Mini-Review/Systematic Review

Virtual rehabilitation is better than conventional physical therapy to improve the functionality of the gait in elderly people? Systematic review and meta-analysis

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Abstract - Aim To compare the Timed Up and Go (TUG) test variables and walking speed between elderly people that carried through the training using virtual reality, sedentary (control), and those submitted to the Conventional physical therapy (exercise therapy). Systematic revision with meta-analysis of clinical essays. **Methods:** The recommendations of The PRISMA STATEMENT were used; having been consulted the following databases: PubMed/Medline, Exerpta Medica DataBASE Guide (IT BASES), Web of Science, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Physiotherapy Evidence Database (PEDro). Participants: Healthy Elderly People. Intervention: Virtual reality or Conventional physical therapy. Group control: physical inactivity. Measures of result: TUG test and walking speed. **Results:** 11282 generated articles of the initial search, 16 articles had entered for the meta-analysis, including 711 participants. The meta-analysis resulted the four following comparisons: [1] Virtual Reality versus Control (TUG), not significant (the IC 95% (-4,29 to 0,66) I^2 = 94%) and [2] Virtual Reality versus Control (walking speed), not significant (IC 95% (-0,14 to 0,56) I^2 = 98%); [3] Virtual Reality versus Conventional physical therapy (TUG), significant, in favor of Conventional physical therapy (IC 95% (-1,02 a -0,06) I^2 = 20%) and [4] Virtual Reality versus Conventional physical therapy (walking speed), significant in favors of Virtual Reality (IC 95% (0,06 a 0,17) I^2 = 0%). **Conclusion:** This demonstrates that the investigated subject needs more studies with a better methodological research design to develop more results in the literature. Register Review: PROSPERO (CRD42021247922).

Keywords: biomechanics, virtual reality, aged, gait.

Introduction

The life expectancy and the longevity of the elderly people population have increased. Aging leads to a reduction of functional capacity, increasing the possibility of chronic-degenerative illnesses. A setting that has become frequent, letting the elderly people with functional and structural limitations, as well as loss of autonomy and independence[1].

Approximately 81% of the 98% of the fractures in the hip area in elderly people are caused by falls[2]. Although many fall risk factors are known, usually it is classified into two categories: ambient (inherent), which can include possible fall factors as lighting, irregular surface, high surface, and obstacles. Another category that can be defined is personal (inherent): gender[3-5], muscular strength[6], time of reaction[7], sight[8], sedentarism[9], a decrease of balance and mobility[10]. Other factors, as speed, gradual fatigue, or fatigue during a task lead to increasing the complexity of the execution of the gait, making it more difficult[11].

The pace is considered a complex motor task that involves cognitive factors, and with the aging process it gradually gets worse[12]. The space-time settings of the gait are modified negatively by aging. Changes in the reduction of the walking speed and the length of the step, increase of the variation of the step in the double support time, and in the width of the step are related to a greater tendency to fall[13-15]. Moreover, muscle shortening, support base extension, reduction on the step height, reduction on the extension of hip and knee, speed decrease, support phase variables, and double support time are characteristics that lead to lower gait efficiency[16].

One of the ways to assess gait performance is through the Timed Up & Go Test (TUG), which is able to assess and identify the risk of falls, in which performance is related to balance, walking and functional capacity of the elderly[17-19]. Among these factors, gait speed is one of the main characteristics associated with falls in the elderly[20].

On healthy elderly people, walking speed ranges from 1.0 to 1.2 m/s, with stride lengths ranging from 1.1 to 1.4 m and cadence from 102 to 114 step/min[21].

For an individual to remain independent, it is mandatory good physical-functional and to be able to perform daily life activities. Getting out of bed or chair, taking care of personal hygiene, shop, walking, going up and downstairs, and staying socially active are practices that can be jeopardized if there are changes in balance and gait[22].

Falls are considered the main cause of death by accident for people aged 65 years or older[23,24], and approximately 30% of this population reports at least one fall each year[3,25]. The occurrence rises to 50% in individuals aged 80 years or older[24]. Approximately 80% of fractures in elderly people are caused by falls, and in almost all fractures in the elderly people (90% of the cases), the most affected part is the hip area[2]. Almost 6.7% of fractures will lead to the elderly's death within 30 days, 10% within 90 days, and 20% to 30% within one year, and 50% of the elderly people who suffers fractures will be left with impaired gait[26]. The fall significantly affects the quality and longevity of older adults' lives and is a great challenge for healthcare providers and healthcare systems worldwide. One of the main purposes of rehabilitation and training of elderly people is to improve their gait skills.

