Physical and psychosocial function in residential aged-care elders: Effect of nintendo wii sports games

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sports games.
Abstract

This mixed-methods, quasi-experimental trial sought to determine if the Nintendo Wii Sports (NWS) active video game (exergame) system could significantly improve the functional ability, physical activity levels and quality of life of 34 older adults (4 males and 30 females, 83 ± 8 years) living in residential aged care (RAC). Change score analyses indicated the intervention group had significantly greater increases in bicep curl muscular endurance, physical activity levels and psychological quality of life than the control group (p < .05). Analysis of the quotes underlying the three themes (Feeling Silly, Feeling Good; Having Fun; and Something to Look Forward to) suggested that intervention group participants developed a sense of empowerment and achievement after some initial reluctance and anxiousness. They felt that the games were fun and provided an avenue for greater socialization. Collectively, these results add some further support to the utilization of NWS exergames in the RAC context.

Key words: exercise; semi-structured group interviews; nursing homes; psychosocial, recreational therapy/activities.
With the ageing of the population in many countries, more older adults may require aged care services and ultimately move into residential age care (RAC), often referred to as nursing or rest homes. Consequently, the benefits of a variety of physical and social activities such as gardening, resistance training and walking have been examined for older RAC residents (Brown, Allen, Dwozan, Mercer, & Warren, 2004; Fiatarone et al., 1994; Hill, Kolanowski, & Kurum, 2010; MacRae et al., 1996). While these studies have reported several physical and psychosocial benefits for the residents, there can be many barriers that prevent these activities being easily accessible. Such barriers may reflect the lack of time the RAC staff have to lead such activities, management’s reluctance to pay additional money to external qualified instructors for activities such as exercise or arts classes, environmental constraints relating to the space and equipment required for such activities or perceived (or real) concerns regarding the safety of these activities (Chen, 2010; McKenzie, Naccarella, & Thompson, 2007).

Therefore, cost-, space- and time-effective strategies that allow more opportunities for RAC residents to engage in physical and social activities are needed. One such option that warrants further investigation are active video exergames like the Nintendo Wii Sports™ (NWS) that can be played standing or sitting with a hand-mounted controller so to perform simulated sporting movements. The NWS allows five games to be played, these being baseball, boxing, golf, tennis and ten pin bowling. Many of these games involve an integration of the
sensory and motor systems, require a mixture of fine and gross-motor movements, and (in some games) the ability to quickly respond to what is observed on the television screen.

Several studies have now demonstrated that some NWS games such as tennis and boxing may be classified as moderate physical activities as they may require three times higher energy expenditure than when performing sedentary activities (Hurkmans, Ribbers, Streur-Kranenburg, Stam, & van den Berg-Emons, 2011; Miyachi, Yamamoto, Ohkawara, & Tanaka, 2010; Taylor et al., 2012). As the number of hours per day that RAC residents may engage in sedentary behavior is substantial, exergames like the NWS may offer a realistic way to increase their levels of physical activity, cardiovascular fitness and overall health and well-being.

Results of the limited peer-reviewed literature indicate that NWS games can significantly reduce depressive symptoms and improve health-related quality of life and cognitive performance in community-dwelling older adults, with trends for improved physical function as assessed by strength, sit to stand and 10 m gait speed tests also observed (Rosenberg et al., 2010; Wollersheim et al., 2010). While older RAC residents may have even more to gain from using the NWS than community-dwelling elders, only four studies involving RAC residents appear to have been conducted. The first two of these were case reports involving an 89 year old female with a history of multiple falls (Clark & Kraemer, 2009) and an 89 year male stroke survivor (Drexler, 2009). These case studies reported that
therapist-supervised NWS play substantially improved balance (Clark & Kraemer, 2009) and fine-motor control of the stroke-affected upper limb (Drexler, 2009). Two somewhat larger studies have also examined the feasibility and potential benefits of the NWS in the RAC context. In the uncontrolled trial by Keogh, Power, Wooller, Lucas and Whatman (2012), a sample of 11 RAC residents performed a self-selected amount of NWS play for a five week period. Keogh et al. (2012) reported no significant changes in dynamic stability, health-related quality of life (QOL) or fear of falling, although the qualitative analysis of informal staff and resident interviews suggested a range of psychosocial benefits for the residents. In a larger qualitative study, Higgins, Horton, Hodgkinson and Muggleton (2010) who interviewed one staff member from each of the 53 high- and low-dependency RAC centers using the NWS reported many benefits for the residents. These reported benefits included increased levels of physical activity and mobility, social interaction, self-esteem and connection with former self (Higgins, et al., 2010).

