

Running head: NINTENDO WII

Nintendo Wii: The Effects of Modern Gaming Technology within a Geriatric Population

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Abstract

Purpose: Today, independent living facilities are exploring the health benefits of the Nintendo Wii. This study explored the effects of cardiovascular functioning, balance, and quality of life of a well-elderly population (N=11) residing in an independent living facility. This study consisted of 12 Wii sessions, conducted over a 4-week period. **Method:** Subjects participated in 20-minute interventions, three times per week. Three dependent variables were measured using the Short Form Health Survey version 2, Berg Balance Scale, and Polar heart monitors. **Results of the Wilcoxon Signed-Rank Test's** revealed there were significant changes in balance; however, no significant changes in quality of life and cardiovascular endurance were found. **Conclusion:** The Wii program resulted in improved levels of balance in all participants.

Nintendo Wii: The Effects of Modern Gaming Technology within a Geriatric Population

As technology continues to advance, the gaming industry is producing increasingly complex video games and gaming systems. The Nintendo Wii® is an innovative gaming system that requires players to utilize a wide variety of functional performance skills to participate in various games (Hertz, 2009 & Glomstad, 2008). Interest in this technology has increased not only among youth, but with the well-elderly population as well. A new product, the Nintendo Wii®, is being marketed to individuals who seek an innovative, hands-on, virtual, and social gaming experience. However, healthcare practitioners are beginning to see the Nintendo Wii® as something much more than just entertainment (Hertz, 2009 & Glomstad, 2008). . This study will examine the health and wellness status of a well-elderly population (N=11) during participation in Nintendo Wii research study.

Researchers are beginning to see the possibility of using virtual technology-based interventions to address issues in a variety of health-related performance areas. There have been several articles on the health benefits of using the Nintendo Wii in occupational therapy. Articles claiming they have evidence of health benefits in the elderly population, individuals with developmental disabilities, physical disabilities, and with all different ages. For example, if an article states it has evidence that participants with Parkinsons disease benefited from the Nintendo Wii by increasing participant's independence level through means of virtual video games and even increased in their functional activities, then it is quite possible to expect researchers to continue investigating the effects of the Wii on the well elderly population or with individuals with varying performance skills (Medical College of Georgia, 2008). Other areas of performance skills that the Nintendo Wii addresses are "attention, following directions, problem solving, visual perceptual skills, listening, and functional movement, and exercise" (Hertz, p. 21,

2009). Currently, there is minimal research-based, quantitative information regarding the impact of the Nintendo Wii® participation on the health and wellness of the well-elderly population.

Seventy percent of Americans are not getting enough regular exercise (Glomstad, 2008). Glomstad (2008) also states, “exercise is much more difficult for older adults, so its important to give them options that are both enjoyable and appropriate to their ability levels” (p. 17). By providing retirement communities and skilled nursing facilities with options of fun, accessible activities, through means of exercise like the Nintendo Wii, elderly wellness promotion programs are on the rise.

Research Problem

More and more occupational therapists are starting to implement Nintendo Wii® activities into their therapy sessions in retirement communities and nursing facilities to address various functional performance skills and incorporate access to real activities (wellness programs in disguise) in which they may not have another opportunity to participate (Glomstad, 2008) . There is a lot of qualitative evidence from therapists claiming the Nintendo Wii® is an effective means of increasing performance skills in a variety of areas. However, there is minimal quality research supporting these statements and minimal quantitative data supporting this research. In order for this type of intervention modality to truly be utilized one day as an effective evidence based practice treatment used in occupational therapy, it is imperative for therapists to work towards publishing data analysis findings into carefully constructed published research studies.

Purpose of the Study

The purpose of this study is to explore the effects of a Nintendo Wii® therapy program on balance, cardiovascular endurance, and quality of life among well-elderly individuals.

“Exercise is much more difficult for older adults, so its important to give them options that are

both enjoyable and appropriate to their ability level” in order to assist in maintaining or improving their levels of balance, cardiovascular endurance, and quality of life (Glomstad, p.7, 2008). This study will be useful because it offers therapists an new, affordable, and innovative way to tackle some of the geriatrics most common manifestations (e.g., balance, cardiovascular endurance, and quality of life) (Glomstad, 2008).