Physical rehabilitation points to conventional physical therapy (motor coordination training, balance training, stretching, muscle strengthening, and functional training) as an approach capable of preventing the decline of functional capacity in elderly people[27]. With technological advances, virtual rehabilitation or virtual reality has been using electronic games lived by the "human-machine interface", updating the clinical practices of rehabilitation professionals. Studies have used virtual rehabilitation as a promising tool for clinical rehabilitation, which can promote benefits in balancing and improving the individual's gait[27-28].

The characteristic of virtual rehabilitation is to generate a stimulus to the sensory and motor systems. The performance of functional activities and the playful character of therapy offers a high degree of motivation, pleasure, and instant feedback in the execution of tasks, thus promoting social interaction when conducted collaboratively, favoring the participation of elderly people in rehabilitation programs[29].

It is already known that virtual reality can improve the functional mobility of healthy elderly people. Despite this information occurring in systematic reviews with meta-analyses, when functional tests are combined assessed (such as Timed Up & Go Test (TUG), Four-Step Square Test (FSST), walking speed, gait cadence, 6-minute walk test, and 8-foot up and down test) and for shifts (5 times Sit-to-Stand test (5STS) and chair test (CST)[30-31]. However, there are no articles confirming this information, regarding the tests distinctly.

Virtual rehabilitation still shows negative and positive shreds of evidence, with conflicting and still insufficient results[28,32-33].

Aging causes physiological changes that can negatively influence the functional capacity of the elderly person, leading to a decline in extent motion, time-space parameters, strength, muscle power, among other changes. Thus, leading to a balance deficit and causing gait variations. In this sense, we raise two questions: Is virtual reality capable of improving elderly people's gait? Being able to improve the elderly people's gait, will it be more effective than conventional physical therapy?

This systematic review with meta-analysis intended to review: [1] Virtual reality versus the placebo group (which did not perform any type of physical activity) and [2] Virtual reality versus conventional physical therapy performed to improve the performance of the elderly people's gait.

Method

The preparation of this systematic review with meta-analysis was carried out according to the recommendations of The PRISMA STATEMENT[34] and carried out orderly, explicit, capable of reproduction and aiming to collaborate with future researches, systematizing the knowledge already acquired. The script "*The PRISMA checklist*" is present in Annex 01. This systematic review was recorded on *the International prospective register of systematic reviews* PROSPERO (CRD42021247922).

Search strategy

A systematic review of the literature was conducted to identify clinical studies that examine the use of a virtual reality strategy compared to a control group (physical inactivity) and a virtual reality strategy compared to conventional physical therapy executed to improve the performance of the elderly people's gait. Aiming to observe the TUG test and walking speed. Studies that used the comparison of two modalities of interventions, such as virtual rehabilitation and conventional physical therapy. The former is defined as the use of advanced technologies, such as computers and multimedia outlying, to provide an interactive and multidimensional simulated environment for the users perceive as like real-life experiences[27]. The latest is defined by any intervention that uses isolated physical exercise as a method of therapy[28].

The databases consulted were *PubMed/Medline, Exerpta Medica Guia DataBASE (EMBASE), Web of Science, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Physiotherapy Evidence Database (PEDro)*, without date or language restrictions. The search was conducted until January 2021. After previous readings it was created a set of keywords to perform the search. The set of keywords used in each database is specified in Annex 2. The set of initial keywords aimed to search for the theme.

Inclusion and exclusion criteria

Only health elderly volunteers participated in the present study. Pathological populations of any order, such as muscleskeletal, cardiovascular, hormonal, metabolic or neurological, as well as participants in post-surgical protocols or drug studies or amputees. For intervention (I), it was compared interventions performed through virtual reality versus the control group (physical inactivity) as well as virtual reality versus conventional physical therapy, including elderly people from 65 years old, healthy, independent, and initially untrained. Control group or placebo were the chosen comparison (C). Outcomes (O) and study design (S) were, respectively, gait speed and TUG in randomized controlled trials.

Inclusion criteria were studies that compared interventions performed through virtual reality versus a control group (physical inactivity) and virtual reality versus conventional physical therapy, including healthy sedentary elderly people from 65 years old, independent, and initially untrained. Studies that measure gait performance using the TUG test and tests of walking speed were included.

