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VERTICAL JUMP OF THE MALE VOLLEYBALL PLAYER DURING THE YEARS OF 1970 TO 2016 - INDOOR AND SAND DOUBLE: A SYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT

The objective of the systematic review and of the meta-analysis was to determine the improvement of the vertical jump during the years or not and compare the vertical jump of the volleyball players versus the double players practiced in the sand. This study followed the methodology proposed the PRISMA statement. The studies were identified in electronic databases during January of 2017 to February of 2017. The author used the FIOCRUZ library to collect some scientific articles. Of these studies, 51 studies were included in this research. The best CMJ of the systematic review was of the double volleyball with 89 ± 7.25 cm. But the best CMJS (81.7 ± 8.83 cm), the best SPJ (97.63 ± 7.32 cm) and the best BJ (78.6 ± 6.30 cm) were of the years 70 to 90 of the indoor volleyball. The Shapiro Wilk test detected no normal data of the effect size. Kruskal Wallis Anova and new statistical detected statistical difference of the CMJ of the years 70 to 90 (effect size of 6.07 ± 6.68) versus the CMJ of the years 10 to 16 (ES of 0.86 ± 1.14) and of the years 00 to 16 (ES of 1 ± 1.13). In conclusion, the years 70 to 90 the CMJS, the SPJ and the BJ of the volleyball players had a higher jump than other years, but these results are not conclusive because of the limitations of the study.

Key words: Sports. Training. Volleyball. Vertical Jump.

RESUMO

Salto vertical do jogador do voleibol masculino durante os anos de 1970 a 2016 - quadra e dupla na areia: uma revisão sistemática e meta-análise

O objetivo da revisão sistemática e da meta-análise foi de determinar a melhora do salto vertical durante os anos ou não e comparar o salto vertical do jogador de voleibol versus o jogador de dupla na areia. Esse estudo seguiu a metodologia proposta pelo PRISMA. Os estudos foram identificados na base de dados no período de janeiro de 2017 a fevereiro de 2017. O autor usou a biblioteca da FIOCRUZ para coletar alguns artigos científicos. Desses estudos, 51 pesquisas foram incluídas nessa investigação. O melhor CMJ da revisão sistemática foi do voleibol de dupla com 89 ± 7,25 cm. Mas o melhor CMJS (81,7 ± 8,83 cm), o melhor SPJ (97,63 ± 7,32 cm) e o melhor BJ (78,6 ± 6,30 cm) foi dos anos 70 a 90 do voleibol. O teste Shapiro Wilk detectou dados não normais do tamanho do efeito. O tamanho do efeito do CMJ teve o seguinte resultado: anos 70 a 90 do voleibol com 6,07 ± 6,68, voleibol de dupla (03 a 14) praticado na areia com 4,33 ± 3,14, anos 00 a 09 do voleibol com 1,15 ± 1,15, anos 10 a 16 do voleibol com 0,86 ± 1,14 e anos 00 a 16 do voleibol com 1 ± 1,13. Anova de Kruskal Wallis e nova estatística detectaram diferença estatística do CMJ dos anos 70 a 90 (tamanho do efeito de 6,07 ± 6,68) versus o CMJ dos anos 10 a 16 (TE de 0,86 ± 1,14) e dos anos 00 a 16 (TE de 1 ± 1,13). Em conclusão, os anos 70 a 90 o CMJS, o SPJ e o BJ dos jogadores de voleibol tiveram um salto elevado do que os outros anos, mas esses resultados não são conclusivos por causa das limitações do estudo.

Palavras-chave: Esporte. Treino. Voleibol. Salto Vertical.

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INTRODUCTION

The skills of the volleyball and of the double volleyball (practiced in the sand) more decisive for the team get the win are the attack, the block and the server (Grgantov, Katric and Marelic, 2005; Marques Junior, 2015; Mesquita and collaborators, 2013; Oliveira and collaborators, 2016), but the volleyball player prefer the jump serve because they practice more points (Marques Junior, 2013, 2015b).

Therefore, the jump of the volleyball player competed on the court and in the sand is an action important during the game because a high jump causes an improvement in the most decisive techniques with the victory of the volleyball (Peeri and collaborators, 2013; Turpin and collaborators, 2014).

The vertical jump is an action very researched in volleyball (Iglesias, João and Tormo, 2016; Rezende and collaborators, 2016), the elite male volleyball player has a jump during the spike of 70 centimeters (cm) to 1 meter or more and the block jump the results is lower (Marques Junior, 2015c).

But the jump of the sand volleyball player during the spike is of 60±2,7 cm (Tilp, Wagner and Müller, 2008) and the block jump is of 46,90±8,80 cm (Bishop, 2003).

The best jump the volleyball literature documented was of the Cuban player Diego Lapera of 1,35 m during the attack (Barros Júnior, 1979). Lapera had 1,81 meters (m), played of outside hitter and was the bronze medalist in the Olympics of 1976 (see Diego in https://www.youtube.com/watch?v=yOMHHEWS5SA&sns=fb).

Therefore, the good vertical jump is important for the volleyball player because the spike reach and the block reach is higher. For example, the middle blocker of the former Soviet Union during the years 70 and 80 of 2 meters of stature, Savin, had a vertical jump of 1 m or more and the spike reach and the block reach was of 3 m or more.

The old record of the spike reach of the male volleyball was of 3,76 m, this occurred in the decade of 80 (Marques Junior, 2005).

Actually, the Cuban player Leonel Marshall of 1,96 meters, with a jump of 1,25 m, played in the Cuban national team in the opposite hitter position has an of the highest reaches of the attack and of the block, 3,83 m, and 3,53 m respectively.

However, two volleyball players had better spike reach than Marshall (Henrique, 2017).

The opposite hitter Muzaj of Poland with 2,08 m had a spike reach of 3,86 m, a block reach of 3,50 m and had a jump during the attack of 1,16 m. But in 2014 the middle blocker Simon of Cuba with 2,08 m had a spike reach of 3,89 m.

The volleyball literature informed about the years 70 to 80, the spike reach of the elite male volleyball player was of 2,50 to 3,17 m (Gladden and Colacino, 1978; Marques Junior, 2016; Puhl and collaborators, 1982).

The years 90 the spike reach increased for 3,00 m or more (Smith, Roberts and Watson, 1992). But the Brazilian opposite hitter Marcelo Negrão of 1,98 m had a high spike reach of 3,60 m during the Olympic Games of 1992 and he was important with his attack for Brazil`s victory in this competition. The years 2000 the spike reach increased for 3,30 m or more (Massa and collaborators, 2003; Przybycien, Sterkowicz and Zak, 2014).

The block reach occurred similar increased during the years, but the reach is less than the attack. But sand volleyball literature did not have documented the reach of the attack and of the block, the causes the researchers did not report (Arruda and Hespanhol, 2008a).

However, some researchers informed that increased of the reach because the volleyball players increased the stature during the years (Cabral and collaborators, 2011; Marques Junior, 2015c; Palao, Manzanares and Valadés, 2014). Then, the spike jump and the block jump changed little during the years. It seems that the stature is the factor most responsible for the player`s highest reach.

The years 70 to 90 the volleyball players (indoor) practiced a higher jump than the years 2000? The double volleyball players the athletes practiced a higher jump than the volleyball players on the court?

These questions the volleyball studies could not answers (Arruda and Hespanhol, 2008; Marques Junior, 2015d, 2017).

Then, the objective of the systematic review and of the meta-analysis was to determine the improvement of the vertical jump during the years or not and compare the vertical jump of the volleyball players versus the double players practiced in the sand.

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MATERIALS AND METHODS

This study followed the methodology proposed in Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement (Moher and collaborators, 2009). The studies were identified in electronic databases during January of 2017 to February of 2017.

Literature searches were conducted in Google Scholar, Research Gate, and PubMed. In electronic databases were consulted using the following keywords: vertical jump and male volleyball, beach volleyball and countermovement jump and volleyball.

The author of the study used the FIOCRUZ library to collect some scientific articles. Relevant articles were obtained in full and assessed against the inclusion and exclusion criteria described below.

Inclusion criteria of the articles were evaluated under the following search strategies: (1) type of participants (male volleyball player practiced on the court and in the sand with age of 18 to 39 years old), (2) type of task (vertical jump of the volleyball player) and (3) type of result (the study determined the height in centimeters of the vertical jump). The studies that were excluded are the articles that were not in accordance with the inclusion criteria of the systematic review.

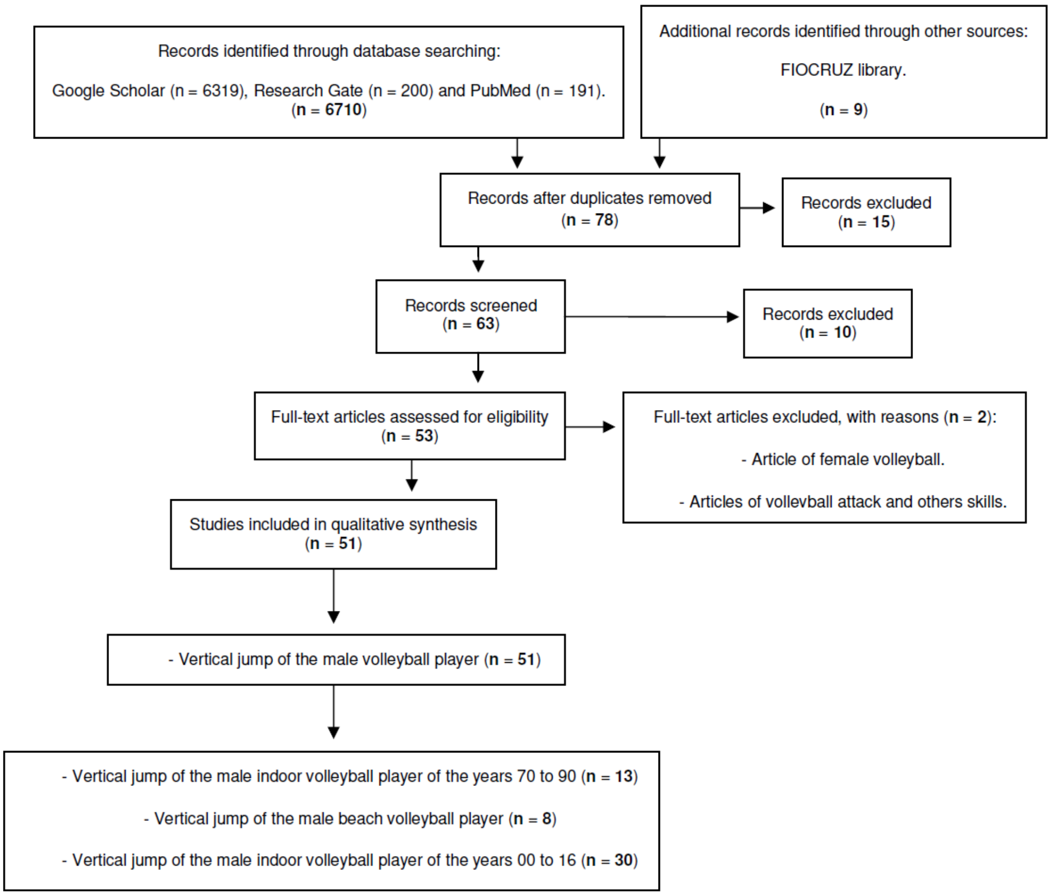

Figure 1 - PRISMA flow diagram of the selection of articles.

In the first phase of analysis, 6710 studies were found using the keywords listed in the previous section. After the reading, the title and the abstract of each study, the second phase of analysis the total was reduced to 78 studies about the vertical jump of the male volleyball player practiced on the court and in the sand with age of 18 to 39 years old.

The researcher was able to read the 78 studies in a period of 150 days and the total

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was reduced to 53 studies with chances of inclusion.

Of these studies, 51 studies were included in this systematic review and meta-analysis. The total of studies of the indoor volleyball during the years 70 to 90 was of 13, 8 studies of the beach volleyball and 30 studies of the indoor volleyball during the years 2000 to 2016. The details for the full strategy were listed in a PRISMA flow diagram, as shown in figure 1.

The researcher used the scale of Galna and collaborators (2009) for the quality assessment of the studies. The scale of Galna and collaborators (2009) use questions (internal validity, external validity and others) about the article and the researcher determined the point of 0 to 1 of each item.

The studies were considered low quality with an average below of 0.60 points.

The use of the scale of Galna and collaborators (2009) occurred in two moments with the objective to check the reliability and determine the level of agreement between the two scores on this instrument. The researcher determined the quality of the studies during an assessment, after 15 days, practiced new assessment of the studies (Marques Junior, 2015c) about the vertical jump of the male volleyball player practiced on the court and in the sand with age of 18 to 39 years.

The reliability of the quality of the studies by the scale of Galna and collaborators (2009) was checked via intraclass correlation coefficient ($p \leq 0.05$).

Cohens`s Kappa was calculated to determine the level of agreement between the two assessments of the studies ($p \leq 0.05$). Bland and Altman (1986) method were applied to assess the level of agreement between the first and second quality assessment of the studies by the scale of Galna and collaborators (2009). All these statistical treatments were performed according to the procedures of the GraphPad Prism, version 5.0.

The data of the studies about the vertical jump of the male volleyball player were treated by various calculations in this meta-analysis with the information of Marques Junior (2014).

The jump in centimeters (cm) was transformed to effect size (*d*) by the equation of Glass, McGaw and Smith (1981) or of Hedges and Olkin (1985). The effect size was corrected with the equation of Hedges and Olkin (1985).

The classification of the effect size followed the scale of Cano-Corres and collaborators (2012). The formula and the classification of the effect size were the following:

The effect size of Glass, McGaw and Smith (1981) and the correction factor of Hedges and Olkin (1985).

Effect Size = [(posttest mean – pretest mean) : pretest standard deviation] . Correction Factor

Correction Factor = 1 – [3 : (4 . m) – 9)]

m = N - 1

N: sample size of the pretest.

The effect size of Hedges e Olkin (1985) and the correction factor of Hedges and Olkin (1985).

Obs.: First calculate the combined standard deviation (combined SD) and after the correction factor to detecting the effect size of each study.

- **Combined SD** = $\sqrt{\dfrac{[(Ne-1)+(EG\ SD)^2]+[(Nc-1)+(CG\ SD)^2]}{(Ne+Nc-2)}}$

Abbreviation: EG: the experimental group, Ne: EG sample size, EG SD: EG standard deviation, CG: control group, Nc: CG sample size, CG SD: CG standard deviation.

Correction Factor = 1 – [3 : (4 . m) – 9)]

m = Ne – Nc - 2

Abbreviation: Ne: EG sample size, Nc: CG sample size.

Effect Size = [(EG mean – CG mean): combined SD]. Correction Factor

Classification of Cano-Corres and collaborators (2012) about the effect size.
Classification of the Effect Size: 0.20 or less is very small the effect, 0.21 to 0.49 is small the effect, 0.50 to 0.79 is medium the effect and 0.80 or more is great the effect.