The current study used a mixed-methods, quasi-experimental design to: 1) quantitatively examine the effect of NWS use on functional ability, physical activity and quality of life of RAC residents; and 2) use a semi-structured group interview approach to obtain the perceptions of RAC residents on the use of the NWS.

**Methods**

**Research Design**
This study utilized a mixed-methods, quasi-experimental design to assess the potential benefit of having the NWS available for an eight week period in a RAC on the residents’ levels of functional ability, physical activity and quality of life. From the interested RAC facilities, one was randomly selected to form the intervention (NWS) group, with the participants from another RAC comprising the control group. Participants in the NWS group selected the frequency, duration and type of NWS games they wished to play, with no coercion by the research team or staff. Although such an approach does not allow a dose-response effect to be determined, it was chosen as it was felt that this would better reflect how the NWS would be used in the RAC facility and therefore the real-world benefits that could be obtained for this population. Semi-structured group interviews provided additional information with regard to changes noted by the participants about their usage and views of the NWS, data that would not have been able to be gathered and analyzed quantitatively (Creswell, Fetters, Plano Clark, & Morales, 2009; Schoenberg & McAuley, 2007; Schoenberg, Miller, & Pruchno, 2011).

**Participants**

All participants in this study were living in a RAC, with the two RAC in a similar geographical location. A total of 34 participants (4 males and 30 females) gave informed consent to participate in the study, with 19 (including 2 males) being assigned to the NWS group and 15 (including 2 males) to the control group by virtue of which RAC they resided. The mean age of
the participants in the study was 83 ± 8 years. After completing the intervention, seven
participants from the NWS group gave informed consent to participate in the semi-structured
group interview. All ethical procedures were approved by the researchers’ institutional ethics
board.

Based on a directive from the RAC management, the staff at each RAC provided a list
of the names of their residents who were considered eligible and suitable for participation in
this study. To be eligible the RAC residents had to be able to walk at least 10 meters unaided or
with a walking aid, have sufficient cognitive ability to understand the instructions associated
with playing the NWS, be able to answer the questions contained in the questionnaires and to
discuss their perceptions of the NWS in a semi-structured group interview. Cognitive ability
was determined based on the RAC’s most recent cognitive assessment of the residents via
standard tools such as the MSSE. These individuals were then invited to an information
session whereby members of the research team described the study and what their involvement
would be if they wished to participate.

**Video Game Intervention**

The NWS was delivered to the relevant RAC facility. The research assistant spent an average
of 15-20 minutes with each participant in the first training session, ensuring they understood
the use of the hand held device, their optimal standing/sitting position and how to play each of
the five games available in the NWS game system. These games included baseball, boxing,
golf, tennis and ten pin bowling. During the initial week of the study the research assistant visited the RAC facility daily, spending two to three hours with the group on each occasion. Some continuing operational support was also provided by the research assistant, throughout the remaining weeks of the intervention, although this amounted to no more than five minutes per participant per day during the three days of attendance by the research assistant over the latter seven weeks. All participants in the NWS group were also asked to record in a log book, positioned next to the NWS system, the duration of each occurrence of their NWS play and the game(s) actually played. The research assistant also consulted the participants and care staff during the study to see if any adverse effects occurred that could be attributed to participating in the NWS intervention. If any adverse effects were noted, details of who, when, where and how were recorded. During the eight week intervention, the participants in the control group did not receive any additional treatment and underwent their normal activities of daily living.