Studies selection

The studies selection was performed by two authors (X1 and X2), if there was a tie in the decision, it would be given to a third author (X3) involved to tiebreak it. *Rayyan QCRI, the Systematic Reviews web app* (free web app for systematic review management) was used (https://rayyan.qcri.org). The studies selection started with the first sorting of titles and abstracts, and a second sorting of the full articles' text. If an eligible study were published in a language not known by the authors (English, Portuguese, and Spanish), every possible effort would be made to obtain a translation. When this was not practical, articles would be excluded.

Study quality

The quality of included studies was assessed by extracting PEDro scores from the physiotherapy evidence database (www.pedro.org.au). The PEDro scale is an 11-item scale designed to rate the methodological quality (internal validity and statistical information) of randomized trials. Each item, except item 1, adds one point to the total score (range 0-10 points). When an essay was not included in the database, it was scored by a reviewer who completed the PEDro Scale training tutorial[35].

Assessment

Two results were obtained from the studies: walking speed and TUG test. To evaluate the aptness of combining studies in a meta-analysis was recorded the time of result measurements and the procedure results used to gauge the different walking speed. The reference values for the TUG are: normal, less than 10 s (in case of using canes and walkers, the time is considered from 10 s to 19 s); risk of falling, from 10 s to 19 s[17,18], and the cut-off point for this test is > 13.5 s, which indicates that the individual has a high risk of falls[19].

Data analysis

The information on the method (i.e., design, participants, intervention, and measures) and the results (i.e., number of participants and means (standard deviation, SD) of walking speed results) were obtained by two reviewers and verified by a third one. When the information was not available in the published essays, the details were requested from the corresponding author.

The post-intervention scores were used to achieve the combined estimate of the intervention effect using the fixed effects model. In the case of divergence, a scale with a value of I^2 close to 0% to 40%: may not be important; 30% to 60%: may represent moderate divergency; 50% to 90%: may represent substantial divergency; 75% to 100%: considerable divergency[36-38]. The post-hoc sensitivity analysis was performed if the result of the random-effects model was different from the fixed effect model. The analyses were conducted using the *software R*. When insufficient data was available for study results to be included in the combined analysis, the difference between the groups was reported. For all measure results, the critical value for statistical significance was established at a level of 0.05 (two-tailed). The combined data for each result were reported as weighted mean difference, with a 95% IC.

Results

Selection of studies

After applying the search strategy in all databases, the literature search produced 11282 potentially eligible articles, but 451 were duplicated. The identification process is presented in Figure 1. After the initial screening, 10831 articles were analyzed individually by peers and 10803 were eliminated according to the exclusion criterion, leaving only 28 articles for a full reading. Of the 28 articles selected, 12 were excluded after full reading for

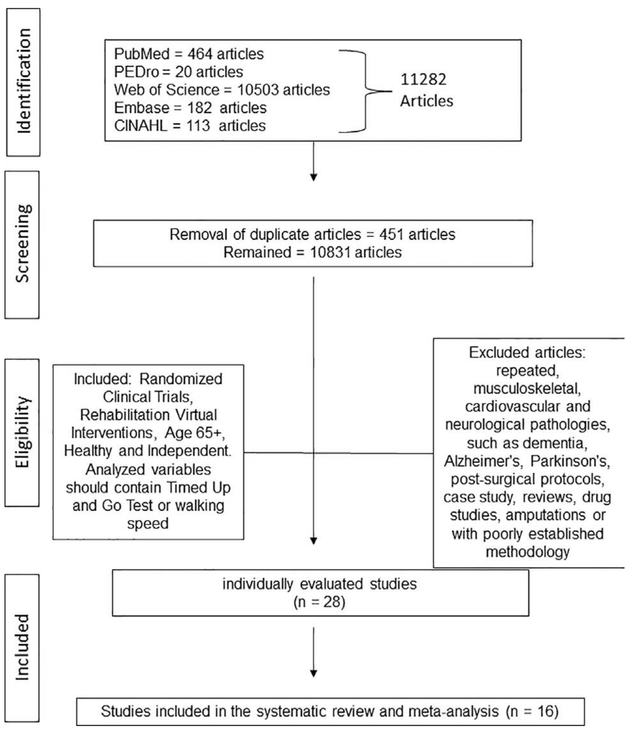

Figure 1 - The flow of studies throughout the review.

not meeting the pre-established inclusion criteria. Therefore, 16 articles were left to produce this systematic review[39-54] (Figure 1).