After the effect size calculations, the fail-safe *n* represents the number of studies with the null result because reduces the average of the effect size (Hagger, 2006). The author used this calculation when necessary. The calculation was the following:

Fail Safe *n* = [sum of the standard deviation: 1.96]^2 – Quantity of Studies

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The third calculation of the study the author determined the standard error, the 95% confidence interval (95% CI), the variance, the study weight, and the weighted effect size were determined with a simple calculation (Neyeloff, Fuchs and Moreira, 2012):

- **Standard Error =** effect size $/\sqrt{\text{effect size . n}}$

95% Confidence Interval = effect size ± (1,96 . standard error)
Variance = standard error^2
Study Weight = 1 : standard error
Weighted Effect Size = study weight . effect size

The heterogeneity was determined using the I^2 index, first the Q test was calculated. The calculations and the classification of the heterogeneity were the following (Higgins and collaborators, 2003):
Q = [sum of the study weight . (sum of the effect size)^2] – [(sum of the study weight . sum of the effect size)^2 : sum of the study weight]
I^2 = [(Q . df) : Q] . 100 = ?%
df = total of studies – 1
Abbreviation: df: degrees of freedom

Classification of the Heterogeneity (I^2 index): 25% the heterogeneity is low, 50% the heterogeneity is moderate and 70% the heterogeneity is high.

The recommendations of Neyeloff, Fuchs and Moreira (2012) were performed, when the heterogeneity is low (25%), the researcher should use the fixed effects model, but with a moderate heterogeneity (50%) or high (70%), the random effects model deserves to be used. The calculations were the following:
Fixed Effects Model
Effect Summary = (sum of the study weight. sum of the effect size): sum of the study weight

- **Standard Error =** $\sqrt{\text{1 : sum of the study weight}}$

95% Confidence Interval = effect summary ± (1,96 . standard error)
Random Effects Model

The calculations were designed to determine the effect summary, the standard error, and 95% confidence intervals, but first some calculations are performed before (variability in the population of effects and the new weight of study) to reach these values.

Variability in the Population of Effects = [Q test – (quantity of studies – 1)] : [sum of the study weight – (sum of the study weight^2 : sum of the study weight)]

New Weight of Study = 1 – (standard error^2 + variability in the population of effects)
Effect Summary = (sum of the new weight of study . sum of the effect size) : sum of the new weight of study

- **Standard Error =** $\sqrt{\text{1 : sum of the new weight of study}}$

95% Confidence Interval = effect summary ± (1,96. standard error)

All calculations of the meta-analysis were performed in Excel® 2010 of the Windows 7. After these calculations the publication bias of the CMJ effect size of each meta-analysis study was established, the funnel plot used was the one developed by Cumming (2014) (see the graph at https://thenewstatistics.com/itns/esci/). The forest plots were made in Excel® 2010 of Windows 7 according to the teachings of Marques Junior (2014).

After these procedures, the effect size of the jump practiced by volleyball player received a statistical treatment. The results are expressed as means and standard deviations. The normality of the data was assessed by the Shapiro Wilk test ($p \le 0.05$) and was observed the normality of the data through of the histogram. In case of data normal, the difference between the jumps during the years was analyzed using one way Anova and the Tukey post hoc test with results accepted a level of significance of $p \le 0.05$. In the case of data not normal, the difference between the jumps during the years was analyzed using Kruskal Wallis Anova and the Dunn post hoc with results accepted a level of significance of $p \le 0.05$. After comparisons of p-significance, the new statistic indicated by Cumming (2014) was performed, which makes the data calculated by significance p more accurate (see graph at https://thenewstatistics.com/itns/esci/).

All these statistical treatments were performed according to the procedures of the GraphPad Prism, version 5.0. The histogram and the bar graph of the effect size were elaborated according to the procedures of the GraphPad Prism, version 5.0. When there was

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a significant difference between the Anova comparisons, a graph was elaborate in BioEstat 5.0 to present this difference between the comparisons.

RESULTS AND DISCUSSION

Intra-observer the level of agreement exhibited Cohen`s Kappa values of 0.42, was a moderate agreement that is appointed by the literature (Landis and Koch, 1977), the result had statistical difference (p = 0.001).

The reliability of the quality of the studies by the scale of Galna and collaborators (2009) was checked via intraclass correlation, the result was of 0.99 (p = 0.0001), this result was excellent (Huijbregts, 2002).

Bland and Altman (1986) method were applied to assess the level of agreement between the first and second quality assessment of the studies by the scale of Galna and collaborators (2009).

Although the difference between the assessment 1 and 2 was low (bias = 0.02) and the limits of agreement ranged from – 0.09 (lower limit of agreement) to 0.13 (upper limit of agreement).

The author considered a high agreement between the assessment 1 and 2 because the values stayed located near of the zero (increase the agreement) and the limits of agreement stayed located near to the zero (increase the agreement), but the LA stayed separated from each other. Then, the limits of agreement (LA) were classified as low medium.

Therefore, a medium agreement between assessment 1 and 2 of the studies by scale of Galna and collaborators (2009) was determined by Bland and Altman (1986) method. The Bland and Altman (1986) showed in figure 6 the agreement between assessments 1 and 2.

The first assessment the researcher found a medium to the high scientific quality of articles.

The second assessment the researcher found a medium to the high scientific quality of articles.

Table 1 shows the methodological quality of the studies. The articles of the years 70 to 80 of the indoor volleyball the line is white, the studies of the double volleyball practiced in the sand the line is blue and the studies of the years 2000 the line is green.

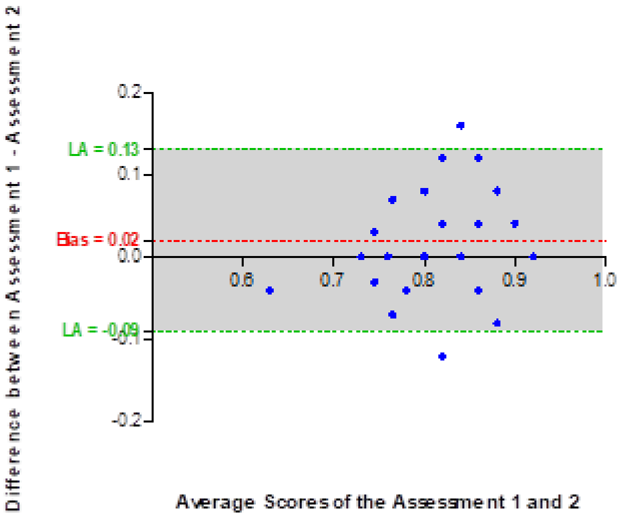

Figure 2 - Bland and Altman plot the 95% limits of agreement (LA) between assessment 1 and 2 by the scale of Galna and collaborators (2009).

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Table 1 - Summary of the quality assessment of the studies selected.

Study	1	2	3	4	5	6	7	8	9	10	11	12	13	Average and Quality of each Study
Rocha (1976)	1	1	1	1	1	1	1	1	0	0	0	0	0	0.61 (medium)
	0.5	1	0.5	0.5	0	1	1	1	0	0	1	1	1	0.65 (medium)
Gladden and Colacino (1978)	1	1	1	1	1	1	1	1	0	1	1	1	1	0.92 (high)
	0.5	1	1	0.5	1	1	1	1	0	0	1	1	1	0.76 (medium)
Komi and Bosco (1978)	1	1	1	0	1	1	1	1	0	1	1	1	1	0.84 (high)
	1	1	1	0	1	1	1	1	0	1	1	1	1	0.84 (high)
Quadra and collaborators (1981)	1	1	1	0.5	0	0.5	1	0	0	0	1	1	1	0.61 (medium)
	0	1	1	0.5	0	1	1	1	0	0	1	1	1	0.65 (medium)
Puhl and collaborators (1982)	1	1	1	0.5	1	1	1	1	0	0	1	1	1	0.80 (medium)
	1	1	1	0.5	1	1	1	1	0	0	1	1	1	0.80 (medium)
Clutch and collaborators (1983)	1	1	1	1	0	1	1	1	1	1	1	1	1	0.92 (high)
	1	1	1	1	1	1	1	1	0	1	1	1	1	0.92 (high)
Marques Junior (2016)	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)
	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)
McGown and collaborators (1990)	1	1	1	1	1	1	1	1	0	0	1	1	1	0.84 (high)
	1	1	1	1	1	1	1	1	0	0	1	1	1	0.84 (high)
Van Soest and collaborators (1985)	0	1	1	0.5	1	1	1	1	1	0	1	1	1	0.80 (medium)
	0	1	1	0.5	1	1	1	1	0	1	1	1	1	0.80 (medium)
Silva and Rivet (1988)	1	1	1	0.5	1	1	1	1	0	0	1	1	1	0.80 (medium)
	1	1	1	0.5	1	1	1	1	0	0	1	1	1	0.80 (medium)
Lee and collaborators (1989)	1	0	1	1	1	1	1	1	0	0	1	1	1	0.76 (medium)
	1	0	1	1	1	1	1	1	0	0	1	1	1	0.76 (medium)
Smith and collaborators (1992)	1	1	1	1	1	1	1	1	0	1	1	1	1	0.92 (high)
	1	1	1	0.5	1	1	1	1	0	1	1	1	1	0.88 (high)
Newton and collaborators (1999)	1	1	1	1	1	1	1	1	0	1	1	1	1	0.92 (high)
	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)
Bishop (2003)	1	1	1	1	1	1	1	1	0	1	1	1	1	0.92 (high)
	1	1	1	0.5	1	1	1	1	0	1	1	1	1	0.88 (high)
Medeiros and collaborators (2008)	1	1	1	0.5	0	1	1	1	0	0	1	1	1	0.73 (medium)
	1	1	1	1	0	1	1	1	0	0	1	1	1	0.76 (medium)
Tilp and collaborators (2008)	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Riggs and Sheppard (2009)	1	1	1	0.5	1	1	1	1	0	0	1	1	1	0.80 (medium)
	1	1	1	0.5	0	1	1	1	0	0	1	1	1	0.73 (medium)
Medeiros and collaborators (2012)	1	1	1	1	1	0	1	1	0	1	1	1	1	0.84 (high)
	1	1	1	1	1	0	1	1	0	1	1	1	1	0.84 (high)
Magalhães and collaborators (2011)	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)
	1	1	1	1	0	1	1	1	0	1	1	1	1	0.80 (medium)
Hespanhol and Arruda (2014)	1	1	1	1	1	1	1	1	1	0	1	1	1	0.92 (high)
	1	1	1	0.5	0	1	1	1	1	0	1	1	1	0.80 (medium)
Turpin and collaborators (2014)	1	1	1	1	1	1	1	1	1	0	1	1	1	0.92 (high)
	1	1	1	1	1	1	1	1	1	0	1	1	1	0.92 (high)
Maffiuletti and collaborators (2002)	1	1	1	1	1	1	1	1	0	1	1	1	1	0.92 (high)
	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Marques and collaborators (2004)	0	1	1	0.5	0	1	1	1	0	1	1	1	1	0.73 (medium)
	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Massa and collaborators (2003)	1	1	0.5	0.5	0	1	1	1	0	1	1	1	1	0.76 (medium)
	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Hasson and collaborators (2004)	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)
	1	1	1	0.5	1	1	1	1	0	1	1	1	1	0.88 (high)
Silva and collaborators (2005)	1	1	0.5	1	1	1	1	1	0	1	1	1	1	0.88 (high)
	1	1	1	0.5	1	1	1	1	0	1	1	1	1	0.88 (high)
Rocha and collaborators (2005)	1	1	0.5	1	1	1	1	1	0	1	1	1	1	0.88 (high)
	1	1	0.5	0.5	1	1	1	1	0	1	1	1	1	0.84 (high)
Soundara and Pushparajan (2010)	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)
	0.5	1	1	0.5	0	1	1	1	0	1	1	1	1	0.76 (medium)
Sheppard and collaborators (2007)	1	1	1	1	1	1	1	1	0	1	1	1	1	0.92 (high)
	1	1	0.5	0.5	0	1	1	1	0	1	1	1	1	0.76 (medium)
Peeni (2007)	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)
	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Hespanhol and collaborators (2007)	1	1	1	1	1	1	1	1	0	1	1	1	1	0.92 (high)
	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Carvalho and collaborators (2007)	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Sheppard and	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)

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collaborators (2008)	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Marques and	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)
Marinho (2009)	0.5	1	1	1	0	1	1	1	0	1	1	1	1	0.80 (medium)
Marques and	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
collaborators (2009)	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Marques and	1	1	1	0	0	1	1	1	0	1	1	1	1	0.76 (medium)
collaborators (2010)	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Sheppard and	1	1	1	0	0	1	1	1	0	1	1	1	1	0.76 (medium)
collaborators (2009)	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Gheller and	1	1	1	1	0	1	1	1	0	0	1	1	1	0.76 (medium)
collaborators (2010)	1	1	1	0.5	0	1	1	1	0	0	1	1	1	0.73 (medium)
Borràs and	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)
collaborators (2011)	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Nuzzo and	1	1	0.5	0.5	1	1	1	1	1	1	1	1	1	0.92 (high)
collaborators (2011)	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Fattahi and	1	1	1	1	1	1	1	1	0	1	1	1	1	0.92 (high)
collaborators (2012)	1	1	1	1	1	1	1	1	0	1	1	1	1	0.92 (high)
Aouadi and	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)
collaborators (2011)	0.5	1	1	0.5	1	1	1	1	0	1	1	1	1	0.84 (high)
Sattler and	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)
collaborators (2012)	1	1	0.5	1	0	1	1	1	0	1	1	1	1	0.80 (medium)
Trajkovic and	1	1	1	1	0	1	1	1	1	1	1	1	1	0.92 (high)
collaborators (2012)	1	1	1	1	0	1	1	1	1	1	1	1	1	0.92 (high)
Seron and	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)
collaborators (2012)	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Jostrzebski and	1	1	1	0	0	1	1	1	0	1	1	1	1	0.76 (medium)
collaborators (2014)	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Pupo and	1	1	1	1	1	1	1	1	0	1	1	1	1	0.92 (high)
collaborators (2014)	0.5	1	1	0.5	1	1	1	1	0	1	1	1	1	0.84 (high)
Coso and	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)
collaborators (2014)	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Freitas and	1	1	1	0.5	0	1	1	1	0	0	1	1	1	0.73 (medium)
collaborators (2014)	1	1	1	0.5	0	1	1	1	0	0	1	1	1	0.73 (medium)
Lima and	1	1	1	0	0	1	1	1	0	1	1	1	1	0.76 (medium)
collaborators (2015)	1	1	1	0.5	0	1	1	1	0	1	1	1	1	0.80 (medium)
Vaverka and	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)
collaborators (2016)	1	1	1	1	0	1	1	1	0	1	1	1	1	0.84 (high)

Legend: Obs.: The numbers in bold are the results of the 1st assessment and without this effect are of the 2nd assessment.

