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The effects of GAMotion (a giant exercising board game) on physical capacity, motivation and quality of life among nursing home residents: A pilot interventional study

Fanny Buckinx[a,*], Olivier Bruyère[a,b], Laetitia Lengelé[a], Jean-Yves Reginster[a], Quentin Marchal[b], Paulin Hurtrez[b], Alexandre Mouton[b]

[a] WHO Collaborating Center for Public Health aspects of musculo-skeletal health and ageing, Division of Public Health, Epidemiology and Health Economics, University of Liège, Belgium

[b] Department of Sport and Rehabilitation Sciences, Multidisciplinary Research Unit on Health and Society, University of Liège, Liège, Belgium

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ABSTRACT

Background: In 2017, our team highlighted promising results of a giant exercising board game on physical activity level and a broader array of physical and psychological outcomes among nursing home residents. However, some improvements of this game were needed to make it more suitable for nursing homes and more challenging in terms of exercises. Therefore, we decided to develop a new version of a giant exercising board game: the GAMotion.

Objectives: The primary objective of this pilot study was to assess the impact of the GAMotion on physical capacity among nursing home residents. The secondary aims were to assess the impact of the GAMotion on motivation and quality of life in this population.

Methods: A one-month pilot interventional study was performed in two comparable nursing homes. Eleven participants meeting the inclusion criteria took part in the intervention in one nursing home, whereas 10 participants were assigned to the control group in the other institution. The GAMotion required participants to perform strength, flexibility, balance and endurance activities. The assistance provided by an exercising specialist decreased gradually during the intervention in an autonomy-oriented approach based on the self-determination theory. Physical capacity (i.e. fall risk using Tinetti test; dynamic balance using Timed Up and Go test (TUG); physical abilities using SPPB test; grip strength using Jamar dynamometer; isometric lower limb muscle strength using MicroFET2 and quantitative evaluation of walking using Locometrix), motivation (i.e. using Behavioral Regulation in Exercise Questionnaire-2) and quality of life (i.e. using EQ-5D questionnaire) were assessed at baseline and at the end of the intervention. A two-way repeated-measure analysis of variance (ANOVA) was used to assess time*group (intervention vs. control group) effects. All the analyses were adjusted on age, which differed significantly between the 2 groups at baseline.

Results: During the intervention period, the experimental group displayed a greater improvement in Tinetti score ($p < 0.0001$), TUG ($p = 0.02$), SPPB ($p < 0.0001$), knee extensor isometric strength ($p = 0.04$), grip strength ($p = 0.02$), symmetry of steps ($p = 0.04$), 3 domains of the EQ-5D (i.e. mobility, self-care, usual activities: $p < 0.0001$) and intrinsic motivation ($p = 0.02$) compared to the control group. No significant improvement was demonstrated on the other parameters.

Conclusion: These promising results should be interpreted with caution because of certain limitations (e.g. small sample size, no blind assessment). Further investigation is required to confirm and evaluate the long-term effectiveness of the GAMotion in nursing homes.

* Corresponding author at: University of Liège, WHO Collaborating Center for Public Health aspects of musculo-skeletal health and ageing, Division of Public Health, Epidemiology and Health Economics, CHU - Sart Tilman, Quartier Hôpital, Avenue Hippocrate 13 (Bât. B23), 4000 Liège, Belgium.

E-mail address: fanny.buckinx@uliege.be (F. Buckinx).

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1. Introduction

Research over past decades reports that nursing home residents spend the majority of their time inactive (Ikezoe et al., 2013) and they walk on average 1678 ± 1621 steps per day, which is far from the recommendations levels advocating a minimum of 3000 steps/day (Buckinx et al., 2017; Tudor-Locke et al., 2011). This sedentary lifestyle has detrimental effects on physical and psychological health, quality of life, and contributes to social isolation (Forster et al., 2017). Moreover, the implementation of physical activity interventions leads to positive effects on functional ability, cognition or mood (Brett et al., 2016). Barriers to practicing physical activity, in older adults, have been described in a literature review and are as follow: 1) health issues, such as limited mobility or arthritis, 2) psychological barriers such as fear of falling/being injured or low motivation, 3) medications related to chronic disease and 4) organizational and environmental barriers, such as no dedicated space for exercise equipment and or lack of time, reported by the staff, to incorporate physical activity into the residents' daily routine (Benjamin et al., 2014). Those time constraints could be at least partly overcomed with self-determination theory oriented interventions emphasing the importance of autonomous regulations in fostering physical activity (Teixeira et al., 2012).