Study characteristics included

Of the sixteen articles, 711 elderly people were included. Walking speed and TUG were evaluated. These sixteen articles are described in Table 1.

Methodological quality assessment

The mean PEDro score of the essays was 5.18 (ranging from 3 to 7) (Table 2). 78% had random allocation, 14% covert allocation, 100% similar groups at baseline, 0% blind participant and blind therapist, 35% blind assessment, 50% <15% dropouts, 42% intention to treat, 92% had difference reported between groups, 92% punctual balance and reported variability.

Participants

A total of 711 elderly people with a mean age of 72.6 years old.

Table 1 - Characteristics of evaluated studies.

Autor	Participants	Age	Country	Intervention			Supervision	Intervention			Variables
				Minutes	x week	total week		Virtual reality	Conventional Physiotherapy	Control Group	
Babadi and Daneshmandi, 2021[39]	36	66.91	Iran	90	3	9	Yes	Sports games	Physiotherapy for balance	-	Timed Up and Go
Bieryla and Dold, 2013[40]	12	81.5	United States	30	3	9	Yes	Balance training games	-	No activity	Timed Up and Go
Chen et al., 2012[41]	40	75.9	China	30	2	6	Yes	strength training games	Physiotherapy for balance	-	Timed Up and Go e Gait speed
Eggenberger et al., 2015[42]	49	79.5	Switzerland	60	2	26	Yes	Dance games	Walking	-	Gait speed
Fakhro et al., 2020[43]	60	72.2	Lebanon Republic	40	3	8	Yes	Sports games	-	No activity	Timed Up and Go
Gallo et al., 2019[44]	42	68	Brazil	40	3	12	Yes	Dance games	-	No activity	Gait speed
Karahan et al., 2015[45]	90	71.4	Turkey	30	5	6	No	Balance training games	Physiotherapy for balance	-	Timed Up and Go
Ku et al., 2019[46]	36	64.8	South Korea	30	3	4	Yes	Balance training games	Physiotherapy for balance	-	Timed Up and Go e Gait speed
Nagano et al., 2016[47]	42	71	Japan	15	2	12	Yes	Gait training games	-	No activity	Timed Up and Go e Gait speed

(*continued*)

Table 1 - continued

Autor	Participants	Age	Country	Intervention			Supervision	Intervention			Variables
				Minutes	x week	total week		Virtual reality	Conventional Physiotherapy	Control Group	
Pichierri et al., 2012[48]	21	86.25	Switzerland	40	2	12	Yes	Strength training games + Dance games	Progressive resistance training games	-	Gait speed
Rendon et al., 2012[49]	40	84.5	United States	45	3	6	Yes	Balance training games	-	No activity	Timed Up and Go
Sadeghi et al., 2021[50]	64	72.3	Iran	40	3	8	Yes	Sports games	Physiotherapy for balance	No activity	Timed Up and Go e Gait speed
Sapi et al., 2019[51]	76	69.34	Hungary	30	3	6	Yes	Sports games	Physiotherapy for balance	No activity	Gait speed
Schattin et al., 2016[52]	27	80	Switzerland	30	3	9	Yes	Dance games	Physiotherapy for balance	-	Gait speed
Singh et al., 2012[53]	36	62.56	Malaysia	40	2	6	Yes	Sports games	Physiotherapy for balance	-	Timed Up and Go
Yang et al., 2020[54]	40	68.12	Taiwan	45	10	5	Yes	Fitness games	Physiotherapy for balance	-	Timed Up and Go

Table 2 - PEDro criteria and scores for included articles.