The numbers from 1 to 13 are the questions of the scale of Galna and collaborators (2009): 1. Research aims or questions stated clearly (Scoring Criteria: 1 – yes; 0.5 – yes, lacking detail or clarity; 0 – no); 2. Participant detailed (number, age, sex, height, weight) (Scoring Criteria: 0 to 1); 3. Recruitment and sampling methods described (1 – yes; 0.5 – yes, lacking detail or clarity; 0 – no); 4. Inclusion and exclusion criteria detailed (1 – yes; 0.5 – yes, lacking detail or clarity; 0 – no); 5. Controlled co-variates (walking speed, age, gender) (0 to 1); 6. Key outcome variables clearly described (1 – yes; 0.5 – yes, lacking detail or clarity; 0 – no); 7. Adequate methodology able to repeat study (participant sampling, equipment, procedure, data processing, statistical) (0 to 1); 8. Methodology able to answer the research question (participant sampling, equipment, procedure, data processing, statistical) (1 – yes; 0 - no). 9. Reliability of the methodology stated (1 – yes; 0 - no); 10. Interval validity of the methodology stated (1 – yes; 0 - no); 11. Research questions answered adequately in the discussion (1 – yes; 0 - no); 12. Key findings supported by the results (1 – yes; 0 - no); 13. Key findings interpreted in a logical manner which is supported by references (1 – yes; 0 - no). Quality of the Studies: 0 to 0.59 is low, 0.60 to 0.80 is medium and 0.81 to 1 is high.

In table 2 was presented a summary of each study selected for the systematic review. The author selected the studies with countermovement vertical jump (CMJ), CMJ with arm swing (CMJS), spike jump (SPJ) and block jump (BJ). The articles of the years 70 to 90 of the indoor volleyball the line is white, the studies of the double volleyball practiced in the sand the line is blue, the studies of 2000 to 2009 the line is green and the studies of 2010 to 2016 the line is pink.

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Table 2 - Summary of the studies selected.

Study	Male Volleyball Players	Vertical Jump Test
Rocha (1976)	Brazilian national team 7th place in the Olympic Games of 1976 (n = 12).	SPJ of 78.50 ± 7.74 cm (pre-test) and 83.67 ± 7.48 (post-test).
Gladden and Colacino (1978)	American volleyball players of 25.2 ± 4.3 years and 1.85 ± 6.6 m of stature (n = 74). The author of the study considered control group (CG) the master team of the research of 40.4 ± 3.4 years and of 1.82 ± 7.3 m (n = 20).	CMJ of 67.4 ± 6.9 cm of the American volleyball players and CMJ of 57.5 ± 5.4 cm of the CG.
Komi and Bosco (1978)	Finnish volleyball players of 24 ± 3.5 years and of 1.85 ± 6.7 m of stature (n = 16). The author of the study considered CG the physical education students of the research of 24 ± 1.4 years and 1.76 ± 8.3 m (n = 16).	CMJ of 43.4 ± 5.2 cm of the Finnish volleyball players and CMJ of 40.3 ± 6.6 cm of the CG.
Quadra and collaborators (1981)	Volleyball national team fom 1979 to 1981 (n = 12 of each team). Soviet Union national team (24.6 ± 2.11 years and 1.93 ± 4.06 m of stature), Poland national team (25.3 ± 2.90 years and 1.91 ± 5.13 m) and Cuba national team (23.8 ± 2.04 years and 1.86 ± 6.51 m). The others national teams the author of the study considered CG because were national teams of low performance in competition (Brazil with 21.7 ± 3.10 years and 1.89 ± 5.72 m, Korea with 23.6 ± 2.12 years and 1.86 ± 4.98 m, China with 22 ± 0.60 years and 1.87 ± 4.02 m). Then, Brazil was CG of the Soviet Union because It had a better result than Korea and China in the competition. Korea was CG of Poland and China was CG of Cuba because of Korea\`s performance in the competition better than China.	The jump test were as follows: Soviet Union (CMJS: 80.3 ± 6.88 cm, SPJ: 88.9 ± 6.89 cm and BJ: 78 ± 5.36 cm), Poland (CMJS: 64.8 ± 7.02 cm, SPJ: 72.9 ± 7.14 cm and BJ: 47.9 ± 5.73 cm) and Cuba (CMJS: 81.7 ± 8.83 cm, SPJ: 91.1 ± 5.57 cm and BJ: 76.5 ± 9.01 cm). The CG had the following result: Brazil (CMJS: 73.5 ± 6 cm, SPJ: 83.4 ± 6.71 cm and BJ: 76.1 ± 6.93 cm), Korea (CMJS: 79.1 ± 3.70 cm, SPJ: 88.71 ± 3.20 cm and BJ: 76.4 ± 3.41 cm) and China (CMJS: 81.4 ± 6.14 cm, SPJ: 91.1 ±.8.16 cm and BJ: 78.6 ± 6.30 cm).
Puhl and collaborators (1982)	American national team of 26.1 ± 3.5 years and 1.92 ± 3.9 of stature (n = 8).	CMJ of 67 ± 11.5 cm of the American national team and the author of the study considered CG the minimum value of CMJ (50 cm) of the American national team
Clutch and collaborators (1983)	Volleyball players of the Brigham Young University of 20 years or more (n = 8 each training).	CMJ of 60.40 ± 9.68 cm (pre-test) and 63.25 ± 8.38 cm (post-test) of the plyometric training and of the weight training. CMJ of 62.61 ± 7.01 cm (pre-test) and 66.24 ± 6.88 cm (post-test) of the weight training.
Marques Junior (2016)	Brazilian national team (n = 12) versus the American national team (n = 12) during the 3rd set of the Olympic Games final of 1984.	The national team had the following result: Brazil (SPJ: 97.63 ± 7.32 cm and 80.36 ± 6.75 cm, BJ: 73.17 ± 9.74 cm and 67 ± 11.11 cm) and United States (SPJ: 93.83 ± 10.76 cm and 74.86 ± 12.76 cm, BJ: 72.51 ± 7.44 cm and 69.6 ± 8.79 cm). The author considered maximum and minimum value with pre and post-test.
McGown and collaborators (1990)	American national team during the preparatory period of the Matveev periodization (25.7 ± 2.5 years and 1.92 ± 5.1 m of stature). The American national team was the gold medal in the Olympic Games of 1984 (n = 12).	SPJ of 83.57 ± 5.7 cm (pre-test) and of 93.63 ± 6.1 (post-test).
Van Soest and collaborators (1985)	Volleyball players of 23 ± 4 years and 1.93 ± 0.06 m of stature (n = 10).	CMJ of 54 ± 0.06 cm of the volleyball players and the author of the study considered CG the CMJ with one leg of 31 ± 0.03 cm of the volleyball players.
Silva and Rivet (1988)	Brazilian national team 4th place in the World Championship of 1986 with 1.85 to 1.96 m of stature (n = 12).	The study determined the jumps of the game positions and the author considered the maximum and minimum value with pre and post-test. The CMJ of 57.17 ± 5.31 cm and of 50.25 ± 6.70 cm, CMJS of 70.67 ± 4.55 cm and of 62.75 ± 4.92 cm.
Lee and collaborators (1989)	American volleyball players (n = 24). But the study did not participate of the meta-analysis because the article had no post-test.	CMJ of 69.3 cm and SPJ of 79.8 cm.
Smith and collaborators (1992)	Canadian national team of 24.8 ± 2.2 years and 1.93 ± 0.04 m of stature (n = 15). The author of the study considered CG the Universiade of 21.1 ± 1.8 years and 1.94 ± 0.04 m of stature (n = 24).	SPJ of 92 ± 0.06 cm and BJ of 76 ± 0.06 of the Canadian national team and CG with SPJ of 86 ± 0.07 cm and BJ of 68 ± 0.06 cm.
Newton and collaborators (1999)	American volleyball players from an NCAA Division I team (n = 8) of 19 years or more.	CMJ of 67.6 ± 4.1 cm (pre-test) and of 71.5 ± 4.6 cm (post-test). SPJ of 78 ± 6.2 cm (pre-test) and of 83 ± 7.2 cm (post-test).
Bishop (2003)	Sand volleyball players of 23 ± 3 years and 1.84 ± 10.2 m of stature (n = 10).	The sand test the author of the study considered CG because the athlete practiced the jump on the different floor of the indoor volleyball. The results were as follows: CMJ of 53.1 ± 10.5 cm, BJ of 46.9 ± 8.8 cm and SPJ of 55.3 ± 11.4 cm. The land tests had the following results: CMJ of 55.1 ± 8.1 cm, BJ of 49.8 ± 8.2 cm and SPJ of 64.9 ± 11.1 cm.
Medeiros and collaborators (2008)	Sand volleyball players of 25.6 ± 7.7 years and 1.92 ± 5.2 m of stature (n = 48).	CMJ of 58.2 ± 4.7 cm and author considered the minimum value with CG (51 cm).

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Tilp and collaborators (2008)	Elite volleyball and/or sand volleyball of 25.1 ± 4 years of 1.88 ± 0.04 m of stature (n = 8). The volleyball player from Austrian.	SPJ of 67.7 ± 5.7 cm during the indoor volleyball and SPJ of 60 ± 2.7 cm during the sand volleyball. The author of the study considered CG the SPJ of the sand volleyball.
Riggs and Sheppard (2009)	Elite sand volleyball players of 2008 Swatch FIVB World Tour Adelaide Australia Open Sand Volleyball. The athletes had 25.2 ± 5.5 years and 1.92 ± 3.3 m of stature (n = 14).	CMJ of 46.86 ± 3.81 cm and the author considered the minimum value of the CG (40.30 cm).
Medeiros and collaborators (2012)	Brazilian sand volleyball players of 28.1 ± 6 years and 1.94 ± 0.06 m of stature (n = 48).	CMJ before of the game was of 53.2 (pre-test), after the 1st was of 53.8 cm (post-test), after the 2nd set was of 54.5 (pre-test) and after the 3rd set was of 55 cm (post-test).
Magalhães and collaborators (2011)	Brazilian sand volleyball players of 28.1 ± 6 years and 1.94 ± 0.06 m of stature (n = 48).	CMJ before of the game was of 56 ± 4 cm (pre-test) and after the game was of 55 ± 3 cm (post-test).
Hespanhol and Arruda (2014)	Brazilian sand volleyball players of 26.04 ± 2.23 years and 1.89 ± 2.09 m of stature (n = 10).	CMJ of 89 ± 7.25 cm and the author of the study considered CG the jump of the sand volleyball (CMJ of 80 ± 8.67 cm).
Turpin and collaborators (2014)	Spanish sand volleyball players of the Spain of 19.7 ± 2.2 years and 1.85 ± 0.05 m of stature (n = 6). CG of 21.2 ± 3.3 years and 1.87 ± 0.06 m of stature (n = 6). The volleyball players practiced weight training and the vibration platform. The CG practiced weight training.	CMJ of 43.7 ± 2.9 cm (pre-test) and 50.2 ± 2.6 cm (post-test). CMJ of the CG was of 43.7 ± 2.6 cm (pre-test) and 44.3 ± 2.9 cm (post-test).
Maffiuletti and collaborators (2002)	Italian volleyball players of 21.8 ± 2.8 years and 1.90 ± 4.4 m of stature (n = 20).	CMJ of 47.9 ± 5.7 cm (pre-test) and 48.1 ± 6 cm (post-test). SPJ of 53 ± 4.8 cm (pre-test) and 54.4 ± 4.8 cm (post-test).
Marques and collaborators (2004)	Portuguese volleyball players of 25.67 ± 2.69 years and 1.92 ± 7.12 m of stature (n = 11).	CMJ of 46.32 ± 4.69 cm (pre-test) and 49.06 ± 5.87 cm (post-test).
Massa and collaborators (2003)	Brazilian volleyball players of 24 ± 3.1 years and 1.97 ± 6.6 m of stature (n = 10). Juvenil volleyball players were the CG, of 18 ± 0.2 years and 1.94 ± 6.2 m of stature (n = 10).	CMJ of 65.6 ± 4.5 cm of the Brazilian volleyball players and 60.8 ± 4.3 cm of the CG.
Hasson and collaborators (2004)	Volleyball players of the NCAA Division I University team (n = 15) of the 20.6 ± 1.6 years and 1.92 ± 0.05 m of stature. CG was composed of untrained persons (n = 13).	CMJ of 53.3 ± 7.7 cm and CG practiced 47.7 ± 4.1 cm.
Silva and collaborators (2005)	Brazilian volleyball players of 25.8 ± 2.6 years (n = 18).	CMJ of 47.5 ± 4.8 cm and CMJS of 38.7 ± 3.9 cm.
Rocha and collaborators (2005)	Brazilian volleyball players of 20.26 ± 2.89 years and 1.94 ± 6.66 m of stature (n = 24). The author of the considered CG the basketball players of 25.57 ± 3.42 years and 1.98 ± 8.12 m of stature (n = 29).	CMJ of 43.92 ± 4.48 cm and CMJS of 53.07 ± 5.35 cm and the CG with CMJ of 42.77 ± 6.92 cm and CMJS 51.36 ± 8.15 cm.
Carvalho and collaborators (2007)	Portuguese national team during the year of 2004 (n = 10).	CMJ of 43.5 ± 3.9 cm (pre-test) and 44 ± 3.7 cm (post-test). SPJ of 68.8 ± 7.7 cm (pre-test) and 67.5 ± 8.9 cm (post-test). BJ of 55.1 ± 5.2 cm (pre-test) and 53.8 ± 5.6 cm (post-test).
Sheppard and collaborators (2007)	Volleyball players of 18.9 ± 2.6 years and 2.03 ± 5.6 m of stature (n = 11).	BJ of 48.4 ± 0.01 cm (pre-test) and 50.5 ± 0.1 cm (post-test).
Peeni (2007)	American volleyball players of the NCAA Division (n = 18). The study divided the volleyball players into two groups: the group (G1) the athletes training back squat for 8 weeks (n = 10) and group 2 (G2) the athletes training front squat for weeks (n = 8).	CMJ of the G1 was of 65.5 ± 5.5 cm (pre-test) and of 70.2 ± 5.9 cm (post-test). CMJ of the G2 was of 64.5 ± 2.8 cm (pre-test) and of 70.6 ± 4.6 cm (post-test).
Hespanhol and collaborators (2007)	Brazilian volleyball players of 19.01 ± 1.36 years and 1.91 ± 5.36 m of stature (n = 10).	The volleyball players practiced two types of jump test: continuous jump test and intermittent jump test. The jump test the volleyball players practiced CMJ. Then, the author of the article considered continuous jump test CG because this type of test is not specific for the volleyball. The CMJ of the continuous jump test was of 47 ± 3.72 cm and the CMJ of the intermittent jump test was of 46.78 ± 3.73 cm.
Sheppard and collaborators (2008)	Volleyball players of 20.8 ± 3.9 years and 2.01 ± 7 m of stature (n = 10).	The study compared the athletes with 7 best and 7 worst of the CMJ during two types of jump tests, the results were as follows: CMJ of 53.14 ± 3.76 cm (7 worst) and of 67.57 ± 2.94 cm (7 best). The SPJ of 66.85 ± 5.34 cm (7 worst) and of 85.57 ± 9.07 cm (7 best). The study compared the athletes with 7 best and 7 worst of the SPJ during two types of jump tests, the results were as follows: CMJ of 53.42 ± 4.24 cm (7 worst) and of 67.14 ± 3.53 cm (7 best). The SPJ of 66.28 ± 4.75 cm (7 worst) and of 87.57 ± 6.85 cm (7 best). Then, the best test the author considered experimental group (EG) and the worst test was the CG.