Taking into consideration the encouraging evidence about the implementation of physical activity interventions in nursing homes (Jansen et al., 2015), and in order to overcome the barriers to physical activity, we previously investigated the effects of a giant exercising board game intervention on ambulatory physical activity and a broader array of physical and psychological outcomes among nursing home residents (Mouton et al., 2017). As explained in our previous publication (Mouton et al., 2017), we decided to use a giant board game since interventions combining physical exercise and behavioral components could lead to an autonomous form of motivation for physical activity through different strategies, including the satisfaction of exercise-related basic psychological needs for autonomy, competence, and relatedness (Teixeira et al., 2012). Indeed, making physical activity more enjoyable and sociable could encourage residents to participate in physical activity more regularly and to move beyond the relatively monotonous lifestyle in nursing homes (Chen and Li, 2014). Moreover, literature indicates that exergaming approaches for physical activity promotion, such as interactive video games, lead to increased enjoyment and motivation in addition to positive cognitive and physical outcomes (Bleakley et al., 2015). Nevertheless, active video game are difficult to implement in nursing home since they mostly involve one-on-one supervision, required technology, and are not as effective as traditional intervention (Bleakley et al., 2015; Molina et al., 2014). In the sense, the GAMotion could be an interesting alternative.

The study, published in 2017, highlighted promising results. Indeed, after a 3-month follow-up period, results showed that a giant board game intervention led to a significant increase in physical activity level (number of steps per day), daily energy expenditure, quality of life (EQ-5D), balance and gait (Tinetti), and strength of the ankle, whereas these improvements were not observed in the control group (Mouton et al., 2017). However, some improvements of this game were needed to make it more suitable in nursing homes and more challenging in terms of exercises. Effectively, some institutions have reported that the board game was too bulky (i.e. 4∗3 m) and that the playing time was too long (i.e. 24 games squares and ~1 h) for the residents. Some residents also reported that the exercises were sometimes too simple. Taking into account the critics mentioned above, a new version of a giant exercising board game, the GAMotion (i.e. contraction of the words "Game" and "Motion"), was developed. In this new version, we decided to reduce the dimensions of the mat (i.e. 4.20 ∗ 1.70 m) and the number of game squares (i.e. 16 squares) and therefore to reduce playing time (i.e. ~30 min). Then, focus groups bringing together public health professionals, sports sciences specialists, physiotherapists and nursing home staff were organized to modify or adapt the exercises.

The aim of the present study was to develop the GAMotion and evaluate its impact on physical capacity. The secondary objectives of this investigation were to assess the impact of the GAMotion on motivation and quality of life in this population.

2. Methods

2.1. Study design and participants

A one-month pilot interventional study was performed in two comparable nursing homes (i.e. number of beds > 90, semi-rural area and similar services, such as nursing care, physiotherapy, physical and social activities) in the Province of Liège: "Val Mosan" and "Saint Joseph". These two nursing homes were randomized in one intervention group and one control group.

Before intervention initiation, investigators met the director and staff of the nursing homes to inform them about the inclusion and exclusion criteria, the study procedures and intervention. A first screening was performed by the medical staff (i.e. physiotherapists and nurses) to identify between 15 and 30 potentially eligible participants who were then approached by the researchers and asked if they were willing to participate in the study. For this pilot study, we decided to include, at least, 10 participants in each residence.

To be considered eligible, participants needed to live in one nursing home that was included in this study, to be aged 65+ years, to be oriented in order to provide informed consent (i.e. MMSE ≥18 (Folstein et al., 1975)) and to be able to walk independently with or without aid(s).

The adherence rate (i.e. the number of sessions completed compared to the number of prescribed) to the intervention was collected.

Because of the pilot design, the study protocol was not previously recorded and a statistical power calculation was not carried out. Regarding other aspects, the CONSORT statement for randomized controlled trial has been followed. This research was approved by the Ethics Committee of the Teaching University Hospital of Liège (under number 2019/58) and all participants gave written informed consent.