Research Questions and Hypotheses

Research Question #1

Does the participation in the Nintendo Wii program result in a statistical significance in the SF-36v2 quality of life scores?

Null Hypothesis #1. There is no significant difference in the distributions of pre- to post-intervention scores on the SF-36v2 scores of participants involved in a Nintendo Wii activity program.

$H_0: \mu_1 = \mu_2$, where

$\mu_1 =$ SF-36v2 pretest scores

$\mu_2 =$ SF-36v2 posttest scores

Alternative Hypothesis #1. There is a significant difference in the distributions of pre- to post- intervention SF36v2 participants involved in a Nintendo Wii activity program.

$H_A: \mu_1 \neq \mu_2$

Research Question #2

Does the participation in the Nintendo Wii program result in a statistical significance in the Berg Balance scores?

Null hypothesis #2. There is no significant difference in the distributions of pre- to post-intervention scores on the Berg Balance scores of participants involved in a Nintendo Wii activity program.

$H_0: \mu_1 = \mu_2$, where

$\mu_1 =$ Berg Balance scores

$\mu_2 =$ Berg Balance scores

Alternative Hypothesis #2. There is a significant difference in the distributions of pre- to post-intervention Berg Balance Scale scores of participants involved in a Nintendo Wii activity program.

$H_A: \mu_1 \neq \mu_2$

Research Question #3

Does the participation in the Nintendo Wii program result in a statistical significance in the heart scores?

Null hypothesis #3. There is no significant difference in the distributions of pre- to post-intervention scores on the heart rate scores among participants involved in a Nintendo Wii activity program.

$H_0: \mu_1 = \mu_2$, where

$\mu_1 =$ Heart rate pretest scores

$\mu_2 =$ Heart rate posttest scores

Alternative Hypothesis #3. There is a significant difference in the distributions of pre- to post-intervention heart rate scores among participants involved in a Nintendo Wii activity program.

$H_A: \mu_1 \neq \mu_2$

Definitions of Terms

Well elderly will be used to refer to individuals, over the age of 59, with no significant medical conditions.

Resting heart rate is the heart rate prior to the initiation of Nintendo Wii® activities. Resting heart rate can be measured by looking at participant's scores on the Polar Heart Rate Monitors.

Quality of life is a subjective term that refers to a broad spectrum of components dealing with an individual's overall state of well-being, including to physical functioning, mental health, role limitations, bodily pain, general health, vitality, and social functioning are just several quality of life components that this particular intervention considered (Matuska et al., 2003; Suzuki et al., 2002). Quality of life can be measured from looking at participants' scores on the SF-36v2.

The *Nintendo Wii* is an innovative technological gaming system that incorporates the use of a television, a game board in which you can either sit on or stand on, and a handheld controller to aid in both portraying and calculating body positioning, visual perception, balance, and gross motor skills in which are required to complete Nintendo Wii games (Hertz, 2008).

Significance of the Study

Currently, there is little research examining the effectiveness of Nintendo Wii® participation as a therapeutic tool. This project will provide information regarding the effects of Nintendo Wii® activities on balance, cardiovascular endurance, and quality of life among the well-elderly. If it is found that participation in the Wii program results in improvements in these performance areas, it would provide evidence to support its use in the clinical settings to a large population of individuals who consume a vast portion of therapy services.

Limitations of the Study

Limitations of this study include the use of a convenience sample, the condensed program length, and variability in Wii Fit activities. First, researchers used a sample of convenience in which participants were similar in demographic characteristics. Therefore, similar environmental and demographic factors may have influenced the results. Another demographic characteristic that may limit the validity of the results is the male to female ratio. A significantly higher number of females than males participated in this study (7 females and 4 males).

Second, participants were encouraged to select the specific Wii Fit balance games they wanted to perform. Although researchers allowed this freedom of choice to ensure client-centered services, this variable may have influenced the results. For example, some participants chose to jog on trails with one of the aerobic games; however, other participants, very capable of jogging, chose to walk. The participants who chose the jogging trails would take longer to have their heart rate return to baseline than those of the walkers. The activities that were offered to participants consisted of a wide range of different endurance activities. Finally, participant bias may have affected the observed outcomes. It is possible that participants performed differently because they knew they were being studied.