**Data collection methods**

The level of functional ability (bicep curl and Four Square Step Test - FSST), physical activity (Rapid Assessment of Physical Activity - RAPA) and quality of life (World Health Organisation Quality of Life Questionnaire – Brief Australian version - WHOQOL-Brief) for each participant were the primary quantitative measures for this study. All of these measures were obtained within one week prior to commencing and one week after completing the intervention phase. Semi-structured group interviews were also facilitated at the conclusion of
the study to gain greater insight into the residents’ perceptions of the NWS in the RAC context.

Data was collected by the members of the research team including the research assistant who was not blinded to the allocation of the participants.

Functional Ability. The bicep curl test was used to assess upper body muscular strength and endurance (Rikli & Jones, 1999). After completing a practice set with no additional load, each participant performed the real trial which involved them flexing and extending the elbow of dominant hand with a weight (men: 4 kg dumbbell, women: 2 kg dumbbell) through a complete range of motion, as many times as possible in 30 seconds. The score was the total number of bicep curls performed through the full range of motion in 30 s.

The FSST was selected as a test of functional ability as it assesses varying aspects of functional ability and dynamic balance in older adults, predicts the incidence of falls and has very high levels of test-retest reliability, with ICC = .93-.99 (Dite & Temple, 2002; Whitney, Marchetti, Morris, & Sparto, 2007). The FSST required the participants to step over four foam sticks (each ~ 1m long) that were laid on the ground at 90° angles to each other (Dite & Temple, 2002; Whitney, et al., 2007). Participants started (stood) in one square facing forward, then moved clockwise around the “plus sign” by moving forward, to the right, backward and then to the left (i.e. the starting square). At this point, the participants reversed their path and moved in an anti-clockwise direction back to their starting position. The instructions given to each participant were “Try to complete the sequence as fast and as safely as possible without
touching the foam sticks”. Three trials of this test were performed in each testing session, with the mean of the best two used for statistical analysis. If the participants were unable to complete this test on their own, they were given the option of using their regular walking aid to assist them in the test (Blennerhassett & Jayalath, 2008). However, for all the participants who used walking aids, a walking frame was their preferred option, which unfortunately could not be used due to the foam sticks on the ground.

Physical Activity. The RAPA questionnaire was used to assess levels of physical activity due to its specificity for older adults, brevity, ability to categorize levels of physical activity and high-very high levels of specificity, sensitivity and reliability (Topolski et al., 2006). A trained research assistant assisted the residents to complete this questionnaire. The categorization of individuals’ physical activity levels were similar to that of Keogh et al. (2010). Specifically, any participants who answered “Yes” to “I rarely or never do any physical activities” were classified as sedentary. Any who answered “Yes” to “I do 30 minutes or more a day of moderate physical activities, 5 or more days a week” or “I do 20 minutes or more a day of vigorous physical activities, 3 or more days a week” were classified as “Active”. All other individuals were classified as “Insufficiently Active”.

Quality of Life. Quality of life was assessed by the WHOQOL-BREF. The WHOQOL-BREF is a validated and very commonly used questionnaire to assess the quality of life of older adults. It consists of 26 items that allow QOL to be determined across four broad
domains: physical health (7 items), psychological health (6 items), social relationships (3 items) and environment (8 items) (Harada, Chiu, King, & Stewart, 2001; McHorney, Ware, Lu, & Sherbourne, 1994; McHorney, Ware, & Raczek, 1993). The WHOQOL-BREF exhibits high reliability (ICC = .65-.92) across all domains (McHorney, et al., 1994; McHorney, et al., 1993) and has been shown to be sensitive to change in older adults (including RAC residents). As with the RAPA, a trained research assistant was used to assist the residents in completing this questionnaire. As the number of items differed across the four domains, the raw domain scores were normalized to 100% to facilitate better comparison between domains. The scores for the four domains of the WHOQOL-BREF were calculated using standard calculations (Krägeloh et al., 2012). The first step in this process involved summing the scores from each of the three to eight items that comprise each of the four domains. These raw domains scores ranged from 3-12 for the Social domain and 8-32 for the Environmental domain. The lowest possible score for each domain was then subtracted from the actual score, with this value divided by the maximum possible score and multiplied by 100 to convert to a percentage, with values ranging from 0-100. The greater the score, the greater the QOL.