2.2. Intervention

A giant exercising board game, the GAMotion, was the central component of the intervention (Fig. 1). It measures 4.20∗1.70 m and comprising 16 squares (50 × 50 cm) of different colors according to the component of physical fitness that was to be performed (i.e., 4 squares/component): strength, flexibility, balance, and endurance. On each square, an illustration explains the movement to be executed and any adaptations for participants with a lower or higher level of physical fitness. In addition to these squares, the board game includes a walking lane in which circles are drawn in order to execute some walking exercises. Ladders and snakes are used to link pairs of squares, so that participants could move forward or backward faster in the game. Then, a card game is provided with the board game. Each card indicates different actions to perform (e.g. "Repeat the exercise with the most advanced person on the game board", "do the exercise all together", "go to the next pink box"). Finally, the game includes a foam die. The rules are simple and made available to the participants in a folder adjacent to the mat. The participant progress on the mat according to the score obtained with the successive rolls of dice, until reaching the last square.

The intervention took place in the physiotherapy room of the nursing home and was supervised by a physiotherapist. The duration of the game was about 30 min and the game requires a minimum of 2 participants. In order to progressively incite nursing home residents to participate independently in the GAMotion, the assistance provided by the supervisor was decreased gradually during the 1-month intervention period: 4 supervised exercising sessions were planned on the board game during the first week and then 3, 2, and 1 sessions were planned during the second, third, and fourth week of the intervention. The

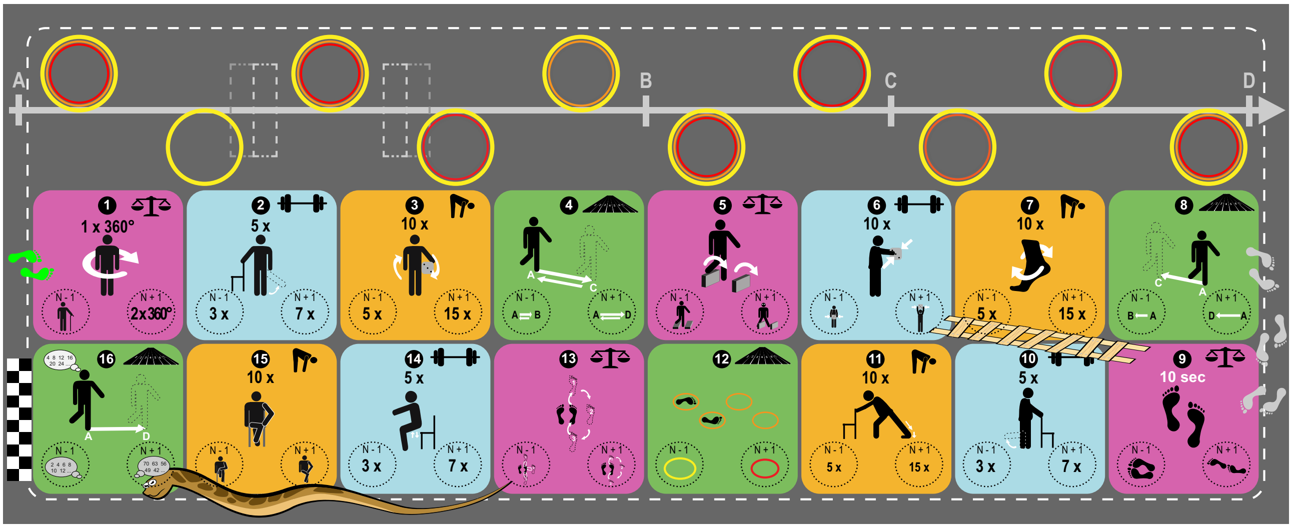

Fig. 1. The GAMotion.

pedagogical strategy was also autonomy oriented: the supervisor helped the participants to play during the first sessions (e.g, miming the body movements) but encouraged them to play as much as possible by themselves. This game is based on the theory of self-determination since it takes into account the three basic psychological needs stated by Ryan & Deci: the need for autonomy, competence and affiliation (Ryan and Deci, 2000). Participants in the control group were requested neither to change their lifestyle during the study nor to get involved in any new type of PA.

2.3. Outcomes measurement

Anamnestic data, physical capacity, motivation and quality of life were collected at baseline (T0) and at the end of the intervention (T1), through a face-to-face interview lasting on an average of 1 h, and combined with the collection of medical records next to the nursing staff. All subjects were tested and interviewed in their room by a clinical research assistant. Data were always collected in the same order as mentioned in the following paragraph.

2.3.1. Socio-demographic data

Information about age, gender and Body Mass Index (BMI) were collected during a face-to-face interview at baseline. Cognitive skills were assessed with the Mini Mental State Examination (MMSE), which consists of a 30-item questionnaire. A maximum score of 30 is attainable for a person without any neuropsychological impairments. Any score greater than or equal to 27 points indicates normal cognition. Below this cut-off, scores can indicate severe (≤9 points), moderate (10–18 points) or mild (19–24 points) cognitive impairment (Tombaugh and McIntyre, 1992).