Study	Random allocation	Hidden allocation	Similar groups at baseline	Participant blinding	Blinded therapist	Blind evaluation	< 15% dropouts	Intent to treat analysis	Difference between groups reported	Point estimate and reported variability	Total (0 a 10)
Babadi and Daneshmandi, 2021 [39]	Y	N	Y	Y	N	Y	Y	N	Y	Y	7
Bieryla and Dold, 2013[40]	Y	N	Y	N	N	Y	Y	N	Y	Y	6
Chen et al., 2012[41]	Y	N	Y	N	N	Y	Y	N	Y	N	5
Eggenberger et al., 2015[42]	Y	N	Y	N	N	N	Y	Y	Y	Y	6
Fakhro et al., 2020[43]	Y	Y	Y	N	N	Y	Y	N	Y	Y	7
Gallo et al., 2019[44]	N	N	Y	N	N	N	N	Y	Y	Y	4
Karahan et al., 2015[45]	Y	N	Y	N	N	N	N	N	Y	Y	4
Ku et al., 2019[46]	Y	N	Y	N	N	N	Y	N	Y	Y	5
Nagano et al., 2016[47]	N	N	Y	N	N	N	N	Y	Y	Y	4
Pichierri et al., 2012[48]	Y	N	Y	N	N	N	N	N	Y	Y	4
Rendon et al., 2012[49]	Y	N	Y	N	N	Y	Y	N	Y	Y	6
Sadeghi et al., 2021[50]	Y	N	Y	N	N	N	Y	N	Y	Y	5

(*continued*)

Table 2 - continued

Study	Random allocation	Hidden allocation	Similar groups at base-line	Participant blinding	Blinded therapist	Blind eva-luation	< 15% dropouts	Intent to treat analysis	Difference between groups reported	Point esti-mate and reported variability	Total (0 a 10)
Sapi et al., 2019[51]	Y	N	Y	N	N	N	N	N	N	Y	3
Schattin et al., 2016[52]	Y	N	Y	N	N	Y	N	Y	Y	Y	6
Singh et al., 2012[53]	Y	Y	Y	N	N	N	Y	Y	Y	Y	7
Yang et al., 2020[54]	N	N	Y	N	N	N	N	Y	Y	Y	4

Y = Yes; N = No
Included studies were rated using the PEDro scale. The studies were considered to be "low risk" of bias if they had a score ≥ 6 points. Studies scoring <6 points were defined to be "high risk" of bias35-36.

Association effects

Virtual Reality versus Control – TUG

The association effect on Virtual Reality versus Control and TUG test was analyzed by combining post-intervention data from six trials involving 199 participants. Analyzing the result in Figure 2, we have the value of the I^2 statistic ($I^2 = 94\%$) and the p value of the Cochran Q test (p value < 0.01). The p-value found was lower than the 5% significance level, indicating statistical evidence of heterogeneity and the I^2 statistic value suggests a high heterogeneity (> 70%) between studies. Due to the high heterogeneity, the random effects model is the most indicated in this meta-analysis.

Analyzing the forest plot (Figure 2) it can be seen that the studies by Fakro et al.[43] and Sadeghi et al.[50] presented different results from the others with weights of 13.9% and 19.3%, respectively.

Additionally, we have the value of the absolute difference between means (MD = -1.81) with their respective 95% confidence interval (-4.29 to 0.66). The p value associated with this test was equal to 0.1512. These results suggest that there is no difference between Virtual Reality and Control when the timed up and go variable is evaluated.

Virtual reality vs. control - walking speed

The association effect on Virtual Reality versus Control and walking speed was analyzed. Combining post-intervention data from four trials involving 168 participants. Analyzing the result in Figure 3, we have the value of the I^2 statistic ($I^2 = 98\%$) and the p value of the Cochran Q test (p value < 0.01). The p-value found was lower than the 5% significance level, indicating statistical evidence of heterogeneity and the I^2 statistic value suggests a high heterogeneity (> 70%) between studies. Due to the high heterogeneity, the random effects model is the most indicated in this meta-analysis.

Analyzing the forest plot (Figure 3) it can be seen that the studies by Sapi et al.[51] and Sadeghi et al.[50] present different results from the others with weights of 10.2% and 30.1%, respectively.

Additionally, we have the value of the absolute difference between means (MD = 0.21) with their respective 95% confidence interval (-0.14 to 0.56). The p value associated with this test was equal to 0.2402. These results suggest that there is no difference between Virtual Reality and Control when the Gait Speed variable is evaluated.