**Semi-Structured Group Interviews.** A qualitative research component involving a semi-structured group interview was included in this study as it allowed the researchers to investigate aspects of the NWS intervention that are difficult to evaluate using quantitative statistics (Schoenberg, et al., 2011). In particular, the semi-structured group interview was
conducted at the conclusion of the study to allow the researchers to obtain a deeper insight into the RAC residents’ experience of using the NWS, including any initial (or ongoing) fears or issues as well as any noticeable changes to personal autonomy and general well-being they felt resulted from its use. The semi-structured group interview was facilitated by two members of the research team and consisted of 8 participants. The interaction and communication between the individuals generated a rich source of data. The semi-structured group interview encouraged individuals to explore their thoughts in a way that is not easily achieved in a one on one interview (Gratton & Jones, 2010; Kitzinger, 1995, 2005). Semi-structured questions (see Table 1) were used to assist the process with the semi-structured group interview recorded on a digital voice recorder that was then transcribed verbatim after completion. Field notes were kept during the semi-structured group interview to provide an additional way to aid credibility and triangulation. After transcription of the semi-structured group interview dialogue it was returned to the participants for members checking. This aimed to ensure that the findings of the research team were confirmed by the participants and thus part of the negotiation process (Scheider, Elliot, LoBiondo-Wood & Haber, 2003).

See Table 1

Data Analysis

Quantitative data analysis involved a two group pre- and post-test design to examine the effect of NWS play on the changes in the dependent variables (functional ability, physical activity
and quality of life). These analyses were all performed using the Pre-Post Parallel Groups Trial spread sheet of Hopkins (2002). Prior to analysis, the functional performance scores were log transformed to reduce non-uniformity of the data as recommended by Hopkins (2002). For all comparisons where the between-group differences at baseline were a moderate effect size or larger, the analyses were also adjusted by using the participants’ baseline scores for that variable as a covariate (Hopkins, 2002; Keogh, Morrison, & Barrett, 2010). The means and standard deviations for the functional ability measures presented in the Tables are the back-transformed means of the log-transformed data. The probability of a between-group difference in response was determined using independent T-tests on the within-group change scores. The magnitude of between-group effect was determined by calculating Cohen’s effect size ($d$), with the uncertainty in the effect expressed as 90% confidence limits (CL) as recommended by Hopkins (2002).

Semi-structured group interview data were analyzed using the general inductive thematic approach, which involves a rigorous analysis of the transcript data to derive themes (Thomas, 2006). This method of analysis was chosen as it allows the identification of common and important themes (Scriven, 1991) and as such is commonly used in similar types of physical activity-related health research involving older adults (Fisken, Keogh, Waters, & Hing, in press; Lees, Clarkr, Nigg, & Newman, 2005; Patel, Schofield, Kolt, & Keogh, 2011). The thematic process involved two members of the research team reviewing and coding the
transcripts individually. The entire research team then independently reviewed the initial
coding to ensure that the themes identified reflected the actual participants’ statements and for a
consensus to be reached on the coding of each transcript. This comparative analysis was used
to corroborate the data and so aid credibility and dependability. This lengthy process allowed
for the emergence of the major themes (Thomas, 2006). Polit, Beck and Hungler (2001)
suggest that ‘prolonged engagement’ of the data encourages more thorough understanding of a
matter under investigation. Ensuring adequate time was spent with the data supports credibility
and thus trustworthiness.