2.3.2. Physical capacity

To meet our primary objective, severals parameters were measured to assess physical capacity.

2.3.2.1. Short physical performance battery (SPPB) test. The SPPB test is composed of three separate tests: balance, 4-metre gait speed and a chair stand test. A score between 0 and 4 is assigned on each test, and the three tests are weighted equally. Therefore, the maximum score is 12 points. The cut-off value used to assess poor physical performance is ≤8 points, according to the EWGSOP group (European Working Group on Sarcopenia in Older People) (Cruz-Jentoft et al., 2010).

2.3.2.2. Tinetti test. The Tinetti test was used to assess body balance and gait abnormalities. This test consists of 16 items: 9 for body balance and 7 for gait. The maximum score is 16 for body balance, 12 for gait, and thus 28 for the global score (balance + gait). A score below 19 indicates a high risk for falls, a score between 19 and 24 indicates a moderate risk for falls, and 28 points indicates no risk of falls (Tinetti, 1986; Tinetti et al., 1988).

2.3.2.3. Timed up and go test. This test consists in standing from a chair, walking a 3-m distance and sitting down again (Podsiadlo and Richardson, 1991). A duration above 30 s indicates limited mobility and an increased risk of falling whereas a duration of < 20 s indicates appropriate mobility with subject likely to be independent in activities of daily living (Mathias et al., 1986).

2.3.2.4. Grip strength. Handgrip strength of the subjects was measured using a hydraulic dynamometer (Seahan Corporation, MSD Europe Bvba, Belgium). Subjects were asked to squeeze the dynamometer as long and as tightly as possible or until the needle stopped rising. Three measurements for each hand, alternating sides, were performed, and the best of the six grip strength measurements was used for statistical analysis (Roberts et al., 2011).

2.3.2.5. Isometric lower limb muscle strength. Maximal isometric muscle strength of 5 different muscle groups (knee extensors and flexors, hip abductors and extensors, ankle extensors) was measured according to the protocol defined by Buckinx et al. (2015b). Three consecutive maximal contractions of each muscle group were performed, and the highest performance was considered for the analysis.

2.3.2.6. Quantitative gait analysis. Quantitative gait analysis of a 10-second period of walking was performed with a tri-axial accelerometer (Locometrix®). As previousy described by Buckinx et al., the method is based on the recording of accelerations according cranial-caudal, antero-posterior, medial-lateral axes of the body at a point near the center of gravity, the median lumbar region (Buckinx et al., 2015a). The system was applied on the lumbar region, at L3-L4 disc space high, using a semi-elastic belt. It was then connected to a computer which calculates the dynamic gait parameters: frequency, symmetry, stability, regularity of gait cycles, cranio-caudal power, medio-lateral power, antero-posterior power. Participants were asked to walk 2 times 20 m, at normal walking speed. The first run was a preliminary test and the second was recorded for the analysis.

To be rational, these parameters have been assessed because the GAMotion exercises were designed to improve them, as shown below

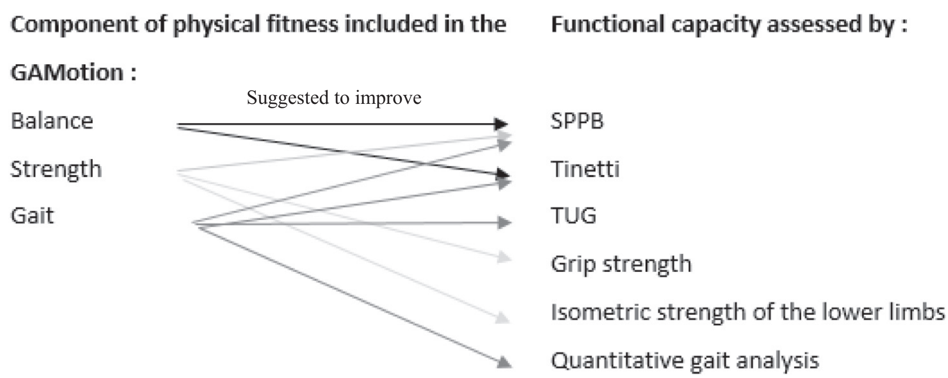

Fig. 2. Relationship between the component of physical fitness included in the GAMotion and the outcomes.