Review of the Literature

While the effectiveness of occupational therapy treatments incorporating the Nintendo Wii Fit® has yet to be proven—due to its recent release—practitioners around the world are reporting encouraging results. This literature review will address the well-elderly deficits pertaining to areas such as balance, cardiovascular endurance, and quality of life through means of technology based interventions using the Nintendo Wii Fit®. The purpose of this literature

review will hopefully add new and current knowledge to vastly growing world of technological advances and will help to continue and influence further occupational therapy research.

The Need

The Centers for Disease Control and Prevention (CDC, 2007) projects that the number of Americans aged 65 and older will more than double in the next 15 years, reaching a record high of 71 million older adults. The rapid increase in the number of older adults in the United States will likely cause a significant increase in the amount of healthcare dollars needed to provide services to this population. The CDC estimates that the cost of providing healthcare to the aging population could place significant economic burdens on society, because the price of providing healthcare to an older adult is three to five times greater than the cost for an individual under 65 years of age. In response to this crisis, researchers must take actions aimed toward health promotion for older adults.

Healthcare professionals must take actions aimed toward health promotion for older adults. It is the ethical responsibility of a practitioner to advocate for the best possible healthcare for their healthcare consumer and it is because of this that practitioners must work aimlessly on discovering client centered approaches to wellness promotion. An experimental study conducted by Hay et al. (2002) demonstrated the potential cost-effectiveness of preventative occupational therapy services for a geriatric population (N=163) by revealing a decrease in medical expenditures for the population involved in a preventative program. Although this decrease was not statistically significant, healthcare costs at follow-up were considerably lower for the occupational therapy group as compared to the control groups. This indicated that activities aimed at improving balance, cardiovascular endurance, and quality of life have the potential to offer significant health benefits to the geriatric population.

An experimental study by Frye et al., 2007 indicated that low impact exercise interventions can improve the upper and lower body strength, balance, cardiovascular functioning, anxiety, and sleep disturbances of older adults. In this study, the researchers randomly assigned the 72 participants to three groups (tai chi, low impact exercise, and a non-exercise control group). Over the course of the intervention process, 12 participants withdrew for medical reasons. Results indicated no statistical change in blood pressure or resting heart rate among participants in the three groups. However, both exercise groups demonstrated statistically significant improvements in strength ($p < .05$), whereas the control did not demonstrate significant improvement in this area.

Cardiovascular Endurance

“Exergaming”, or the use of physically interactive videogames to promote movement, is a form of active-input gaming. Popular games such as *Dance Dance Revolution* and various games for the Nintendo Wii® have caused both the healthcare industry and the educational system to show interest in using exergaming as a form of intervention (Medina, 2008). Straker and Abbott (2007) investigated the cardiovascular responses and energy expenditure of twenty, 9-to-12-year-old children playing traditional electronic games as compared to active-input games. Researchers used a within-subjects design to test these variables. This study revealed that playing traditional electronic games resulted in little change to heart rate or energy expenditure compared with watching a DVD. In comparison, active-input games resulted in a statistically significant ($p < .001$) increases of 59% in heart rate and 224% in energy expenditure.

Balance

Betker, Szturm, Moussavi, & Nett (2006) examined whether coupling foot center of pressure (COP)-controlled video games with standing balance exercises would improve dynamic

balance control and increase the subjects' motivation to perform the exercises. This study utilized a case study design with pre- and post-exercise measurements. Subjects included in this study were a young adult with an excised cerebellar tumor, a middle-aged adult with a right cerebrovascular accident, and a middle-aged adult with traumatic brain injury. Findings indicated that the participants demonstrated improved dynamic balance, less falls, decreased COP excursion limits, and increased practice volume after the intervention phase.

Quality of Life

Participating in occupational therapy wellness programs (i.e., the Nintendo Wii research study) may potentially lead to improvements in quality of life. A study by Matuska et al., (2003) evaluated a pilot occupational therapy wellness program designed to teach older adults how participation in meaningful social and community occupations can improve their quality of life. The study consisted of 65 older adults (aged 70-92 years) from Midwestern and Western communities; however, only 39 of the participants provided complete surveys for data analysis. Researchers administered the Short Form-36® (SF-36) Health Survey pre- and post-program to measure improvements in the vitality, social functioning, role-emotional, and mental health domains. Scores from the SF-36® Health Survey indicated statistically significant improvements in vitality ($p < .05$), social functioning ($p < .01$), and mental health ($p < .05$).