Results

Quantitative Data

There were no significant between-group differences in the quantitative outcome measures at
baseline ($p = .071 – .966$). However, there were a number of outcome measures in which effect
size analyses indicated a moderate between-group baseline difference. The moderate or larger
effect size ($d$) differences were found for the bicep curl ($d = .84 \pm .76$), FSST ($d = .74 \pm 1.53$),
physical WHOQOL ($d = .88 \pm 1.13$) and social WHOQOL ($d = .60 \pm .66$) domain scores. For
all but the social WHOQOL, these baseline differences were characterized by the NWS group
having superior scores.

The study began with 19 participants in the NWS group and 15 in the control group.

However, only 13 participants in the NWS group and 13 in the control group completed the
study. Within the NWS group, reasons for discontinuing included deterioration in health (n = 2), social and family commitments (n = 1) and the death of one participant (n = 1). For all other participants who discontinued their participation in the trial, no one specific reason was given to the research team for their discontinuation. Inspection of the adverse effect logbook and consultation with the care staff indicated that this death and the deterioration in health of some participants was not connected to their involvement in the project, meaning no NWS-related adverse effects were observed for the study.

Each participant in the intervention group averaged 30 ± 24 minutes (range = 1 - 105 minutes) of NWS time per week, over the eight weeks of the study, with each participant maintaining a similar duration of NWS over the majority of these eight weeks. Ten pin bowling (16 ± 9 minutes, range = 0 – 43 minutes per participant per week) was the most commonly played game followed by tennis (8 ± 22 minutes, range = 0 – 84 minutes per participant per week), golf (4 ± 4 minutes, range = 0 – 10 minutes per participant per week), boxing (1 ± 2 minute, range = 0 – 5 minutes per participant per week) and baseball (1 ± 1 minute, range = 0 – 5 minutes per participant per week).

The results for the pre-post changes in the quantitative outcome measures for the two groups are summarized in Table 2. Of the two functional performance measures (bicep curl and FSST), the NWS had a significantly greater increase in bicep curl repetitions than the control group (p = .038, d = .65 ± .50). There was also a significantly greater increase in
self-reported physical activity levels (as indicated by the mean RAPA score) for the NWS than control group ($p = .009, d = 1.19 \pm .71$). This increase for the NWS appeared to reflect the transition of one initially “Sedentary” individual to “Insufficiently Active” and two “Insufficiently Active” individuals to “Active”. Significantly greater improvements in psychological QOL (as assessed by the WHOQOL-BREF) were observed for the NWS than the control group ($p = .012, d = .74 \pm .46$). While non-significant, a moderate effect size between-group difference in response was observed for physical QOL, with the change favoring the NWS group ($p = .096, d = .92 \pm .93$).

See Table 2

**Semi-Structured Group Interview Data**

Seven of the 13 participants who completed the intervention participated in the semi-structured group interview. This group comprised one male and six females and were comparable to the overall group mean data for the intervention group in relation to their age and minutes of NWS games played per week. The analysis of the semi-structured group interview transcription revealed the participants’ experience of using the NWS. Of particular interest was the fact that most of the participants were interested in continuing to play the NWS after the study was finished. This request was supported by the RAC intervention facility that purchased a unit. The findings are presented as themes that are essential to extrapolate the overriding experiences of participants. Verbatim excerpts shared by the participants are included to assist
the reader in contextualizing these themes. The themes presented below include: a) feeling silly, feeling good, b) having fun, and c) something to look forward to.

**Feeling silly, feeling good.** None of the participants had experienced using video sports games prior to enrolling in the study. Understandably, most reported that this caused them some initial concern, as they were reluctant to show their lack of skill and knowledge in front of others. These feelings are exemplified by the following quotes, with one participant (P4) stating “I didn’t want to do it [use the NWS]. I don’t know how to use a computer so I thought it would be too hard for me to do” and another (P6) saying “I thought I’d look silly in front of the others when I got it all wrong and I couldn’t hit the ball, so I was very nervous when I first had a go”.