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Marques and Marinho (2009)	Volleyball team was divided into two groups: starts (27.4 ± 2.2 years and 1.93 ± 0.5 m of stature, n = 13) and non-starters (24.5 ± 4 years and 1.91 ± 0.6 m of stature, n = 9).	CMJ of 45.5 ± 4.2 cm (starts) and of 44.7 ± 3.4 cm (non-starters). The author of the study considered CG the CMJ of the non-starters.
Marques and collaborators (2009)	Volleyball players of 26.6 ± 3.1 years of different positions (n = 35).	The study determined the jumps of the game positions and the author considered the maximum and minimum value with pre and post-test. The CMJ of 47.01 ± 3.39 cm and of 41.91 ± 2.57 cm.
Sheppard and collaborators (2009)	Volleyball players of 20.9 ± 2.6 years and 1.98 ± 5.6 m of stature. The author of the article considered CG the minimum value and EG the maximum value.	CMJ of the EG was of 57.4 ± 9.5 cm (n = 71) and of the CG was of 55.9 ± 8.7 cm (n = 49). SPJ of the EG was of 79.1 ± 9.2 cm (n = 71) and of the CG was of 73.9 ± 7.8 cm (n = 22).
Marques and collaborators (2010)	Volleyball team was divided into two groups: starts (26.9 ± 3 years and 1.90 ± 0.1 m of stature, n = 22) and non-starters (24.6 ± 4 years and 1.90 ± 0.1 m of stature, n = 13).	CMJ of 45.6 ± 4.3 cm (pre-test) and of 48.2 ± 5.4 cm (post-test) of the starts. CMJ of 44.7 ± 3.5 cm (pre-test) and of 47.3 ± 2.4 cm (post-test) of the non-starts.
Soundara and Pushparajan (2010)	Volleyball players of 18 to 25 years (n = 30). The athletes were divided into two groups: EG and CG. EG practiced the plyometric training (n = 15) and the CG did not practice (n = 15).	SPJ of 55.40 ± 6.31 cm (pre-test) and of 59.40 ± 5.85 (post-test). BJ of 48.53 ± 4.10 cm (pre-test) and of 51.60 ± 4.22 cm (post-test). The CG practiced SPJ of 51.67 ± 3.99 cm (pre-test) and of 52.40 ± 4.07 cm (post-test). The CG practiced BJ of 42.67 ± 5.14 cm (pre-test) and of 43.47 ± 4.55 cm (post-test).
Gheller and collaborators (2010)	Volleyball players of 21.5 ± 1.6 years and 1.82 ± 6.8 m of stature (n = 11).	CMJ of 56.6 ± 7.4 cm.
Borràs and collaborators (2011)	Spanish volleyball players of three years: 2006 (23.5 ± 1.7 years and 1.94 ± 7.7 m of stature, n = 23), 2007 (26.5 ± 4.1 years and 1.93 ± 8.2 m of stature, n = 15) and 2008 (23.6 ± 1.7 years and 1.91 ± 7.4 m of stature, n = 13).	The CMJ was the following: 46.5 ± 3.5 cm (2006), 47.3 ± 5.7 cm (2007) and 49.7 ± 4.6 cm (2008). The CMJS was the following: 56.8 ± 6.4 cm (2007) and 59.8 ± 5.1 cm (2008). Then, the author considered pre-test the minimum value and the post-test the maximum value.
Nuzzo and collaborators (2011)	Volleyball players of 19.7 ± 1.5 years and 1.80 ± 6.2 m of stature (n = 40).	The volleyball players practiced the jump test with various types of instruments (CMJ = pre-test: 55.4 ± 8 cm, post-test: 56.1 ± 9 cm). Then, the author of the article chose the jump test with the highest jump.
Fattahi and collaborators (2012)	Volleyball players of 27.93 ± 3.92 years (n = 40).	CMJ of 60.5 (spikers), 57.2 (setters) and 42.6 (liberos).
Aouadi and collaborators (2011)	Volleyball players of 21 ± 1 years and 1.86 ± 5 m of stature (n = 23).	CMJS of 50.07 ± 3.9 cm (tallest players, n = 16) and 47.63 ± 3.5 cm (shortest players, n = 17). The author considered maximum and minimum value with pre and post-test.
Sattler and collaborators (2012)	Volleyball players of 18 to 30 years and 1.77 m to 2.07 m of stature.	CMJ of 43.21 ± 4.91 cm (opposite, n = 15), 43.63 ± 4.84 cm (middle, n = 26), 42.27 ± 4.23 cm (setter, n = 19) and of 46.55 ± 5.01 cm (outside, n = 24). The author considered maximum and minimum value with pre and post-test. BJ of 48.19 ± 6.35 cm (opposite), 47.42 ± 5.66 cm (middle), 46.47 ± 5.18 cm (setter) and of 49.87 ± 5.44 cm (outside). SPJ of 64.25 ± 7.3 cm (opposite), 61.84 ± 7.23 cm (middle), 61.16 ± 6.89 cm (setter) and of 66.06 ± 6.06 cm (outside).
Trajkovic and collaborators (2012)	Volleyball players of 22.3 ± 3.7 years and 1.90 ± 4.2 m of stature (n = 16).	CMJ of 44.84 ± 4.15 cm (pre-test) and 47.09 ± 3.86 cm (post-test). SPJ of 61.84 ± 4.90 cm (pre-test) and 64.69 ± 4.63 cm (post-test).
Seron and collaborators (2012)	Brazilian volleyball players of 25.62 ± 4.1 years and 1.95 ± 0.1 m of stature.	The players had the following results: setter (CMJ: 42.23 cm, SPJ: 78 cm and BJ: 58 cm, n = 2), middle block (CMJ: 39,55 cm, SPJ: 73 cm and BJ: 53 cm, n = 4), outside hitter (CMJ: 42,96 cm, SPJ: 80 cm and BJ: 60 cm, n = 5) and opposite hitter (CMJ: 38.55 cm, SPJ: 77 cm and BJ: 58 cm, n = 2).
Jostrzebski and collaborators (2014)	Volleyball players were divided into two groups to do the plyometric training: high-intensity jumping group (HIJG, 21.2 ± 1.36 years, n = 10) and low-intensity jumping group (LIJG, 20.7 ± 1.52 years, n = 10).	The jump of the HIJG had pre and post-test (CMJ: 38.6 ± 5.28 cm and 43.9 ± 5.49 cm, CMJS: 47 ± 5.19 cm and 52.8 ± 4.57 cm, SPJ: 57.7 ± 6.36 cm and 60.9 ± 7.16 cm, BJ: 48.1 ± 6.76 cm and 49.7 ± 5.54 cm) and of the LIJG pre and post-test (CMJ: 40.5 ± 4.20 cm and 44.1 ± 5.53 cm, CMJS: 50.1 ± 5.29 cm and 52.1 ± 6.49 cm, SPJ: 59 ± 4.84 cm and 62.3 ± 5.92 cm, BJ: 46.9 ± 5.84 cm and 49.9 ± 6.13 cm).
Pupo and collaborators (2014)	Volleyball players of 23,8±3,8 years and 1,85±4,7 m of stature (n = 21).	CMJ of 42.64 ± 5.19 cm (pre-test) and 42.94 ± 5.69 cm (post-test).

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Coso and collaborators (2014)	Volleyball players of 21,8±6,9 years and 1,80±8 m of stature (n = 15).	CMJ of 35.9 ± 4.4 cm (pre-test) and 37.7 ± 4.6 cm (post-test).
Freitas and collaborators (2014)	Brazilian volleyball team, they were divided into two groups: training load (TL, 23.37 ± 2.94 years and 1.95 ± 0.06 of stature, n = 8) and normal training (NT, 19.75 ± 1.48 years and 1.88 ± 0.07 of stature, n = 8).	CMJ of the NY was of 51.76 ± 6.61 cm (pre-test) and 52.71 ± 5.51 cm (post-test). CMJ of the TL was of 48.83 ± 3.86 cm (pre-test) and 49.04 ± 4.98 cm (post-test).
Lima and collaborators (2015)	Brazilian volleyball players of the Brazilian army of 28.38 ± 4 years and 1.92 ± 6.62 m of stature (n = 18).	CMJ of 35.77 ± 4.67 cm (intermittent jump of 0 to 15 seconds) and 31.94 ± 4.51 cm (intermittent jump of 15 to 30 seconds). The author of the study considered CG the intermittent jump of 15 to 30 seconds.
Vaverka and collaborators (2016)	Elite volleyball players who were members Czech Republic in 2013 (27.9 ± 7.1 years and 1.92 ± 0.09 m of stature, n = 18).	CMJ of 37 ± 0.05 cm and CMJS of 52 ± 0.08 cm.

Table 3 - Type of jumps evaluation in the studies and with the articles were used in this research.

Quantity of Study	CMJ	CMJS	SPJ	BJ	Type of Study Used in this Research
Indoor Volleyball (years 70 to 90)					
n = 13	10	2	8	3	systematic review
n = 7	7	3	5	3	meta-analysis
Sand Double (year of 2003 to 2014, 11 year)					
n = 8	8	0	2	2	systematic review
n = 7	7	0	2	1	meta-analysis
Indoor Volleyball (year of 2000 to 2009, 10 years)					
n = 14	13	2	4	2	systematic review
n = 12	12	1	4	2	meta-analysis
Indoor Volleyball (year of 2010 to 2016, 7 years)					
n = 16	14	4	5	4	systematic review
n = 11	11	3	5	4	meta-analysis
Indoor Volleyball (year of 2000 to 2016, 17 years)					
n = 30	25	6	8	5	systematic review
n = 23	11	4	9	6	meta-analysis

Legend: Abbreviation of the jump tests: CMJ – countermovement vertical jump, CMJS - countermovement vertical jump with arm swing, SPJ – spike jump and BJ – block jump.

Table 3 shows the number of studies, the type of jump test and the use of articles in this research.

The results of the systematic review about the vertical jump of the male volleyball player had several types of jump.

The years 70 to 90 of the indoor volleyball the minimum and maximum values of the jump were as follows: CMJ of 40.3 ± 6.6 cm and of 69.3 cm, CMJS of 62.75 ± 4.92 cm and of 81.7 ± 8.83 cm, SPJ of 72.9 ± 7.14 cm and of 97.63 ± 7.32 cm and BJ of 47.9 ± 5.73 cm and of 78.6 ± 6.30 cm.

The double volleyball practiced in the sand (year of 2003 to 2014) the minimum and maximum values of the jump practiced on the court were as follows: CMJ of 43.7 ± 2.9 cm and 89 ± 7.25 cm, SPJ of 64.9 ± 11.1 cm and of 67.7 ± 5.7 cm and BJ of 49.8 ± 8.2 cm.

The double volleyball practiced in the sand (year of 2003 to 2014) the minimum and maximum values of the jump practiced in the sand were as follows: CMJ of 53.1 ± 10.5 cm and 80 ± 8.67 cm, SPJ of 55.3 ± 11.4 cm and of 60 ± 2.7 cm and BJ of 46.9 ± 8.8 cm.

The years 2000 to 2009 of the indoor volleyball the minimum and maximum values of the jump were as follows: CMJ of 41.91 ± 2.57 cm and of 70.6 ± 4.6 cm, CMJS of 51.36 ± 8.15 cm and of 53.07 ± 5.35 cm, SPJ of 53 ± 4.8 cm and of 87.57 ± 6.85 cm and BJ of 48.4 ± 0.01 cm and of 55.1 ± 5.2 cm.

The years 2010 to 2016 of the indoor volleyball the minimum and maximum values of the jump were as follows: CMJ of 42.27 ± 4.23 cm and of 60.5 cm, CMJS of 47 ± 5.19 cm and of 59.8 ± 5.1 cm, SPJ of 51.67 ± 3.99 cm and of 80 cm and BJ of 42.67 ± 5.14 cm and of 60 cm.

Figure showed the CMJ of the volleyball player during the years.

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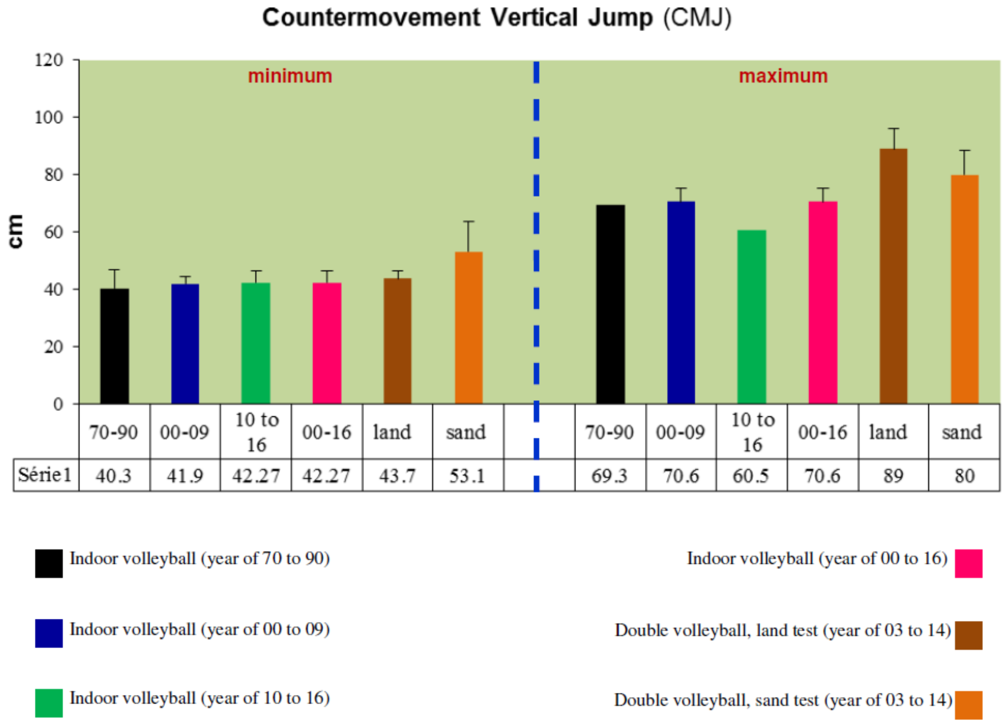

Figure 3 - Minimum and maximum of the CMJ practiced by the volleyball players.

The CMJ of the double volleyball during the minimum and the maximum jump was better than the indoor volleyball (see figure 7).

The motive was the greater effort that the sand causes during the jump (Muramatsu and collaborators, 2006). Then, the training of the indoor volleyball in the sand is important for increasing the jump of the spike and of the block (Trajkovic, Sporis and Kristicevic, 2016).