Both meaningful social and community occupations tie into the Wii program because the research study attempted to integrate an array of different interpersonal communication skills with participants' peers and the facility's faculty. Participation in the Nintendo Wii also caters to participants' vitality, social functioning, and role-emotional, and mental health domains through active participation with the Wii games, upholding roles within the community during the study activity, and maintaining and modifying behaviors appropriately to carry out meaningful

occupations with the immediate environment (community). Results of this particular study support the use of preventative wellness programs for older adults.

Lack of Research

The use of physically interactive videogames for rehabilitation purposes is an increasingly popular phenomenon. However, empirical evidence does not yet exist to support the quantitative data and benefits that older adults may acquire from participating in interactive video games (Trout & Christie, 2007). The purpose of the present study was to explore the health benefits of participation in Nintendo's Wii Fit® with a well-elderly population. This predicament indicates the need for research to examine the potential health benefits of participation in physically interactive videogames.

There is minimal published research exploring the effectiveness of the Nintendo Wii Fit® in improving particular targeted performance skills. However, rehabilitation professionals, working with individuals who have fall risks, mobility deficits, and multiple functional limitations that have lead to a decrease in independence and lower life-satisfaction are in an optimal clinical position to address such topics through education and intervention (Hart-Hughes, Quigley, Bulat, Palacios, & Scott, 2004). Increased understanding of the health benefits associated with the Nintendo® Wii™ gaming system is important for supporting its use in the evidence-based practice of healthcare practitioners.

Method

Research Design

This quasi-experimental study utilized a single group, pretest-posttest design in which pretest measurements represent the participants' level of functioning at the time the study was initiated and posttest measurements represent the participants' level of functioning following the

intervention phase. The intervention phase consisted of each subject participating in Nintendo® Wii Fit™ activities for three, 20-minute sessions per week, over a 4-week period. In each session, eleven participants engaged in 10-minutes of Wii Fit® balance activities directly followed by 10-minutes of Wii Fit® aerobic activities. The games utilized on the Nintendo Wii throughout intervention are listed with a brief description in appendix A.

Participants

The eleven well-elderly participants in this study, which was conducted August 2008 to October 2008, were residents of an independent retirement community in the Midwestern United States. Participants for this research study consisted of seven females and four males ranging from 59-years of age to 89-years of age. The mean age of participants was 81.2 years. To recruit participants for this study, researchers obtained a small convenience sample (N=11) from the independent retirement community activity director via verbal encouragement, demonstration of intervention to potential participants and their friends and families, posters, and the use of promotional flyers in the mail. Exclusion criteria for this study included unstable health, anyone with doctor's orders to abstain from any moderate level of exercise, or the inability to attend intervention sessions on a consistent basis. Inclusion criteria for this study consisted of anyone that was residing in the independent living facility, who fit the well-elderly definition, and who was able to attend at least 80% of the attendance requirements. During the initial recruitment phase, potential participants received a demonstration and opportunity to test out the Nintendo Wii, signed informed consent, media release, and health consent form.

Instrumentation

Berg Balance Scale. The Berg Balance Scale consists of a list of 14 areas assessed, all pertaining to balance, and all added at the end for a total score. Each area assessed is scored on a

five point scale (ranging from 0-4) based on the quality of the subjects' task performance. A score of "0" indicates the lowest level of function. Total scores less than 30 indicate a 100% predicative risk for falls; total scores less than 40 indicate a need for specific balance training; and total scores less than 45 indicate a need for an assistive device. Mackintosh, Datson, and Freyer (2006) considered the Berg Balance Scale the *gold standard* in their study examining the psychometric properties of various balance scales. In addition, several studies indicate high validity and reliability ratings of the Berg Balance Scale (Bennie et al., 2003; Mackintosh et al., 2006; Whitney et al., 2003).

Short-Form 36 Health Form version 2 (SF-36v2). The SF-36v2 is a standardized assessment that measures individuals' perceived quality of life in regards to physical functioning, mental health, role limitations, bodily pain, general health, vitality, and social functioning (Matuska et al., 2003 & Suzuki et al., 2002). Interpretation of scoring is based on a scale from 0-100; scores between 45 and 55 are within the norm-based range (*i.e.*, mean norm-based score of 50 with a standard deviation of 5). Scores falling below 45 are considered below the average range for the U.S. general population. For a more detailed description as to the SF-36v2 intricacies, please see the SF-36v2 Statistical Manual (Ware et al., 2007).