However, once they had overcome this fear they enjoyed the feeling of achievement. For example, one participant (P3) stated “My grandchildren were amazed that I knew what they were doing…… that made me feel a bit proud of myself”, while another participant (P2) said “At the beginning I wouldn’t go near it until it was handed to me. At the end I was the one turning it [NWS games] on. It made me feel good….clever”.

**Having fun.** The participants felt that having the opportunity to spend time with their peers whilst performing a novel activity was a valued aspect of the use of the NWS games. This was evident in the statements of two participants (P3 and P4) who stated “It was a lot of fun watching each other. We laughed at each other and it didn’t really matter after a while if we
did it bad. It was all about the fun” and “I hadn’t had a game a tennis with anyone for years and
I know this isn’t real but we did have a competition and it was really good fun”, respectively.

Being able to play the NWS games provided fun and laughter as shown in the following
excerpts. One participant (P7) stated “At 91 years of age I’m fascinated by it, I found it most
interesting. I thoroughly enjoyed particularly the tennis, I liked the doubles because of the
interaction with other people and I’d really like installed in the village” while another (P1) said
“Well I’ve damn well enjoyed it. It’s all been good news for me. I said I’d use it [NWS games]
again. I like being with people and I thought it was a little bit competitive but it was good”.

Comments also show that it was not only the social interaction occurring between
participants that promoted enjoyment, but this also came from the reaction of others who were
purely observing. One participant (P6) stated “I really enjoyed the fact the other people could
watch and cheer us on…..after a while it didn’t matter if you did a bad shot cause the people
watching felt for you like it was them playing”. Others (P1 and P4) said “Marjorie laughed
until she hurt her ribs laughing when we missed a shot” and “Even people in the room that
weren’t playing joined in to watch and cheer us on. It was good for us and it gave them
something different to look at. They talked to [the research assistant] as well”.

**Something to look forward to.** Several members of the group mentioned one of the
themes that introduced a slightly different perspective. Some of the participants described
feelings of anticipation for when they would next play or watch others playing the NWS games.
It was also noted that having the research team present at some of the sessions had additional positive impact for some participants. Several (P5 and P4) found that having a ‘new face’ to interact with and someone who would sit and listen was something to look forward to. Quotes to support these themes included “I did feel silly to begin with …. but I did get better and it gave me something to look forward to. My days are quite quiet and I get lonely, so it was good” and “We look forward to [the research assistant] coming and you other people as well. It gave us someone different to talk to”.

Discussion

While there was considerable between-participant variability in the weekly duration of NWS games played over the eight week intervention, the majority of the participants played the NWS games in the company of other residents. According to the analysis of the semi-structured group interview data, this helped to create a competitive and supportive atmosphere. NWS game play also lead to significant improvement in some aspects of functional ability, physical activity and quality of life in RAC residents.

The significant improvement in bicep curl strength observed in the present study is the first significant between-group effect observed in older adults and the first in RAC residents. Due to the importance of upper limb muscular strength and endurance in relation to maintaining independence in performing activities of daily living involving lifting, reaching and carrying, such a finding would appear of substantial practical significance. This increase
In strength was likely a result of the relatively frequent and intense movements of the arm segments that are needed to play a number of the NWS games (Pasch, Bianchi-Berthouze, van Dijk, & Nijholt, 2009).