However, the double volleyball a result was different of the expected when the volleyball player jumped on the sand (53.1 ± 10.5 cm) the minimum CMJ was better than the CMJ on the land (43.7 ± 2.9 cm). The author did not identify the motive.

The minimum CMJ of the indoor volleyball was similar. But the maximum CMJ of the indoor volleyball the better jump was of 70.6 ± 4.6 cm of the years 2000 to 2009, in second place was the CMJ of 69.3 cm of the years 70 to 90 and in third place was the CMJ of 60.5 of the years 2010 to 2016. The maximum CMJ of the indoor volleyball of this study was higher than the maximum CMJ of the study of Marques Junior (2015c) (57.4 ± 9.5 cm).

Other studies about CMJ detected a maximum jump of 55 ± 1.41 cm (Marques Junior, 2005) and of 61 cm (Marques Junior, 2010) of the indoor volleyball players. Therefore, the articles collected in this study had a high CMJ. But the systematic review had a limitation, the n of the CMJ was small (see table 3).

Figure 8 showed the CMJS of the volleyball player during the years.

The CMJS of the indoor volleyball of the years 70 to 90 was better than the indoor volleyball of the other years (see figure 8). The motive of the better CMJS of the years 70 to 90 was the jump of the Cuban volleyball players of the study of Quadra and collaborators (1981).

Cuban volleyball players had the better jump of the world during the vertical jump, the spike jump and the block jump. Second Komi (1984), the best jump is related with the force, muscle fibers, type of training, the stretch-shortening cycle, the jump technique, and others.

Second Arruda and Hespanhol (2008b), the CMJS of the indoor volleyball players had a result between 56.28 ± 5.27 cm to 58.3 ± 4.71 cm. Then, the CMJS of the indoor volleyball of the years 2000 to 2009 and of the years 2010 to 2016 had a result similar to that of the literature (see figure 8).

Figure 9 showed the SPJ of the volleyball player during the years.

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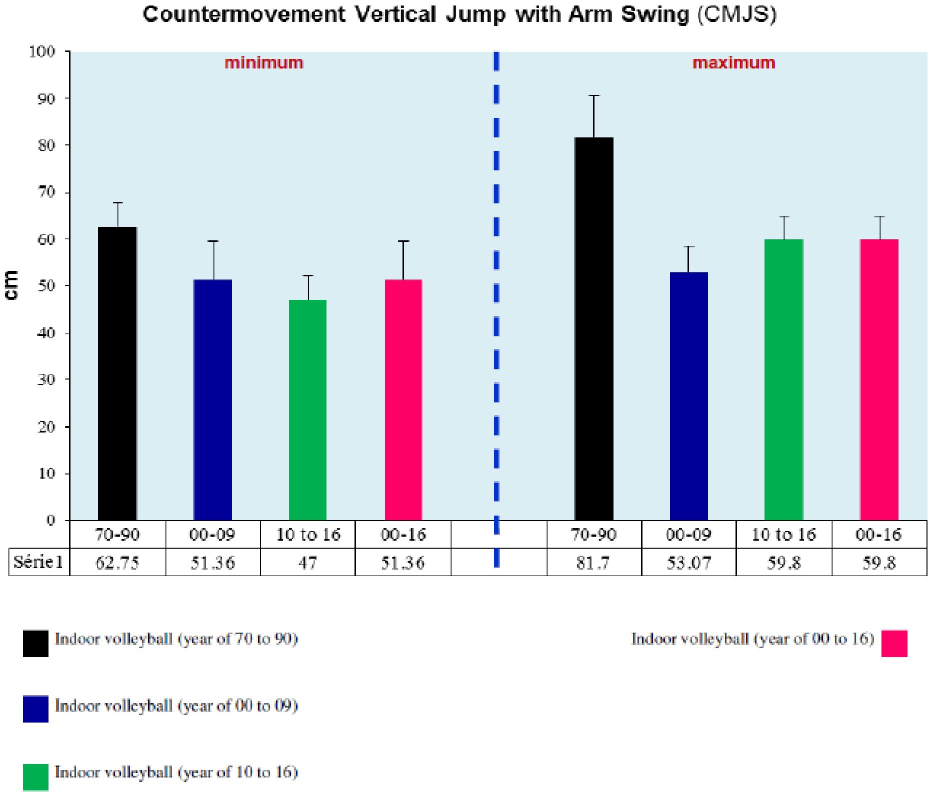

Figure 4 - Minimum and maximum of the CMJS practiced by the volleyball players.

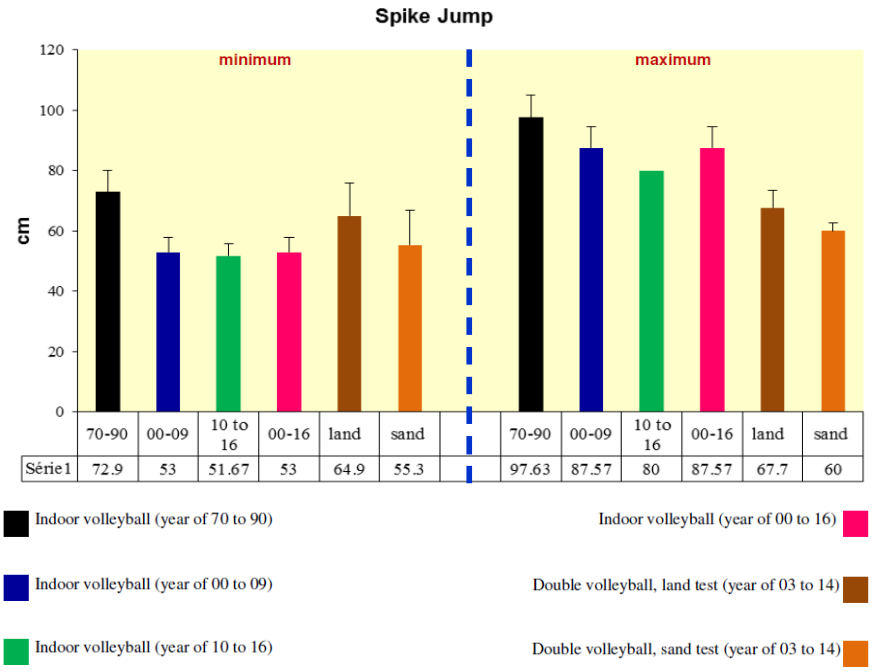

Figure 5 - Minimum and maximum of the SPJ practiced by the volleyball players.

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The SPJ had a similar result to the CMJS, the best result was of the years 70 to 90. The volleyball players of the years 70 to 90 practiced SPJ of 72.9 ± 7.14 cm and of 97.63 ± 7.32 cm. The others years of the indoor volleyball, the minimum SPJ was of 51.67 ± 3.99 cm and the maximum SPJ 85.57 ± 6.85 cm. The double volleyball practiced in the sand had worse results than the years 70 to 90 (see figure 9).

What is the cause of this better result of the years 70 to 90?

Maybe it was the sample, indoor volleyball players of the years 70 to 90 had three articles with volleyball players of the Olympic Games (Marques Junior, 2016; McGown and collaborators, 1990; Rocha, 1976) and one article with volleyball players of the World Championship of 1986 (Silva and Rivet, 1988).

Another article with high jump was the study of Quadra and collaborators (1981), the volleyball players were of several volleyball national teams. However, the double volleyball practiced in the sand, the sample was of two studies without the presence of the best players of this modality, Brazilians and United States of America (Bishop, 2003; Tilp, Wagner and Müller, 2008).

The volleyball players of the years 2000 to 2009, the sample was of four studies, with Italian volleyball players (Maffiuletti and collaborators, 2002), other with Portuguese national team (Carvalho, Vieira and Carvalho, 2007) and the latest study of volleyball players (Sheppard and collaborators, 2008). The year 2000 to 2009, the best volleyball national teams during the Olympic Games were Brazil, United States of America, Russia, Italy, and Yugoslavia (see https://pt.wikipedia.org/wiki/Voleibol_nos_Jogos_Ol%C3%ADmpicos).

Then, the years 2000 to 2009, the sample had a small number of the best volleyball national teams, only Italy players.

The volleyball players of the years 2010 to 2016, the sample was of five studies, with Brazilian volleyball players (Seron and collaborators, 2013) and others the nationality of the volleyball players was not established by the studies (Jostrzebski and collaborators, 2014; Sattler and collaborators, 2012; Soundara and Pushparajan, 2010). Then, it seems that the sample of the years 2010 to 2016 was not composed of good jumpers. But, the years 70 to 90 the sample was composed by good jumpers of the volleyball – Cuban, Brazilians, United States of American, Soviet Union and others.

Figure 10 showed the BJ of the volleyball player during the years.

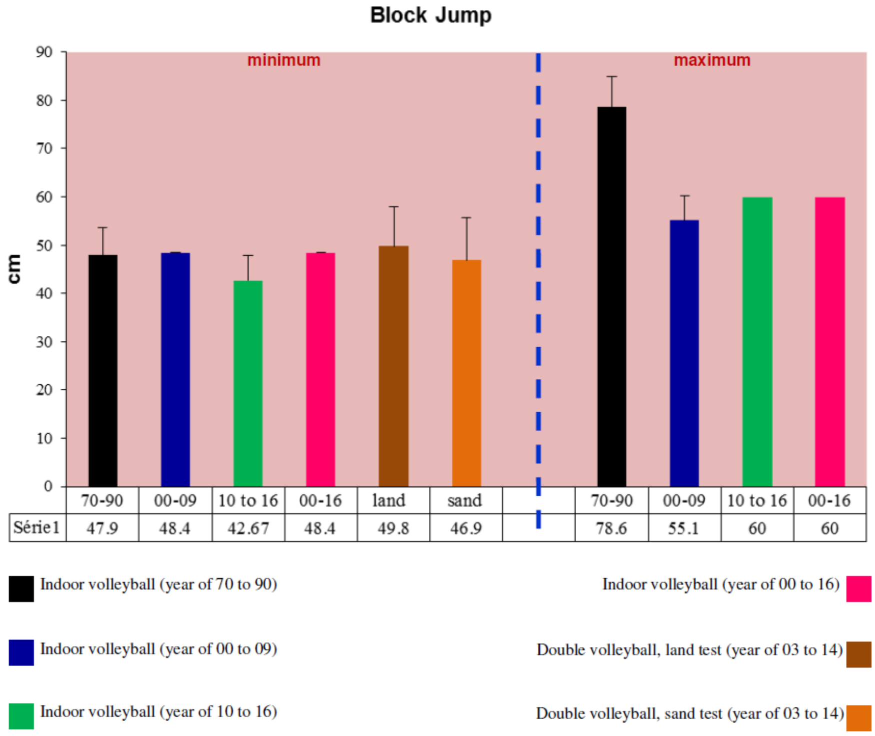

Figure 6 - Minimum and maximum of the BJ practiced by the volleyball players.

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The minimum BJ had result similar between the years. But the maximum BJ the best jump was of the years 70 to 90.

The motive was the same of the SPJ, the years 70 to 90 had volleyball national team of 1979 to 1981, Soviet Union volleyball players practiced BJ of 78 ± 5.36 cm and China volleyball players practiced BJ of 78.6 ± 6.30 cm (Quadra and collaborators, 1981).

Then, the study of the years 70 to 90 had good jumpers. However, indoor volleyball of the years 2000 to 2009 (55.1 ± 5.2 cm) and 2010 to 2016 (60 cm) had a worse result because the articles did not have Olympic athletes. Therefore, the level of the volleyball players of the years 2000 to 2009 and of 2010 to 2016 was worse than in the years 70 to 90.

Second Arruda and Hespanhol (2008a), BJ of the indoor volleyball players had a result of 60.8 ± 6.3 cm and of 65.6 ± 4.5 cm. Marques Junior (2015a) detected BJ of the volleyball players of 46.47 ± 5.18 cm to 60 cm. Then, the studies had a result similar to the years 2000 to 2009 and from 2010 to 2016.

The systematic review had limitations, the jump test used in each study were different. For example, Marques Junior (2016) determined the SPJ and the BJ with Kinovea® software, but Rocha (1976) measured the SPJ with the Sargent jump test simulating the spike. Bishop (2003) determined the SPJ and the BJ with the Yardstick jump (see in http://performbetter.co.uk/product/yardstick-jump-testing-system/) and Maffiuletti and collaborators (2002) used the Optojump (see in http://www.optojump.com/What-is-Optojump/The-single-meter.aspx and http://www.optojump.com/support/software-tutorial.aspx).

Therefore, the type of jump test equipment perhaps differ the result of the evaluation. The study of Moura and collaborators et al. (2015) evidenced a difference in jump height of three jump tests with female volleyball players of 15.4 ± 0.9 years (n = 13) – Abalakov jump (a jump of 36,7±3,9 cm), contact mat (a jump of 35.4 ± 3.8 cm) and videogrammetry (a jump of 34.9 ± 3.5 cm).

The results of the CMJ of the meta-analysis were presented table 4. The articles about CMJ of the years 70 to 90 of the indoor volleyball the line is white, the studies of the double volleyball (2003 to 2014) practiced in the sand the line is blue, the studies of 2000 to 2009 of the indoor volleyball the line is the second white and the studies of 2010 to 2016 of the indoor volleyball the line is second blue.

The results of the CMJS of the meta-analysis were presented table 5. The articles about CMJS of the years 70 to 90 of the indoor volleyball the line is white, the studies of 2000 to 2009 of the indoor volleyball the line is yellow and the studies of 2010 to 2016 of the indoor volleyball the line is second white.

Table 4 - Results of the studies with CMJ.