Polar Heart Rate Monitor. The Polar heart rate monitor is a means of recording heart rate in current time. This tool consists of a chest strap that measures heart rate in beats per minute, interpreted by way of a digital watch worn on the wrist. Prior research studies have utilized this device to evaluate cardiovascular endurance (Dolbow, Farley, Kim, & Caputo, 2008; Finucane, Fiddler, & Lindfield, 2008; Robert-McComb, Roh, & Williams, 2006).

Apparatus

1. The Nintendo Wii is the virtual gaming system used in this study. The Nintendo Wii® is an innovative technological gaming system that incorporates the use of a television. This gaming system is highly sensitive to body movement and calculates balance and endurance by means of very sensitive weight shifting maneuvers on a game board and based on the positioning of the hand held controller. The Nintendo Wii system costs \$249 and the actual game, The Wii Fit costs \$89 (Herz, 2009).

Procedures

Study site. Data for this study was previously collected at the University of Southern Indiana. Data analysis was done on the campus of Saginaw Valley State University. Previous study was conducted at an independently-living facility.

Data collection. Data was collected at the independent living facility involved in this study. Two researchers familiar with the SF-36v2 administration procedures oversaw administration of the SF-36v2 evaluations. Another researcher from the research team viewed each completed SF-36v2 form to ensure that each form was correctly completed.

Two researchers scored the Berg Balance Assessment, with an interrater reliability of 95%. The two researchers discussed discrepancies in all scores in order to justify the most appropriate score. One participant required a modified version of the Berg Balance Assessment due to a muscular disease, Charcot-Marie Tooth (CMT), which inhibited his ability to complete the standardized assessment. Researchers used clinical reasoning skills and modified the balance assessment to measure sitting balance versus standing balance. Baseline measurements for balance and quality of life were gathered prior to implementing intervention, and at the conclusion of the 4-week intervention period.

The researchers also measured cardiovascular endurance prior to the study, after the sixth session, and at the completion of the final session. Cardiovascular endurance was analyzed three separate times throughout the 4 weeks of interventions (i.e., prior to the intervention phase, during the intervention phase, and following the intervention phase) by means of establishing the amount of time for each individual's heart rate to return to his/her resting heart rate. The Polar heart rate monitors were applied prior to the intervention, and the resting heart rate was immediately recorded. The participants actively engaged in 10-minutes of balance activities followed by 10-minutes of aerobic activities. The heart rate immediately following the aerobic session was recorded. Following the 10-minute aerobic session, each subject was asked to sit and relax. The amount of time, recorded in seconds, for each participant's heart rate to return to the resting rate was recorded. To maintain consistent measurements and to help ensure validity and reliability, each participant was required to participate in the aerobic activities for the second half of each session and peak heart rate, the heart rate in which immediately follows aerobic activity, and recovery heart rate were both recorded for each participant.

Intervention. The intervention phase consisted of 12 Wii sessions conducted over a 4-week period. During this time, participants were encouraged to continue participating in their normal routines (e.g., golf, resident council, shuffleboard, crafts, daily walks, facility outings, and aerobics class offered at the facility). The researchers allowed participants to reschedule missed intervention sessions; missed intervention sessions had to be rescheduled within the same week of the missed session in order for the participant to make up the missed intervention session. In order for a participant's data to be included in the study, an 80% attendance policy was mandated.

During each session, 2-3 participants (depending on residents' schedules) engaged in Nintendo Wii Fit® balance and aerobic activities in one of the three facility's activity rooms. A chair was placed in front of the Nintendo Wii Fit® balance board as an additional safety precaution in order to prevent falls. Participants were encouraged to only use the chair for additional support as needed.

One of the male participants required a piano bench for each intervention due to a muscular disease that prevented the individual from standing for a long period. Researchers adapted the Nintendo's Wii Fit® activities to include this participant to determine how this intervention affected dynamic balance. The adapted intervention method for the participant consisted of the participant sitting on the Nintendo Wii Fit's® balance board which was placed on a piano bench. The male participant, previously mentioned, did some activities standing; however, when he became fatigued he was encouraged to sit due to decrease in endurance and balance.