In contrast, no significant improvement in balance was observed in the NWS group of the present study. Such a finding was consistent with that of Keogh et al. (2012), but inconsistent with one other study (Clark & Kraemer, 2009). This discrepancy in results could reflect many between-study differences in study sample and methodology. For example, participants in the current study and that of Keogh et al. self-selected their NWS usage, with a mean weekly NWS game time of ~ 30 minutes per participant, seen in both studies across the 5-8 week long interventions. This contrasted with the other study which involved 180 minutes of NWS per week for two weeks (Clark & Kraemer, 2009). In addition, the participants in the current study and Keogh et al. were not supervised when playing these games and many chose to play the NWS games in a seated rather than standing position. This again differed to the other study (Clark & Kraemer, 2009), whereby a physiotherapist supervised all sessions and required the participants to perform the NWS games in a standing posture. Collectively, these results suggest that for the NWS to improve balance in older adults, the games may need to be supervised and/or played standing upright for more than 30 minutes per week for multiple weeks. Unfortunately, such recommendations may be challenging to implement in the RAC context as the staff may already be too busy with their
regular care duties to supervise the residents with high falls risk who may be most likely to benefit from such attention.

Significant increases in the level of physical activity were also observed for the NWS group, with the change being approximately half of the smallest unit of measurement on the RAPA questionnaire. This between-group mean change appeared to be a result of one initially “Sedentary” individual becoming “Insufficiently Active” and two “Insufficiently Active” individuals becoming “Active”. This significant increase in physical activity was perhaps a little surprising as ten-pin bowling which has been shown to require significantly less energy expenditure than other NWS games like tennis and boxing was by far the most commonly played NWS game by the RAC residents (Hurkmans, et al., 2011; Miyachi, et al., 2010). While the validity of self-reported physical activity is also somewhat questionable, with this perhaps even more so for RAC residents, the increased levels of physical activity seen in this study further supports the views of 53 RAC staff in the study of Higgins et al. (2010) who felt that the RAC residents who used the NWS became more physically active.

Such results also appear consistent with Keogh et al. (2012) who proposed that the NWS may act as a primer to increase levels of physical activity in initially sedentary or insufficiently active RAC residents. Further studies in this area should seek to examine the effect of playing one specific NWS game like boxing or tennis that requires greater energy expenditure and confirm these findings by using more valid measures such as doubly labeled water or indirect
calorimetry or even more indirect measures such as accelerometers or pedometers (Colbert, Matthews, Havighurst, Kim, & Schoeller, 2011).

Analysis of the WHOQOL-BREF data revealed some positive effects of the NWS on the QOL of the RAC residents. Specifically, a significantly greater increase in psychological QOL and a non-significant but moderate effect size increases in physical QOL were observed for the NWS than control group. Such results appeared consistent with the significant increases in mental health-related QOL reported for community dwelling elders using the NWS (Rosenberg, et al., 2010).

Consistent with the recommendations of Schoenberg et al. (2011), a qualitative research component was utilized to complement and add to the quantitative quality of life data obtained through the WHOQOL-BREF. Potentially the most important theme emerging from the semi-structured group interview of the present study was the increased and enhanced social interaction, with this being described not just in relation to playing the games but also when watching others playing. Similar qualitative improvements in socialization have been reported by community-dwelling older women (Wollersheim, et al., 2010) and by RAC staff for their residents (Higgins, et al., 2010; Keogh, et al., 2012) in other NWS studies. Such reported improvements in socialization from both the RAC resident and staff perspectives further support the use of qualitative research in this domain. Therefore, whilst this improved socialization was not an unexpected outcome, it was interesting to see that it did not coincide...
with a significant increase in the WHOQOL-BREF social domain score within the current study, especially when other quantitative aspects of QOL tended to improve. Closer inspection of the specific items comprising the social domain revealed that of the three questions, one was concerned with the individuals’ sex life. As many of the participants were widows or widowers and did not have a sexual partner, such a question was therefore unlikely to be applicable and hence generally not answered. A RAC specific version of QOL tool like the WHOQOL-BREF may therefore be useful to develop, focusing on socialization aspects of more relevance to this population.

