated with increased musculoskeletal injury risk for lower limbs when comparing to subjects who scored below this threshold [3]. However, due the variability in asymmetry, it seems premature for specialists providing the standardized threshold above which the rate of musculoskeletal injuries increases. Indeed, this threshold could differ depending on the morphological demands of the sport/physical performance itself, given the individual demands of each subject [41]. Among these physical activities, jumping, kicking and cycling have been indicated as detrimental to performances by increasing the inter-limb's difference [3]. Although in the present study, the SJG had beneficial effects on UA Index by showing a reduction in UA of 18.9% between PRE and POST intervention, only a few participants had an asymmetry threshold lower than 15%. Therefore, considering that the effect of repetitive jumps on the elastic mini-trampoline played a key role in decreasing UA, and in light of the beneficial effects of SJ, health specialists may consider incorporating repetitive jumps on elastic platforms into their training to acutely reduce lower limb UA and the associated injury risks. Furthermore, when testing the relationship between the difference in PRE exercise and POST exercise UA Index values with UA Index baseline parameters for the SJG, subjects with low baseline values had a minimal or detrimental effect on the UA Index Δ change. Thus, they tended to slightly improve or did not improve their UA Index after SJ training. However, subjects with higher UA Index baseline values tended to decrease their UA Index Δ change POST exercise with significant improvements. When considering the results of the present study, health specialists could consider encouraging mini-trampoline training for athletes or untrained subjects who present higher baseline UA values, in order to decrease the UA and the risk of injury with respect to subjects who present lower baseline values.

Research has highlighted the importance of monitoring not only the magnitude of the asymmetries but also their directions [42]. The direction of asymmetry is commonly referred to the stronger-performing limb (dominant vs. non-dominant and left vs. right) during a task, such as the leg jumping higher during a unilateral jump task [43]. This asymmetry variability has also been observed in squats, countermovement jumps and drop jumps in youth soccer athletes, concluding that the dominant limb is stronger than the non-dominant one [44]. In the present study, only for the SJG, two BA categories (equal and change) were created, in order to determine if subjects displaying a change in BA index needed a higher or lower reduction in UA Index. The equal category represents subjects with no difference in BA Index from PRE to POST, whereas the change category represents those having difference in BA Index from PRE to POST. Findings from the present study did not highlight a significant difference between the two BA categories (equal and change). This could mean that the total reduction in UA was similar between subjects that maintained the same direction of asymmetry (equal category) and the subjects that change the direction of asymmetry (change category). These findings could indicate that structured training programs aiming at eliminating or limiting the asymmetries of athletes and non-athletes, should not focus on the execution of exercises for the weaker-performing limb only. Rather, not well-tailored training programs, such as monopodalic-only training, could lead to a change in the direction of asymmetry, and then move from the dominant limb to the non-dominant one or conversely, by not achieving improvements in UA. Therefore, exercises that focus on the execution of both limbs, such as SJ training, could represent an important method in improving UA in healthy young and athlete populations, independently from the direction of asymmetry.

Although this study provided some insights, some limitations need to be acknowledged. Only young adults who declared themselves to be minimally active were included. Therefore, populations with different PA levels and ages, such as sedentary and athletes, children and older, should be evaluated. Moreover, healthy individuals were enrolled. Therefore, future studies should also involve subjects with lower limb injuries or patients with dysfunctions such as Parkinson's and Alzheimer's, by ensuring the due precautions (i.e., safety) and modifications (i.e., shorter training duration, lighter exercise intensity, etc.). Finally, the present study only focused on the acute effects of SJ, and therefore, future studies should examine the chronic effects of mini-trampoline SJ training on balance UA and BA Indexes.

5. Practical Applications

The findings showed how SJ training had different effects on balance UA and BA Indexes. SJ reduced UA percentage, by giving to health specialists an alternative method to train their subjects, based on the settled individualized aims. Based on the abovementioned results, practitioners and health coaches might choose the SJ training to reduce UA Index in subjects at risk of lower limb injuries or adopt the SJ method during the warm-up of specific sport disciplines in order to increase specific dynamic balance performances that require a high involvement of the dominant limb.

6. Conclusions

Studies widely demonstrated how plyometric training could minimize inter-limb imbalance by reducing asymmetries and the relative risk of sport or physical-related injuries. However, to date, this is the first study aiming at evaluating the effect of SJ on dynamic balance UA and BA Indexes, and it could have a high impact on training and evaluations protocols both in field and laboratory settings. In particular, the findings from the present study suggested that SJ training has the potential to reduce the UA Index in healthy subjects. In addition, the results indicated that subjects with higher baseline values of lower-limb asymmetry had a higher Δ change for the UA Index after the SJ training, suggesting that coaches and health specialists could consider encouraging the use of mini-trampoline training for athletes or untrained subjects at highest risk of musculoskeletal lower-limb injuries.

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Institutional Review Board Statement: The study was approved on 4 December 2019 from the Institutional Review Board of the Department of Human Sciences, Society, and Health of the University of Cassino and Lazio Meridionale (approval Number 26898).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data acquired and analyzed in the present study are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflict of interest.

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