Throughout the intervention sessions, participants were encouraged to select their own games from the appropriate category (i.e., balance and aerobic). One researcher assisted each participant throughout the intervention session by aiding the participants with the electronic device (i.e., Nintendo Wii® remote) and standing nearby for additional safety precautions. After each participant completed his or her 10-minute balance activities, the researcher then switched the participant's gaming system to an aerobic activity that was selected by the participant. Forms recording the participants' duration of activity participation, selected games, time, date, and comments were completed for each intervention session. At the end of each intervention session, participants were able to make an appointment for the following intervention session. Upon completing the very last of the Nintendo Wii interventions, all participants completed another

BBS assessment and a SF-36v2 to collect further data and to reassess the participants level of balance and quality of life.

Data analysis. A Wilcoxon Signed-Rank Test was used to analyze the data from the study. The Wilcoxon Signed-Ranks Test was used to determine if significant changes occurred from pretest to posttest interventions (Berg Balance Scale and heart rate recovery time for each subject). Additionally, the Wilcoxon Signed-Ranks Test was used to evaluate pretest-posttest difference scores in each of the eight subcategories of the SF-36v2. Mean scores were utilized to compare individual performance scores to overall group performance scores for each measure. In addition, group means were utilized to analyze participants' demographic characteristics in comparison with the entire group. Statistical testing occurred at the .05 level of significance to ensure an appropriate level of reliability and validity.

Results

At the conclusion of the study, all of the initial participants were still meeting the attendance requirement. The research study required an 80% attendance rate; however, the study's eleven participants obtained a 98.5% attendance rate with no participant missing more than one intervention session. The Wilcoxon Signed-Ranks test was utilized on all dependent variables (balance, heart rate, and quality of life) with $P \leq .05$. In this study, $N=11$ ($N=10$ for BBS only), critical value of $T=5$, and $p \leq .05$. Although, this study predominantly focused on the quantitative data, qualitative data was collected and documented in participant's journals for further data analysis for a later date. There was a large quantity of observable findings and verbal statements that supported the significance of the Nintendo Wii and the balance and quality of life.

Balance

The Berg Balance Scale (BBS) assessment scores obtained pre- post-intervention were evaluated using the Wilcoxon Signed-Ranked test. The continuum of scores on the BBS ranged from zero to 56 (zero being the worst score and 56 being the best score). Interestingly in this study, there was not one participant who declined in their balance scores when baseline measurements were evaluated. All participants were found to be in either medium (50% of participants) or low fall risk (50% of participants) categories based on their BBS scores prior to intervention. Amazingly, post-test scores revealed there was no longer needs for either assistive devices or further specific balance training with any and all of the participants. Post intervention scores revealed that all of the participants (N=11) were now in the low fall category, demonstrating significant improvements from participants' initial baseline measurement score.

As mentioned earlier, there was one male participant who was unable to be included in the BBS mean group score because of physical deficits that prohibited him from completing the BBS assessment satisfactorily, making N=10 for this particular assessment for this dependent variable. It is important to note that researchers were able compensate and adapt the Nintendo Wii and the immediate environment to assist him with overcoming the barriers brought about by his deficits. The male participant with the physical deficit was able to improve his BBS score and demonstrating observable improvements. At the end of the study, this same participant increased his dynamic sitting balance and was able maintain balance on Nintendo Wii board without requiring the assistance of his arm rests. Researchers all agreed it was best that his scores were excluded in order to preserve the integrity, validity, and reliability of this study. However, researchers thought it was important to document the qualitative findings on this participant to

demonstrate that the Nintendo Wii has the ability to meet the needs of an array of different client factors and performance skills.

Cardiovascular Endurance and Quality of Life

All study participants had a 100% response rate to the questions on the SF-36v2 assessment, given appropriate supervision and verbal cues and scanning the participants' assessments before allowing the assessment to be collected by researchers. All study participants were 100% compliant in allowing researchers to collect all necessary heart rates needed throughout the entire study. After careful review of the results from the Wilcoxon Signed-Rank Test, researchers discovered there was no statistical significance in both quality of life and cardiovascular endurance. A type II error in the calculation of dependent variables, cardiovascular endurance and quality of life, is assumed by researchers due to the conflicting qualitative and quantitative data gathered throughout the study. Documentation of observations and statements pre intervention and post intervention reveal very different results than did the SF-36v2. After very thorough and careful review, researchers mutually agreed to omit cardiovascular endurance and quality of life data from the results of this study, due to disagreeing variables.