Study	Effect Size and Classification	Standard Error	95% confidence interval (lower limit to upper limit)	Variance	Study Weight	Weighted Effect Size
Gladden and Colacino (1978)	8.25 (great)	0.30	7.66 to 8.83	0.09	11.11	91.66
Komi and Bosco (1978)	2.00 (great)	0.35	1.31 to 2.68	0.68	8.16	16.32
Puhl and collaborators (1982)	13.78 (great)	1.07	11.68 to 15.87	1.14	0.87	12.03
Clutch and collaborators (1983)	1.28 (great)	0.33	0.63 to 1.92	0.10	9.18	11.75
Clutch and collaborators (1983)	1.85 (great)	0.39	1.08 to 2.61	0.15	6.57	12.16
Van Soest and collaborators (1985)	18.29 (great)	1.35	15.64 to 20.93	1.82	0.54	10.03
Silva and Rivet (1988)	0.94 (great)	0.28	0.39 to 1.48	0.07	12.75	11.98
Newton and collaborators (1999)	2.17 (great)	0.52	1.15 to 3.18	0.27	3.69	8.02
Bishop (2003)	0.65 (medium)	0.25	0.16 to 1.14	0.06	16.00	10.40
Medeiros and collaborators (2008)	6.82 (great)	0.38	6.07 to 7.56	0.14	6.92	47.22
Riggs and Sheppard (2009)	5.48 (great)	0.63	4.24 to 6.71	0.39	2.51	13.80
Medeiros and collaborators (2012)	5.90 (great)	0.35	5.21 to 6.58	0.12	8.16	48.16
Medeiros and collaborators (2012)	4.92 (great)	0.32	4.29 to 5.54	0.10	9.76	48.04
Magalhães and collaborators (2001)	9.83 (great)	0.45	8.94 to 10.71	0.20	4.93	48.54
Hespanhol and Arruda (2014)	3.60 (great)	0.60	2.42 to 4.77	0.36	2.77	10.00
Turpin and collaborators (2014)	1.63 (great)	0.52	0.61 to 2.64	0.27	3.69	6.02
Turpin and collaborators (2014)	0.17 (very small)	0.17	0.16 to 0.50	0.02	34.60	5.88
Maffiuletti and collaborators (2002)	0.03 (very small)	0.04	0.04 to 0.10	0.00	6.25	18.75
Marques and collaborators (2004)	0.53 (medium)	0.16	0.87 to 1.19	0.02	39.06	20.70
Massa and collaborators (2003)	2.88 (great)	0.54	1.82 to 3.93	0.29	3.42	9.87
Hasson and collaborators (2004)	3.84 (great)	0.37	3.11 to 4.56	0.13	7.30	28.04
Rocha and collaborators (2005)	0.78 (medium)	0.12	0.54 to 1.01	0.01	69.44	54.16
Carvalho and collaborators (2007)	0.11 (very small)	0.10	0.08 to 0.30	0.01	10.00	11.00

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Peeni (2007)	0.76 (medium)	0.28	0.21 to 1.30	0.07	12.75	9.69
Peeni (2007)	1.83 (great)	0.48	0.88 to 2.77	0.23	4.34	7.94
Hespanhol and collaborators (2007)	0.33 (small)	0.18	0.02 to 0.68	0.03	30.86	10.18
Sheppard and collaborators (2008)	0.28 (small)	0.17	0.05 to 0.61	0.02	34.60	9.68
Marques and Marinho (2009)	0.54 (medium)	0.15	0.24 to 0.83	0.02	44.44	24.00
Marques and collaborators (2009)	1.94 (great)	0.24	1.46 to 2.41	0.05	17.36	33.68
Sheppard and collaborators (2009)	1.14 (great)	0.10	0.94 to 1.33	0.01	10.00	11.00
Marques and collaborators (2010)	0.58 (medium)	0.16	0.26 to 0.89	0.02	39.06	22.65
Marques and collaborators (2010)	0.69 (medium)	0.23	0.23 to 1.14	0.05	18.90	13.04
Nuzzo and collaborators (2011)	0.09 (very small)	0.05	0.01 to 0.18	0.00	40.00	36.00
Borràs and collaborators (2011)	0.88 (great)	0.20	0.48 to 1.27	0.04	25.00	22.00
Sattler and collaborators (2012)	0.32 (small)	0.08	0.16 to 0.47	0.01	15.00	50.00
Trajkovic and collaborators (2012)	0.51 (medium)	0.18	0.81 to 1.17	0.03	30.86	15.74
Seron and collaborators (2013)	4.07 (great)	0.56	2.97 to 5.16	0.31	3.18	12.97
Jostrzebski and collaborators (2014)	0.89 (great)	0.30	0.30 to 1.47	0.09	11.11	9.88
Jostrzebski and collaborators (2014)	0.76 (medium)	0.28	0.21 to 1.30	0.07	12.75	9.69
Pupo and collaborators (2014)	0.06 (very small)	0.05	0.03 to 0.15	0.00	40.00	13.00
Coso and collaborators (2014)	0.38 (small)	0.16	0.06 to 0.69	0.02	39.06	14.84
Freitas and collaborators (2014)	0.14 (very small)	0.09	0.03 to 0.31	0.01	12.00	17.28
Freitas and collaborators (2014)	0.05 (very small)	0.06	0.06 to 0.16	0.00	27.00	13.88
Lima and collaborators (2015)	2.74 (great)	0.39	1.97 to 3.50	0.15	6.57	18.01

Table 5 - Results of the studies with CMJS.

Study	Effect Size and Classification	Standard Error	95% confidence interval (lower limit to upper limit)	Variance	Study Weight	Weighted Effect Size
Quadra and collaborators (1981)	3.75 (great)	0.56	2.65 to 4.84	0.31	3.18	11.95
Quadra and collaborators (1981)	9.65 (great)	0.90	7.88 to 11.41	0.81	1.23	11.91
Quadra and collaborators (1981)	0.13 (very small)	0.10	0.06 to 0.32	0.01	1.00	13.00
Silva and Rivet (1988)	1.47 (great)	0.35	0.78 to 2.15	0.12	8.16	12.00
Newton and collaborators (1999)	2.23 (great)	0.53	1.19 to 3.26	0.28	3.55	7.93
Rocha and collaborators (2005)	1.07 (great)	0.14	0.79 to 1.34	0.01	51.02	54.59
Borràs and collaborators (2011)	0.45 (small)	0.14	0.17 to 0.72	0.01	51.02	22.95
Aouadi and collaborators (2011)	0.67 (medium)	0.17	0.33 to 1.00	0.02	34.60	23.18
Jostrzebski and collaborators (2014)	0.99 (great)	0.31	0.38 to 1.59	0.09	10.40	10.30
Jostrzebski and collaborators (2014)	0.34 (small)	0.18	0.01 to 0.69	0.03	30.86	10.49

Table 6 - Results of the studies with SPJ.

Study	Effect Size and Classification	Standard Error	95% confidence interval (lower limit to upper limit)	Variance	Study Weight	Weighted Effect Size
Rocha (1976)	0.61 (medium)	0.23	0.15 to 1.06	0.05	18.90	11.53
Quadra and collaborators (1981)	2.85 (great)	0.49	1.88 to 3.81	0.24	4.16	11.87
Quadra and collaborators (1981)	6.11 (great)	0.71	4.71 to 7.50	0.50	1.98	12.12
Marques Junior (2016)	2.34 (great)	0.26	1.83 to 2.84	0.06	14.79	9.91
Marques Junior (2016)	1.36 (great)	0.34	0.69 to 2.02	0.11	8.65	5.79
McGown and collaborators (1990)	1.61 (great)	0.37	0.88 to 2.33	0.13	7.30	4.89
Smith and collaborators (1992)	4.97 (great)	0.58	3.83 to 6.10	0.33	2.97	14.77
Bishop (2003)	3.10 (great)	0.56	2.00 to 4.19	0.31	3.18	9.88
Tilp and collaborators (2008)	4.90 (great)	0.78	3.37 to 6.42	0.60	1.64	8.05
Maffiuletti and collaborators (2002)	0.28 (small)	0.12	0.04 to 0.51	0.00	69.44	19.44
Carvalho and collaborators (2007)	0.15 (very small)	0.12	0.08 to 0.38	0.01	69.44	10.41
Sheppard and collaborators (2008)	0.33 (small)	0.18	0.02 to 0.68	0.03	30.86	10.18
Sheppard and collaborators (2009)	4.09 (great)	0.18	3.73 to 4.44	0.03	30.86	12.63
Soundara and Pushparajan (2010)	0.62 (medium)	0.20	0.22 to 1.01	0.04	25.00	15.50
Soundara and Pushparajan (2010)	0.17 (very small)	0.11	0.04 to 0.38	0.01	82.64	14.04
Sattler and collaborators (2012)	0.70 (medium)	0.12	0.46 to 0.93	0.01	69.44	48.61
Trajkovic and collaborators (2012)	0.55 (medium)	0.19	0.17 to 0.92	0.03	27.70	15.23
Seron and collaborators (2013)	6.46 (great)	0.70	5.08 to 7.83	0.49	2.04	13.18
Jostrzebski and collaborators (2014)	0.40 (medium)	0.20	0.01 to 0.79	0.04	25.00	10.00
Jostrzebski and collaborators (2014)	0.61 (medium)	0.25	0.12 to 1.10	0.06	16.00	9.76

The results of the SPJ of the meta-analysis were presented table 6. The articles about SPJ of the years 70 to 90 of the indoor volleyball the line is white, the studies of the double volleyball (2003 to 2014) practiced in the sand the line is green, the studies of 2000 to 2009 of the indoor volleyball the line is second white and the studies of 2010 to 2016 of the indoor volleyball the line is second green.

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The articles about BJ of the years 70 to 90 of the indoor volleyball the line is white, the studies of the double volleyball (2003 to 2014) practiced in the sand the line is pink, the studies of 2000 to 2009 of the indoor volleyball the line is second white and the studies of 2010 to 2016 of the indoor volleyball the line is the second pink. The results of the BJ of the meta-analysis were presented table 7.

The meta-analysis had a study with value null, the SPJ of Quadra and collaborators (1981) between Cuba and China. The fail-safe *n* was of 49,07.

The pooled estimate of the effect size and the pooled estimate of 95% confidence interval the author calculated and table 8 presents this result.

Table 7 - Results of the studies with BJ.

Study	Effect Size and Classification	Standard Error	95% confidence interval (lower limit to upper limit)	Variance	Study Weight	Weighted Effect Size
Quadra and collaborators (1981)	1.48 (great)	0.35	0.79 to 2.16	0.12	8.16	12.08
Quadra and collaborators (1981)	19.70 (great)	1.28	17.19 to 22.20	1.63	0.61	3.72
Quadra and collaborators (1981)	1.13 (great)	0.31	0.52 to 1.73	0.09	10.40	11.75
Marques Junior (2016)	0.51 (medium)	0.21	0.09 to 0.92	0.04	22.67	15.19
Marques Junior (2016)	0.30 (small)	0.16	0.01 to 0.61	0.02	39.06	26.17
Smith and collaborators (1992)	7.02 (great)	0.42	6.19 to 7.84	0.17	5.66	39.79
Bishop (2003)	1.15 (great)	0.34	0.48 to 1.81	0.11	8.65	9.94
Carvalho and collaborators (2007)	0.22 (medium)	0.15	0.07 to 0.51	0.02	44.44	9.77
Sheppard and collaborators (2007)	18.97 (great)	41.50	18.54 to 19.81	0.05	17.22	11.01
Soundara and Pushparajan (2010)	0.70 (medium)	0.22	0.26 to 1.13	0.04	20.66	14.46
Soundara and Pushparajan (2010)	0.15 (very small)	0.10	0.04 to 0.34	0.01	10.00	15.00
Sattler and collaborators (2012)	0.64 (medium)	0.12	0.40 to 0.87	0.01	69.44	44.44
Seron and collaborators (2013)	6.46 (great)	0.70	5.08 to 7.83	0.49	2.04	13.18
Jostrzebski and collaborators (2014)	0.21 (small)	0.14	0.06 to 0.48	0.01	51.02	10.71
Jostrzebski and collaborators (2014)	0.46 (medium)	0.21	0.04 to 0.87	0.01	22.67	4.76

Table 8 - Pooled estimate used in the forest plots.

Study	CMJ	CMJS	SPJ	BJ
Indoor Volleyball (years 70 to 90) Effect Size (mean and standard deviation) 95% confidence interval (lower limit to upper limit)	6.07 ± 6.68 (great) 4.94 to 7.18	3.44 ± 3.70 (great) 2.51 to 4.39	2.83 ± 2.00 (great) 1.99 to 3.66	5.02 ± 7.61 (great) 4.13 to 5.19
Sand Double (year of 2003 to 2014, 11 year) Effect Size (mean and standard deviation) 95% confidence interval (lower limit to upper limit)	4.33 ± 3.14 (great) 3.56 to 5.12	- -	4.00 ± 1.27 (great) 2.68 to 5.30	1.15 (great) 0.48 to 1.81
Indoor Volleyball (year of 2000 to 2009, 10 years) Effect Size (mean and standard deviation) 95% confidence interval (lower limit to upper limit)	1.15 ± 1.15 (great) 0.78 to 1.61	1.07 (great) 0.79 to 1.34	1.21 ± 1.92 (great) 0.96 to 1.50	9.59 ± 13.26 (great) 9.30 to 10.16
Indoor Volleyball (year of 2010 to 2016, 7 years) Effect Size (mean and standard deviation) 95% confidence interval (lower limit to upper limit)	0.86 ± 1.14 (great) 0.54 to 1.27	0.61 ± 0.28 (medium) 0.22 to 1.00	1.35 ± 2.25 (great) 0.87 to 1.85	1.43 ± 2.47 (great) 9.30 to 10.16
Indoor Volleyball (year of 2000 to 2016, 17 years) Effect Size (mean and standard deviation)	1.00 ± 1.13 (great)	0.70 ± 0.32 (medium)	1.30 ± 2.04 (great)	3.47 ± 6.61 (great)
All results of the volleyball (indoor and sand double, years 70 to 16) Effect Size (mean and standard deviation) 95% confidence interval (lower limit to upper limit)	2.60 ± 3.78 (great) 1.45 to 3.75	2.07 ± 2.87 (great) 0.02 to 4.12	2.11 ± 2.12 (great) 1.11 to 3.10	3.94 ± 6.61 (great) 0.27 to 7.60

Legend: Abbreviation of the jump tests: CMJ – countermovement vertical jump, CMJS - countermovement vertical jump with arm swing, SPJ – spike jump and BJ – block jump.

The statistical heterogeneity of the sample during the CMJ was high, I^2 index of 3600%. Then, the random effects model was calculated, the results were the following: effect summary of 108.43, standard error of 13054.18 and 95% confidence interval of -25477.76 to 25694.62 (lower limit to upper limit). The statistical heterogeneity of the sample during the CMJS was high, I^2 index of 600%. Then, the random effects model was calculated, the results were the following: effect summary of 20.75, standard error of 4831.42 and 95% confidence interval of -9448.84 to 9490.34 (lower limit to upper limit).

The statistical heterogeneity of the sample during the SPJ was high, I^2 index of

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1500%. Then, the random effects model was calculated, the results were the following: effect summary of 42.21, standard error of 0.89 and 95% confidence interval of 40.44 to 43.97 (lower limit to upper limit). The statistical heterogeneity of the sample during the BJ was high, I^2 index of 900%. Then, the random effects model was calculated, the results were the following: effect summary of 70.3, standard error of 0.07 and 95% confidence interval of 70.14 to 70.45 (lower limit to upper limit).

The Shapiro Wilk test detected no normal data. The histogram showed the no normal data in figure 11.

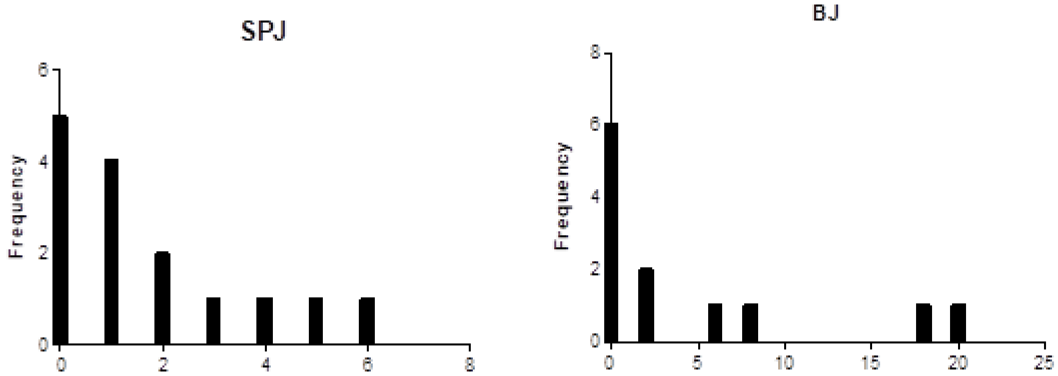

Figure 7 - Histogram of the SPJ and of the BJ.