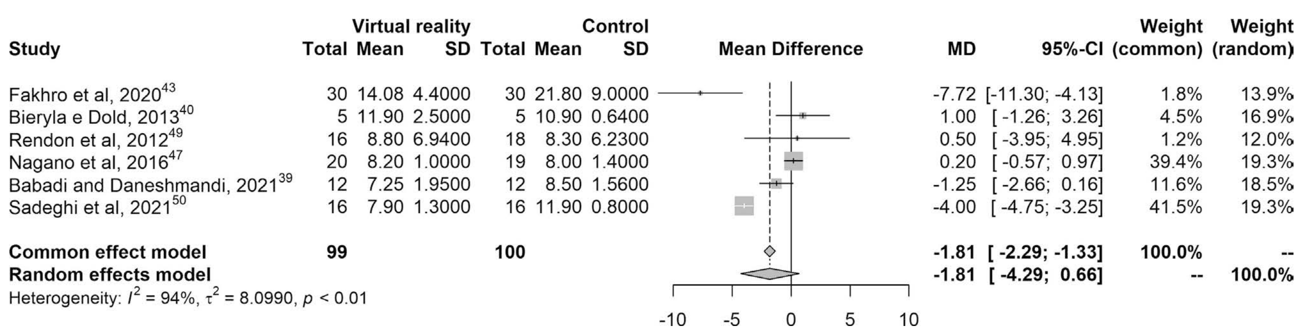

Figure 2 - Forest plot (model of random effects) for the variable Timed Up and Go (post).

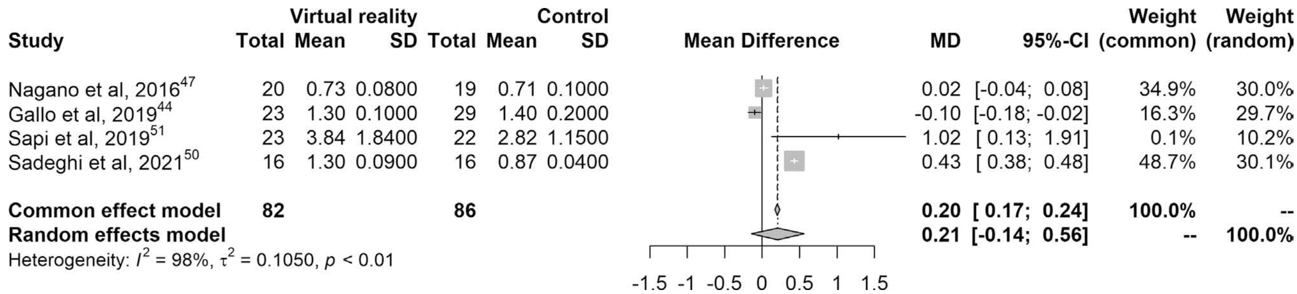

Figure 3 - Forest plot (model of random effects) for the walking speed variable (post).

Virtual reality versus conventional physical therapy – TUG

The association effect on Virtual Reality versus Conventional physical therapy and TUG test was analyzed by combining post-intervention data from seven trials involving 298 participants. Analyzing the result in Figure 4, we have the value of the I^2 statistic (I^2 = 40%) and the p value of the Cochran Q test (p value = 0.13). The p-value found was higher than the 5% level of significance, indicating that there is no statistical evidence of heterogeneity, and the value of the I^2 statistic suggests moderate heterogeneity between the studies.

Analyzing the forest plot (Figure 4) it can be seen that the study by Yang et al.[54] and Sadeghi et al.[50] present different results from the others with weights of 10.0% and 15.8%, respectively.

Additionally, we have the value of the absolute difference between means (MD = -0.54) with their respective 95% confidence interval (-1.02 to -0.06). The p value associated with this test was equal to 0.0272. As the p-value is less than 5% of significance, we have strong evidence of the difference between Virtual Reality and Conventional Physiotherapy when the timed up and go variable is evaluated. In addition, the value of the meta-analytic measure of -0.54 indicates that the variable "Time Up and Go" in the Conventional Physiotherapy group is higher on average, 0.54 units, compared to the Virtual Reality group.

Virtual reality vs. conventional physical therapy - walking speed

The association effect on Virtual Reality versus Conventional physical therapy and TUG test was analyzed by combining post-intervention data from six trials involving 224 participants. Analyzing the result in Figure 5, we have the value of the I^2 statistic (I^2 = 0%) and the p value of the Cochran Q test (p value = 0.98). The p value found was higher than the 5% level of significance, indicating that there is no statistical evidence of heterogeneity and the value of the I^2 statistic suggests non-heterogeneity (close to 0%) between studies. On this low heterogeneity, possibly a random effect model is no longer indicated, but what has to be taken into account is if the objective of this research is to make extrapolations to other populations, if this is the objective, the random effect model continues. being the most suitable for modeling.