There were many participants that reported observing an increase in their standing tolerance as well as observable findings in their dynamic standing balance. Two participants who were once in wheelchairs coming to the study were now walking to the last intervention, no longer requiring the wheelchair to assistance in functional mobility. Three different family members of the participants noted observable changes in participants moods, increase in motivation to participate in more leisure activities, and less observable symptoms of stress or anxiety. By the end of the last intervention, it was documented in every single participants' chart

that each participant had verbalized at one time that they enjoyed the Nintendo Wii and were documented as smiling and in a good mood during participation in the study.

Discussion

Research suggests with standardized assessments, careful data analysis, and thorough review and observation, that the Nintendo Wii intervention method used within this study is an effective means for addressing balance deficits found within the well-elderly population. The study was forced to omit the data results for the cardiovascular endurance and quality of life measurements due to a potential type two error; however, the qualitative data collected showed a positive relationship between the Nintendo Wii and the quality of life and could further benefit from continued research. Prior to the data collection, researchers found only one source of information on the Nintendo Wii; however, by the time the data analysis portion of this study took place, there had been several Nintendo Wii articles in various magazines and websites discussion boards written; however, none that utilize standardized assessments.

Recommendations for future research

Therapists utilizing the Nintendo® Wii™ in occupational therapy practice must continue to examine the therapeutic benefits of Nintendo's® Wii™ activities. A variety of directions are warranted for future research. First, it is recommended that future studies that examine balance also address the association of fear of falling and the effects of participation in Nintendo's® Wii Fit™ activities. This may reveal pertinent information about the participants' self-perception of balance. Future researchers may also consider studying the different Nintendo® Wii Fit™ balance activities separately to identify if one specific game is more effective than others. Lastly, researchers should study the therapeutic benefits of using the Nintendo® Wii™ with a variety of

clients to identify the numerous potential benefits of incorporating this interactive game into occupational therapy practice.

Conclusion

Occupational therapists working with the well elderly frequently address issues of balance, cardiovascular endurance, and quality of life. Discovering the best methods for improving such variables is imperative for these practitioners. Results from this study reveal statistically significant improvements in balance, and no significant changes in cardiovascular endurance and quality of life as indicated by the Polar Heart Monitors and SF-36v2®. Although this study did not reveal a statistically significant improvement in participants' quality of life, qualitative information indicates that the participants received numerous quality of life benefits as a result of participating in the study. Results reveal that occupational therapists working with geriatric clientele can utilize the Nintendo ® Wii Fit™ as an evidence-based intervention to improve balance. Finally, results also indicate a need for further research to determine cardiovascular and quality of life benefits and to further explore additional benefits of the Nintendo Wii that have not yet been tested.

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Appendix A: Nintendo Wii Games

The games utilized on the Nintendo Wii throughout intervention are listed below with a brief description.

Balance Activities:

1. Ski jump- involves standing on game board and bending legs, hips and straightening legs at appropriate intervals
2. Ski and snowboard slaloms- involves bending of the hips and knees and while weight bearing to angle the snowboard in the correct direction
3. Heading soccer balls- standing on the game board and performing weight bearing activities to shift weight to assist in simulating head butting a ball
4. Table tilt- involves standing on the game board and performing very sensitive weight shifting exercises to complete each level
5. Tight rope tension- involves standing on game board and marching in place while attempting to maintain balance and appropriate weight bearing strategies evenly
6. Balance bubble- involves standing on game board and leaning in various directions to assist in weight bearing to complete activity
7. Penguin slide- involves standing on game board and shifting weight to either the left or the right given appropriate visual cues

Aerobic Activities:

1. Jogging- involves both marching/jogging in place while holding and swinging joy stick in hand
2. Step aerobics- involves maintaining balance while stepping up and down in random order onto the game board at various speeds

3. Hula-hoop- involves stepping onto the game board, swinging the hips in a wide circle (legs slightly bent), and maintaining balance
4. Rhythm boxing- standing while holding joystick in one hand while carrying out punching arm motions