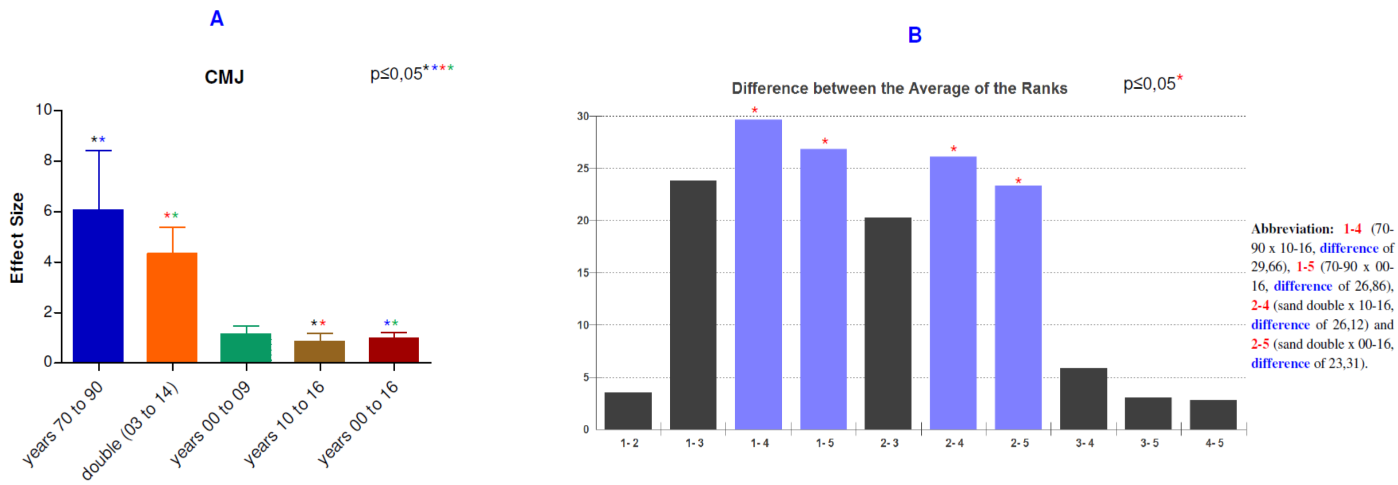

Figure 8 - (A) Effect size of the CMJ and (B) difference between the comparisons of the CMJ.

The study practiced the ANOVA comparisons of the effect size of each jump test.

Kruskal Wallis Anova detected significant difference of the CMJ, H (4) = 19.61, p = 0.0006. The Dunn post hoc detected significant difference ($p \le 0.05$) of the CMJ between the following years: years 70 to 90 (effect size of 6.07) versus years 10 to 16 (effect size of 0.86) – difference in rank sum of 29.66, years 70 to 90 versus years 00 to 16 (effect size of 1) - difference in rank sum of 26.86, sand double (3 to 14, effect size of 4.33) versus years 10 to 16 – difference in rank sum of 26,12 and sand double (03 to 14) versus years 00 to 16 - difference in rank sum of 23.31. Figure 12 illustrates the result.

The new statistic of Cumming (2014) determined a statistical difference in six comparisons. Table 9 shows these results.

When the same comparison had statistical difference during the significance p and during the new statistical the result had a statistical difference (Marques Junior, 2018). The study determined a statistical difference in two comparisons. The figure 13 illustrates the result of the CMJ.

The funnel plot was used to establish the publication bias of the CMJ effect size

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(ES). Figure 14 illustrates the result of the CMJ.

The data were spaced, evidencing heterogeneity and the appearance of the points was asymmetric. Then, the CMJ had publications bias.

Kruskal Wallis Anova detected no significant difference of the CMJS, H (4) = 19.61, p = 0.0006. The graph 8 illustrates the result. Kruskal Wallis Anova detected no significant difference of the SPJ, H (4) = 8.68, p = 0.06. Kruskal Wallis Anova detected no significant difference of the BJ, H (4) = 3.11, p = 0.53. The figure 15 illustrates the result.

The new statistic of Cumming (2014) without statistical difference table 10 shows the results (CMJS, SPJ and BJ).

Table 9 - Results of the new statistic referent to the CMJ.

Comparisons	Overlap	p	Comparisons	Overlap	p
years 70 to 90 x double (03 to 14)	1.25	0.54	double (03 to 14) x years 10 to 16	0.05*	0.002*
years 70 to 90 x years 00 to 09	0.38*	0.02*	double (03 to 14) x years 00 to 16	0.01*	0.001*
years 70 to 90 x years 10 to 16	0.38*	0.01*	years 00 to 09 x years 10 to 16	1.61	0.55
years 70 to 90 x years 00 to 16	0.38*	0.01*	years 00 to 09 x years 00 to 16	1.80	0.80
double (03 to 14) x years 00 to 09	0.12*	0.003*	years 10 to 16 x years 00 to 16	1.57	0.69

Legend: n = 10 or more: Overlap of 0.50 or less* and p≤0.05* (statistical difference)

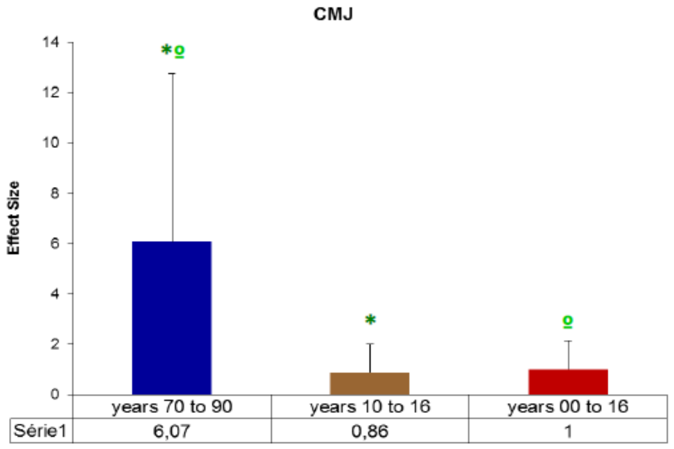

Figure 9 - CMJ with statistical difference.

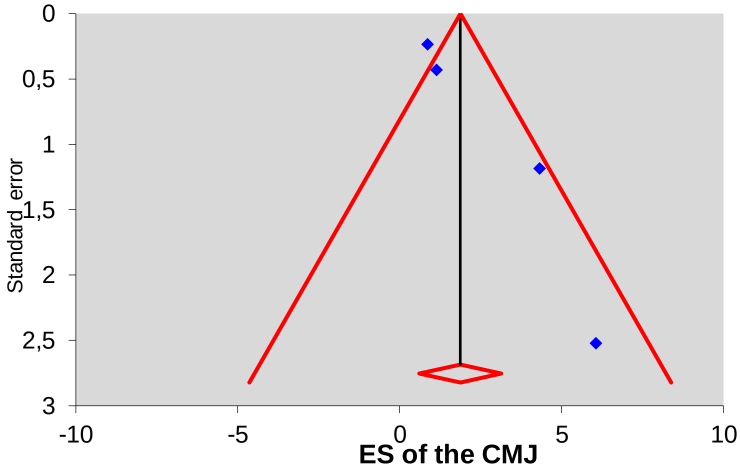

Figure 10 - Funnel plot with the CMJ effect size data.

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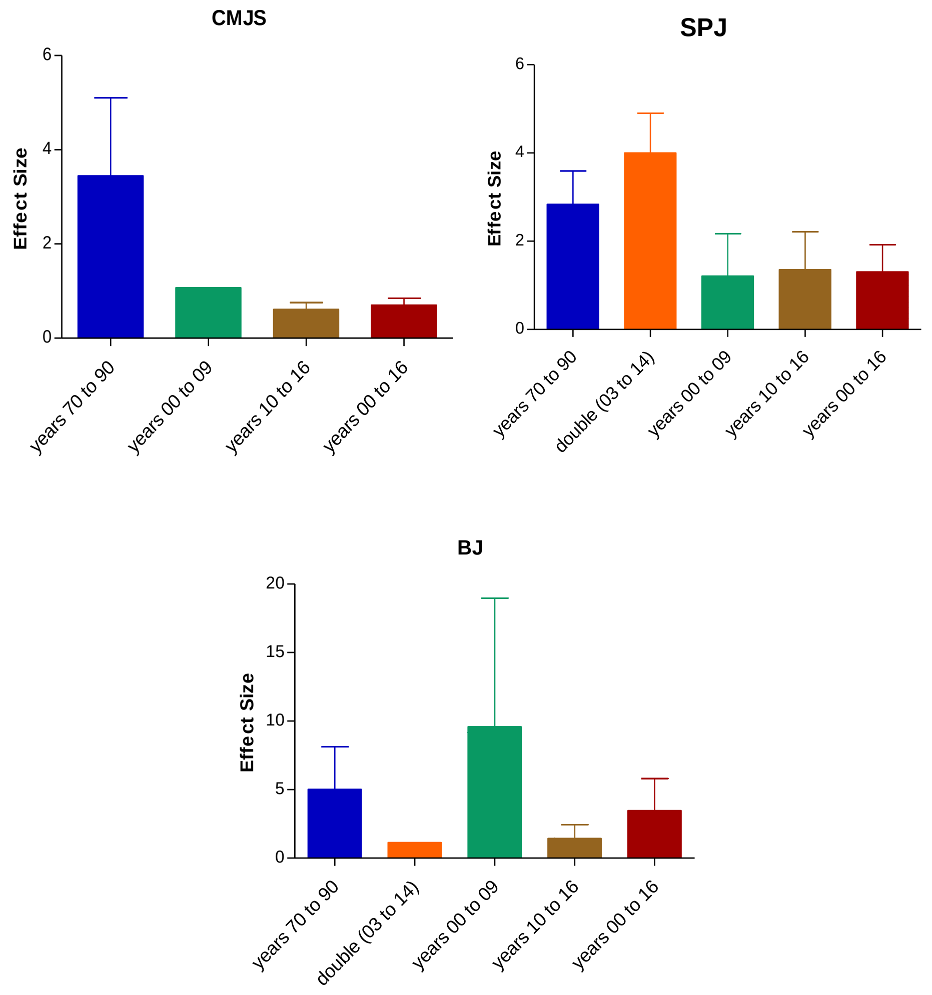

Figure 11 - Effect size of the CMJ, of the SPJ and of the BJ.

Table 10 - Results of the new statistic referent to the CMJS, SPJ and BJ.

Comparisons of the CMJS	**Overlap**	**p**	**Comparisons of the SPJ**	**Overlap**	**p**	**Comparisons of the BJ**	**Overlap**	**p**
years 70 to 90 x years 00 to 09	0.01	0.43	years 70 to 90 x years 00 to 16	1.28	0.23	years 70 to 90 x years 10 to 16	0.72	0.37
years 70 to 90 x years 10 to 16	0.21	0.25	double (03 to 14) x years 00 to 09	0.91	0.15	years 70 to 90 x years 00 to 16	1.04	0.73
years 70 to 90 x years 00 to 16	0.14	0.18	double (03 to 14) x years 10 to 16	0.81	0.17	double x years 00 to 09	0.01	0.47
years 00 to 09 x years 10 to 16	0.01	0.07	double (03 to 14) x years 00 to 09	0.54	0.13	double x years 10 to 16	0.01	0.95
years 00 to 09 x years 00 to 16	0.01	0.11	years 00 to 09 x years 10 to 16	1.39	0.94	double x years 00 to 09	0.01	0.68
years 10 to 16 x years 00 to 16	1.56	0.54	years 00 to 09 x years 00 to 09	1.85	0.94	years 00 to 09 x years 10 to 16	0.42	0.27
Comparisons of the SPJ	**Overlap**	**p**	years 10 to 16 x years 00 to 09	1.53	1.00	years 00 to 09 x years 00 to 16	0.97	0.45
years 70 to 90 x double (03 to 14)	0.75	0.47	**Comparisons of the BJ**	**Overlap**	**p**	years 10 to 16 x years 00 to 16	1.54	0.58
years 70 to 90 x years 00 to 09	1.44	0.27	years 70 to 90 x double (03 to 14)	0.01	0.50			
years 70 to 90 x years 10 to 16	1.42	0.29	years 70 to 90 x years 00 to 09	1.39	0.62			

Legend: n = 3: Overlap of 1 and 0.50* and p≤0.05* (statistical difference)

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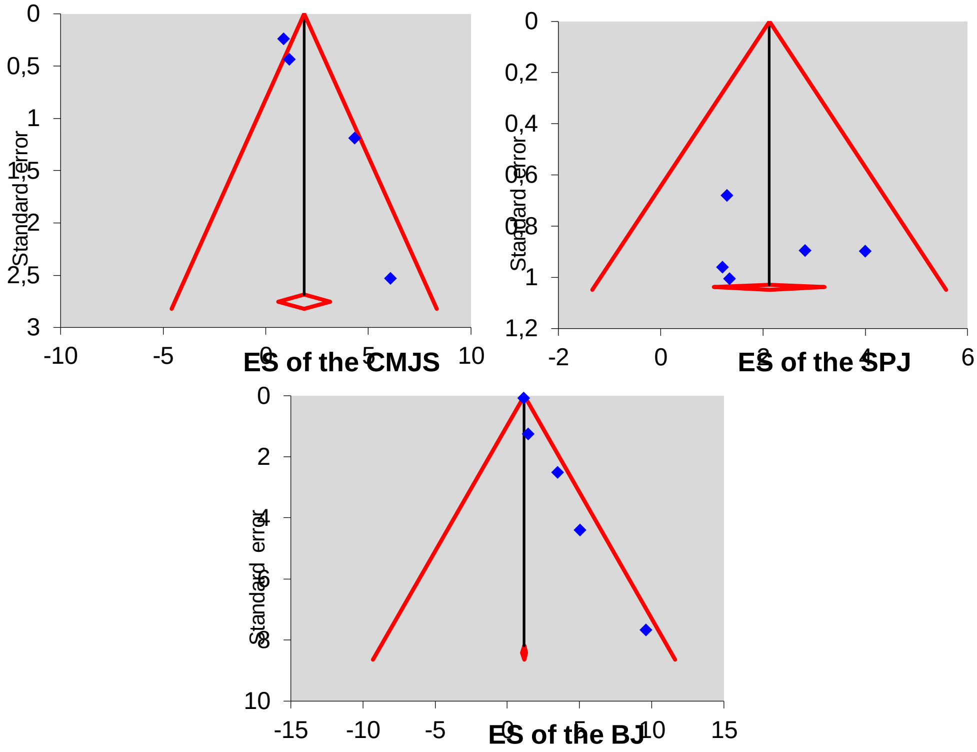

Figure 12 - Funnel plot with the effect size data (CMJS, SPJ and BJ).