Another interesting finding was how the RAC residents’ initial apprehension about the NWS due to the lack of prior knowledge or experience in using technology changed to a feeling of pride and personal satisfaction after becoming competent in using the system. The process of learning to play the NWS and in gaining newfound competency in such a novel task has been suggested to be a key factor for older adults playing digital games (Diaz-Orueta, Facal, Nap, & Ranga, 2012) and to have the potential to improve self-confidence in other aspects of their life (O'Sullivan, 2005). The increased self-confidence and pride that the RAC residents obtained as they gained the ability to operate the NWS games may have also been crucial in the NWS becoming a fun rather than fearful activity (Diaz-Orueta, et al., 2012). The fun the residents spoke about was described while playing as well as watching others play the NWS.

Such views appear consistent with the semi-structured group interview transcripts which
suggested that many participants had feelings of loneliness or boredom prior to the arrival of the NWS and that the anticipation of playing or even watching others play the NWS gave them something to look forward to in their weekly schedules. However, some of the participants also cited that the presence of the research assistant or other members of the research team was also good to combat their feelings of loneliness and boredom with their daily routines. Thus, it is a little unclear if the positive socialization effects reported during the semi-structured group interview were a result of the NWS alone, or if the presence of the researchers in the lives of the RAC residents also contributed to this. Nevertheless, the use of the NWS by the participants appeared to increase several aspects of personal independence. This may not only of benefit for their personal well-being but also for the staff at the rest homes who were able to utilize their time in other capacities.

As a small pilot study, there were several limitations inherent to the present study. The first involved the use of a quasi-experimental design which lead to a number of moderate effect size between-group differences at baseline and hence the need to use covariates in some of the statistical analyses. As a pilot study, there was also the potential that we had insufficient statistical power for many of the analyses. Post-hoc power analyses using the current study’s effect sizes confirmed a lack of sufficient statistical power for many of the outcome measures. As a result, the larger studies that might be conducted in the future can now use our effect size data to determine the appropriate sample size required in clinical studies using the NWS or
other exergames for RAC residents. The research assistant involved in our pilot study was involved in the training and data collection sessions, meaning that she was not blinded to the treatment condition of the participants. This could have resulted in some bias, especially within the self-reported and qualitative aspects of the study. We could also be criticized for not using an intent to treat analysis, but we felt that such an approach was not appropriate due to our aim to determine the effect of the intervention for those who complete it, as well as the relatively high number of RAC residents who by virtue of their age, overall health and number of co-morbidities were unlikely to complete the intervention and/or pre- and post-assessments. This reflected one of the challenges in conducting research in RAC context. Understandably there was initial reticence for some of the residents to participate, with some only agreeing to participate after they had seen others using the NWS and ‘having fun’. Further, the majority of the quantitative measures while commonly used with community-dwelling older adults have not specifically been validated within the RAC setting. This may have resulted in several of our assessments such as the FSST, the social domain of the WHOQOL-BREF and the RAPA physical activity questionnaire being of somewhat unknown validity and/or feasibility for at least some of the RAC residents. Another issue was that the FSST was only able to be completed by 15 of the 26 (58%) participants who completed the study. These quantitative assessment issues further validate the use of a mixed method analysis in this study whereby the qualitative measures complemented the quantitative outcomes and allowed an examination of
issues that quantitative statistics could not adequately do within this context (Creswell, et al., 2009; Schoenberg, et al., 2011).

Conclusions

The present study appears to add substantially to the literature on the potential benefits and limitations of the NWS for older adults in RAC as it uses a mixed methods approach, has a larger sample than other studies and is the first to utilize a control group (Creswell, et al., 2009). Specifically, this study demonstrates that older adults in RAC can significantly increase their upper body strength, physical activity levels and psychological quality of life by playing a self-selected quantity of NWS per week for a period of eight weeks.

Future research in this area should seek to assess the effect of NWS play on a wider spectrum of outcome measures and domains using a mixed method approach than the present study. To facilitate this process, the development and validation of some new quantitative assessments for the RAC context including accelerometry monitoring of physical activity might be useful, as all quantitative measures used in this study had been validated for more-functioning, community-dwelling elders. Future studies should also strive to include larger sample sizes and examine how alterations in the type and manner in which the NWS games are played may alter the physiological and psychosocial response.
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