Additionally, we have the value of the absolute difference between means (MD = 0.12) with their respective 95% confidence interval (0.06 to 0.17). The p value associated with this test was equal to 0.0001. As the p-value is less than 5% of significance, we have strong evidence of the difference between Virtual Reality and Conventional Physiotherapy when the Gait Speed variable is evaluated. In addition, the value of the meta-analytic measure of 0.12 indicates that the variable "Gait Speed" in the Virtual Reality group is higher on average, 0.12 units, compared to the Conventional Physiotherapy group.

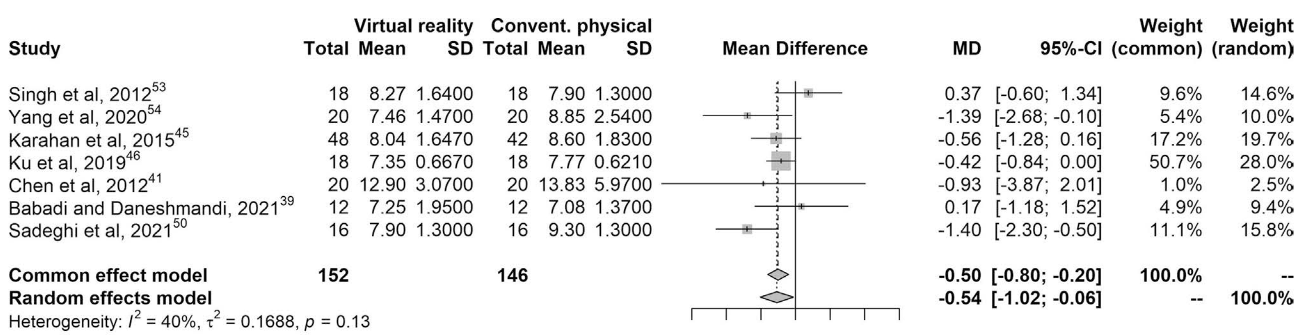

Figure 4 - Forest plot (model of random effects) for the Timed Up and Go variable (post).

Study	Virtual reality Total	Virtual reality Mean	Virtual reality SD	Convent. physical Total	Convent. physical Mean	Convent. physical SD	MD	95%-CI	Weight (common)	Weight (random)
Chen et al, 2012[41]	20	0.69	0.2200	20	0.54	0.2400	0.15	[0.01; 0.29]	13.7%	13.7%
Pichierri et al, 2012[48]	11	0.88	0.2480	10	0.82	0.0590	0.06	[-0.09; 0.21]	12.2%	12.2%
Schattin et al, 2016[52]	15	1.08	3.6793	14	1.04	0.2425	0.04	[-1.83; 1.91]	0.1%	0.1%
Sapi et al, 2019[51]	30	3.84	1.8400	23	3.77	4.3800	0.07	[-1.84; 1.98]	0.1%	0.1%
Eggenberger et al, 2015[42]	24	1.79	0.7100	25	1.70	0.6100	0.09	[-0.28; 0.47]	2.0%	2.0%
Sadeghi et al, 2021[50]	16	1.30	0.0900	16	1.18	0.0900	0.12	[0.06; 0.18]	71.8%	71.8%
Common effect model	**116**			**108**			**0.12**	**[0.06; 0.17]**	**100.0%**	**--**
Random effects model							**0.12**	**[0.06; 0.17]**	**--**	**100.0%**

Heterogeneity: $I^2 = 0\%$, $\tau^2 = 0$, $p = 0.98$

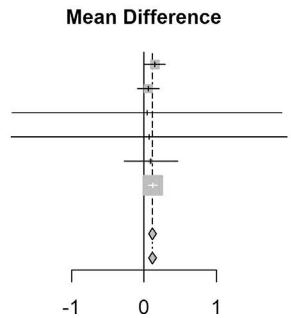

Figure 5 - Forest plot (model of random effects) for the walking speed variable (post).