The funnel plot was used to establish the publication bias of the CMJS effect size (ES), of the SPJ effect size and of the BJ effect size. Figure 16 illustrates the result.

The data were spaced, evidencing heterogeneity and the appearance of the points was asymmetric. Then the three types of jump (CMJS, SPJ and BJ) had publications bias.

The years 70 to 90 of the indoor volleyball had high result during the CMJS (62.75 ± 4.92 cm and 81.7 ± 8.83 cm, effect size of 3.44 ± 3.70 – great effect), the SPJ (72.9 ± 7.14 cm and 97.63 ± 7.32 cm, effect size of 2.83 ± 2 – great effect) and the BJ (47.9 ± 5.73 cm and 78.6 ± 6.30 cm, effect size of 5.02 ± 7.61 – great effect) of the systematic review and of the meta-analysis. But the CMJ of the indoor volleyball of the years 70 to 90 had the best effect size (ES of 6.07 ± 6.68) but the jump of the systematic review was the third best value of the maximum CMJ (69,3 cm) and the minimum jump had a result similar between the years. Then, this result was slightly different between the systematic review and meta-analysis.

Double volleyball practiced in the sand (2003 to 2014) had the second best result of the CMJ (89 ± 7.25 cm) and of the effect size (ES of 4.33 ± 3.14). But double volleyball practiced in the sand had the best effect size (ES of 6.07 ± 6.68) of the SPJ and the SPJ had the second best result of the minimum value (64.9 ± 11.1 cm) and the fourth best of the maximum value (67.7 ± 5.7 cm). Then, this result was slightly different between the systematic review and meta-analysis.

The indoor volleyball of the years 2000 to 2009 and of the years 2010 to 2016, the effect size had a lower value than the years 70 to 90 of the indoor volleyball during the CMJ, CMJS and the SPJ. However, the effect size of the BJ of the years 2000 to 2009 (9.59 ± 13.26) had the best value.

But the years 70 to 90 the best jump occurred in the systematic review during the CMJS (62.75 ± 4.92 cm and 81.7 ± 8.83 cm), the SPJ (72.9 ± 7.14 cm and 97.63 ± 7.32 cm) and the BJ (maximum value of 78.6 ± 6.30 cm). These results of the years 70 to 90 were better than the years 2000 and the double volleyball.

The discussion of the systematic review detected limitations (small n, different jump test) and the articles of the years 70 to 90 of the indoor volleyball had a sample better, three articles with volleyball players competed in the Olympic Games (Marques Junior, 2016;

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McGown and collaborators, 1990; Rocha, 1976) the study of Quadra and collaborators (1981) with volleyball players of Cuba and of the Soviet Union, national volleyball team with the best jump. Then, indoor volleyball of the years 70 to 90 had an advantage during the jump because of these reasons.

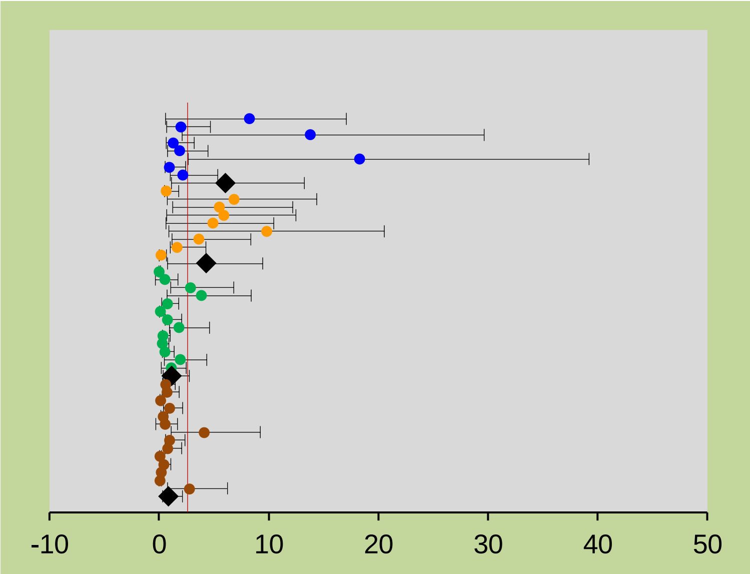
The forest plots summarize the individual result of each study in the meta-analysis (Verhagen and Ferreira, 2014).

The order of each study ball (blue, orange, green and brown) presented in forest plots is the same of table 4 to 7 of each jump test.

For example, the CMJ the first study of table 4 is of Gladden and Colacino (1978) and in the forest plots (see graph 11) the first blue ball is the study of Gladden and Colacino (1978). The last study of table 4 is the article of Lima and collaborators (2015) and in the forest plots, the last brown ball is the study of Lima and collaborators (2015).

The pooled estimate is a black diamond in the forest plots and the value of the black diamond of each year was presented in table 8.

Figure 17 shows the forest plots of the CMJ.



Legend: Meaning: Blue Ball – effect size (ES) of the years 70 to 90 of the indoor volleyball, Right Horizontal Line – upper limit of 95% confidence interval, Left Horizontal Line – lower limit of 95% confidence interval, Vertical Line – null effect, Black Diamond – pooled estimate of each year, Orange Ball – ES of the sand double (03 to 14) volleyball, Green Ball – ES of the years 00 to 09 of the indoor volleyball, Brown Ball – ES of the years 10 to 16 of the indoor volleyball.

Figure 13 - Forest plots of the CMJ.

The years 70 to 90 of the indoor volleyball with blue ball, only effect size (EF) with significant difference ($p \leq 0.05$) were the study of Van Soest and collaborators (1985) (EF of 18.29) and the study of Silva and Rivet (1988) (EF of 0.94). The sand double volleyball (03 to 14) with the orange ball, only effect size (EF) with significant difference ($p \leq 0.05$) were the study of Bishop (2003) (EF of 0.65) and of Turpin and collaborators (2014) (EF of 0.17). The others results of the years 70 to 90 and of the sand double volleyball (03 to 14) had no significant difference ($p>0.05$) because the confidence interval crossed the vertical line of the null effect.

The years 00 to 09 of the indoor volleyball with green ball had several results with significant difference ($p \leq 0.05$), but the results of the years 00 to 09 with no significant difference were the study of Massa and collaborators (2003) (ES of 2.88), of Hasson and collaborat ors (2004) (ES of 3.84), of Peeni (2007) (ES of 1.83), of Marques and collaborators (2009) (ES of 1.94) and the pooled estimate (ES of 1.15).

The years 10 to 16 of the indoor volleyball with brown ball had several results

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with significant difference ($p \le 0.05$), but the results of the years 10 to 16 with no significant difference were the study of Seron and collaborators (2013) (ES of 4.07) and the study of Lima and collaborators (2015) (ES of 2.74).

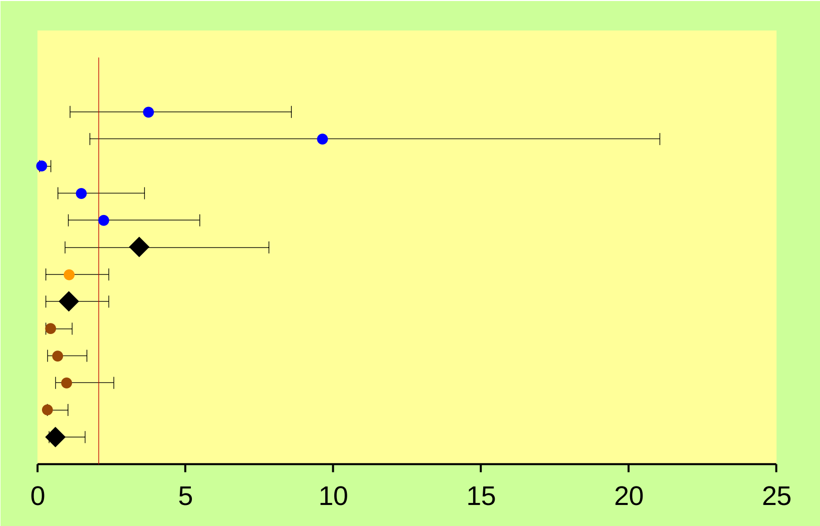
Figure 18 shows the forest plots of the CMJS.

The years 70 to 90 of the indoor volleyball had a study with significant difference ($p \le 0.05$), the article of Quadra and collaborators (1981) (ES of 0.13).

But the years 10 to 16 of the indoor volleyball had four results with significant difference ($p \le 0.05$). The studies were the following: Borrás and collaborators (2011) (ES of 0.45), Aouadi and collaborators (2011) (ES of 0.67), Jostrzebski and collaborators et al. (2014) (ES of 0.34) and pooled estimate (ES of 0.61).

The others results of the years 70 to 90, of the years 00 to 09 and of the 10 to 16 had no significant difference ($p > 0.05$).

Figure 19 shows the forest plots of the SPJ.



Legend: Meaning: Blue Ball – effect size (ES) of the years 70 to 90 of the indoor volleyball, Right Horizontal Line – upper limit of 95% confidence interval, Left Horizontal Line – lower limit of 95% confidence interval, Vertical Line – null effect, Black Diamond – pooled estimate of each year, Green Ball – ES of the years 00 to 09 of the indoor volleyball, Brown Ball – ES of the years 10 to 16 of the indoor volleyball.

Figure 14 - Forest plots of the CMJS.

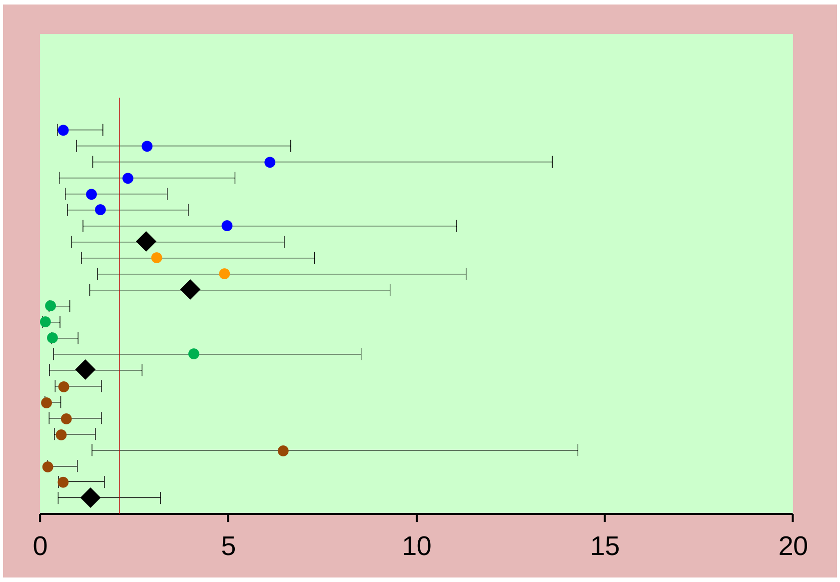


Figure 15 - Forest plots of the SPJ.

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The forest plots of the SPJ had several results with no significant difference (p>0.05). The years 70 to 90 (blue ball) had a study with significant difference (p≤0.05), the article of Rocha (1976) (ES of 0.61).

The years 00 to 09 (green ball) had three studies with significant difference (p≤0.05), the article of Maffiuletti and collaborators (2002) (ES of 0.28), of Carvalho and collaborators (2007) (ES of 0.15) and of Sheppard and collaborators (2008) (ES of 0.33).

But the years 10 to 16 (brown ball) had several studies with significant difference (p≤0.05), the articles of Soundara and Pushparajan (2010) (ES of 0.62 and 0.17), of Sattler and collaborators (2012) (ES of 0.70), of Trajkovic and collaborators (2012) (ES of 0.55) and of Jostrzebski and collaborators (2014) (ES of 0.61).

Figure 20 shows the forest plots of the BJ.

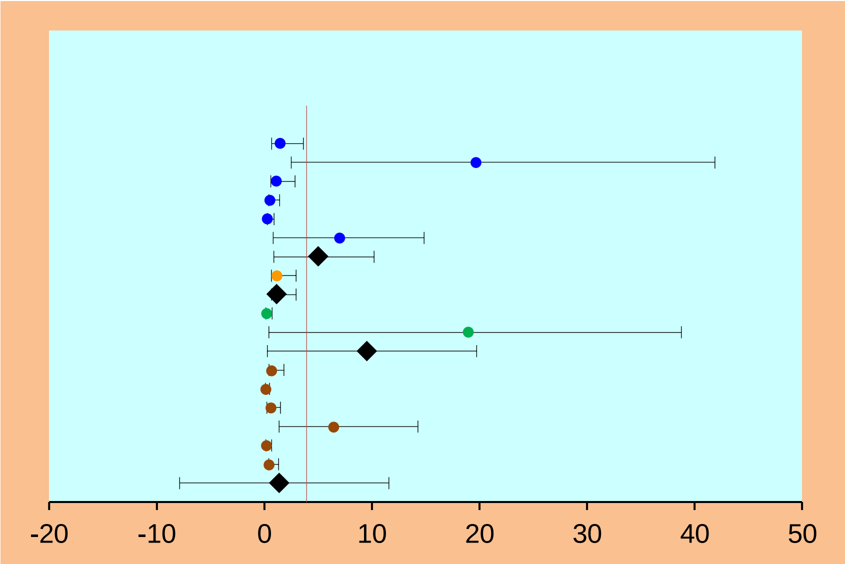

Figure 16 - Forest plots of the BJ.

The forest plots of the BJ had several articles with significant difference (p≤0.05), see the studies in table 7.

The studies with no significant difference were seven, but the quantity was small. The studies of the years 70 to 90 (blue ball) were the following: Quadra and collaborators (1981) (ES of 19.70), Smith and collaborators (1992) (ES of 7.02) and pooled estimate (ES of 5.02). The studies of the years 00 to 09 (green ball) were the following: Sheppard and collaborators (2007) (ES of 18.97) and pooled estimate (ES of 9.59). The studies of the years 10 to 16 (brown ball) were the following: Seron and collaborators (2013) (ES of 6,46) and pooled estimate (ES of 1,43).

Therefore, the article detected the height of the jump from 1970 to 2016 of the male volleyball player.

CONCLUSION

The systematic review and meta-analysis of the male volleyball players was the first study during the years 70 to 16 about the vertical jump. The author verified the vertical jump of four types of test, the CMJ, the CMJS, the SPJ, and the BJ. The years 70 to 90 of the indoor volleyball the CMJS, the SPJ and the BJ of the volleyball players had a higher jump than others years, but these results are not conclusive because of the limitations of the study. However, some authors informed about the stature of the male volleyball players, the years 70 to 90 the athletes had smaller stature than the years 2000 (Arruda and Hespanhol, 2008a; Marques Junior, 2012, 2012b; McGown and collaborators, 1990; Rocha, 1976), then the volleyball players had to jump more.

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