Discussion

In the present study two physiotherapy modalities are compared, namely, virtual reality and conventional physiotherapy based on exercises. This systematic review provides evidence that there is no significant difference when comparing virtual reality versus control (physical inactivity) under the TUG and walking speed variables, yet with a divergence of $I^2 = 94\%$ and $I^2 = 98\%$ respectively. Furthermore, the results of comparing virtual reality versus conventional physical therapy, the TUG variable is significantly favorable to virtual reality (0.54 units) with the absolute value difference between means (MD = -0.54) with its respective confidence interval of 95% (-1.02 to -0.06), yet with little important heterogeneity (40%). The walking speed variable is significantly favorable to conventional physical therapy (0.12 units), the absolute value difference between means (MD = 0.12) with its respective confidence interval of 95% (0.06 to 0.17), but with a nonimportant heterogeneity (0%).

The association on virtual reality versus control showed no statistical difference concerning the TUG test. This meets with the work presented by Booth et al.[55] that found the same result in the meta-analysis. What differs their study with the present meta-analysis is that the present one submits a high divergence generated by four studies, while Booth et al.[55] meta-analysis submitted no divergence in two studies in a population of 80 participants. Furthermore, the walking speed variable also showed no significant difference in association with virtual reality versus control. This fact can be justified by the methodological factor and a low number of studies involved. Other findings of this meta-analysis in association with virtual reality versus conventional physical therapy, the TUG variable proved favorable to the virtual reality group, the same happened with Fang et al.[56], in the meta-analysis. Booth et al.[55], found no significant difference. This finding should be sustained due to its comparison presenting a divergence of 0% under two studies and a small population of 44 individuals. The association with virtual reality versus conventional physical therapy on the walking speed variable pointed to statistically significance in favor of conventional physical therapy, which has been present in the literature[57]. However, Booth et al.[55] did not find a significant difference in this variable, yet its divergence was substantial, but the statistical tests were based on three studies with a population of 68 participants. The results of our review may be in line with which says that virtual reality therapy may become a complementary therapy to conventional physical therapy[58].

There was an inconsistency in the results measures used that showed there is no statistical difference in the relation of virtual reality versus control (physical inactivity). We believe that this is due to the low number of studies (4 studies for TUG and 3 studies for walking speed). This shows that more studies are need to assess the TUG tests and walking speed separately, providing better methodological research designs to improve the quality of existing evidence. We do not know if the same happens for the association of virtual reality versus conventional physical therapy. The TUG and walking speed variables showed different results. We do not know if this is due to chance or methodological factors, such as no divergence was found in both analyses, a low number of articles was included in the analysis, and finally an average PEDro of articles below 5.18 for all the analyses. Considering the studies available for a meta-analysis, it may be more appropriate to consider, in a future study, only the comparison of data from treatments that used virtual reality with those that used conventional physical therapy[58].

It is clear in the literature that virtual reality is a recent and promising technique and can improve the mobility and functional mobility of healthy elderly people[31]. In this way, we can say that virtual reality rehabilitation does not exist as a gold standard in relation to the methodology of games[59]. Thus, through a critical analysis of the studies, it might be suggested that generally, the time of neuromuscular and motor-sensory adaptation requires a longer time for response. Some studies may present insufficient intervention time to obtain satisfactory results related to gait's mobility demands. Virtual reality, in particular interactive game systems, potentially have more motivational influence and present itself as an efficient strategy to better engage elderly people in physical exercise programs[58].

Interventions performed through virtual reality have clinical benefits, such as double task training, cognitive and motor skills stimulation, a possibility of a new experience as they offer a stimulating and challenging environment[60].

The present study has some limitations, such as the low methodological quality of the studies that proposed to study the theme and limited samples. In addition, there are still few studies on the present theme of this systematic review. The strength of this review is to present the current evidence on the topic involving rehabilitation with virtual reality, as well as providing evidence on how the physiotherapy intervention is presented in this context.

The TUG test is commonly used and recommended in clinical practice to assess fall risk. In this sense, some prospective studies use logistic regression techniques to associate the TUG test and the probability of future falls. The assessment of walking speed is also a method of verifying the fall tendency in elderly people, thus, the low walking speed is directly linked to the greater fall propensity and gait stability[13-15].

Conclusion

This systematic review with meta-analysis shows us that conventional physical therapy is more efficient to increase gait speed, while virtual reality therapy has been shown to be more efficient to improve the response to the TUG test. This was observed when conventional physical therapy was compared to virtual reality treatment. However, when these therapies are compared to a control group the results are inconclusive. This shows that the subject investigated needs more studies with better methodological research designs to generate more results in the literature. However, we should not dismiss virtual reality, as it is a promising new technique that can improve the mobility and functional mobility on healthy elderly people.

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