(Fig. 2):

In addition, flexibility exercises could have an indirect impact on all the outcomes.

2.3.3. Motivation for physical activity

As described in our previous study related to the giant exercising board game intervention (Buckinx et al., 2017), the French version of the Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2) was used to assess the participants' motivation concerning exercise. The BREQ-2 consists of 19 items measured on a 5-point Likert-type scale ranging from 0 (not true for me) to 4 (very true for me), five factors (amotivation, external, introjected, identified and intrinsic motivation) (M.Sabisto, 2011).

2.3.4. Quality of life

The EuroQol 5-dimension (EQ-5D) questionnaire was used to assess the quality of life. Through this questionnaire, health problems were self-reported according to 5 dimensions (i.e. mobility, self-care, usual activity, pain/discomfort, and anxiety/depression) and each dimension included 3 levels: no problems, some problems, and severe problems. The EQ-5D health states were then converted into a single summary index, providing a score ranging from 1 (perfect health) to 0 (death) (Cleemput, 2010; Rabin and de Charro, 2001).

2.4. Statistical analysis

A Shapiro–Wilk test verified the normal distribution for all parameters. Quantitative variables that were normally distributed were expressed as the mean ± standard deviation (SD), and quantitative variables that were not normally distributed were reported as the median and percentiles (P25–75). Qualitative variables were reported as absolute and relative frequencies (%). An independent sample *t*-test, or the non-parametric Mann-Withney test, was used to identify between-group baseline differences. A one-way repeated-measure analysis of variance (ANOVA) was used to estimate time and time*group (intervention vs. control group) effects. All statistical analyses were adjusted on baseline significant differences between groups (i.e. age) using analysis of covariance (ANCOVA). Corrections for multiple comparisons were performed using Benjamini-Hochberg's false discovery rate (BH false discovery rate).

Statistical analyses were performed using SPSS 25.0 (Chicago, IL, USA) on an intention-to-treat basis. Results were considered statistically significant when 2-tailed P-values were < 0.05.

3. Results

3.1. Participants

The selection of participants for the present study is summarized in Fig. 3. Medical staff of the nursing homes was asked to pre-screen between 15 and 30 eligible participants. Respectively, 9.5% and 8.5% of the population of the intervention and control nursing homes were prescreened. Among these eligible residents, 5 refused to participate in the intervention group (26%) and 3 did not reach the required MMSE score. In the control group, 14 residents declined to participate (50%), and 4 had an insufficient MMSE score. Finally, 11 and 10 residents were respectively included in the intervention and control groups.

Table 1 shows baseline socio-demographic characteristics of the participants included in the study. Both group were comparable, excepted for age. The intervention group was significantly older (70 (66–73) years) than the control group (84 (78.5–88.8) years; $p = .002$). Therefore, all the analyses presented in this article are adjusted on age.

3.2. Effects of the intervention on physical capacity, motivation and quality of life

Evolution of physical capacity, but also motivation and quality of life, in both groups and between groups, during data collection period, is presented in Table 2.

First, regarding physical capacity, intervention group displayed a significant improvement of SPPB test ($p < 0.0001$), Tinetti test ($p = 0.04$) and isometric strength of the lower limb muscle strength (p-value between 0.004 and 0.03 for the different muscle groups tested) between T0 and T1. In the control group, we observed a significant decrease in isometric strength of the knee extensors ($p = 0.01$) and a significant improvement in walking speed ($p = 0.04$). Moreover, a significant between groups difference was observed for the evolution of SPPB test ($p < 0.0001$), Tinetti test ($p < 0.0001$), Timed Up and Go test ($p = 0.02$) (Fig. 4). These results remained significant after correction for multiple comparison (BH false discovery rate). A significant between groups difference was also observed forisometric strength of the lower limb muscle groups tested (p-value between 0.004 and 0.02) and stride symmetry ($p = 0.04$). After BH correction, we observed a significant difference for isometric strength of hip abductors and extensors and ankle extensors).

Then, identified and intrinsic motivation significantly improved during the intervention period in the intervention group ($p = 0.01$ and 0.04, respectively). However, there was no difference in motivation, between T0 and T1, in the control group. A between group difference was highlighted for intrinsic motivation ($p = 0.02$). After BH correction, this difference was not significant.

Finally, no intra-group difference was observed for quality of life, neither in the intervention group nor in the control group. Nevertheless, inter-group difference was shown for 3 domains of the quality of life: autonomy, self-care and usual activity ($p < 0.0001$). These differences were not significant after BH correction.

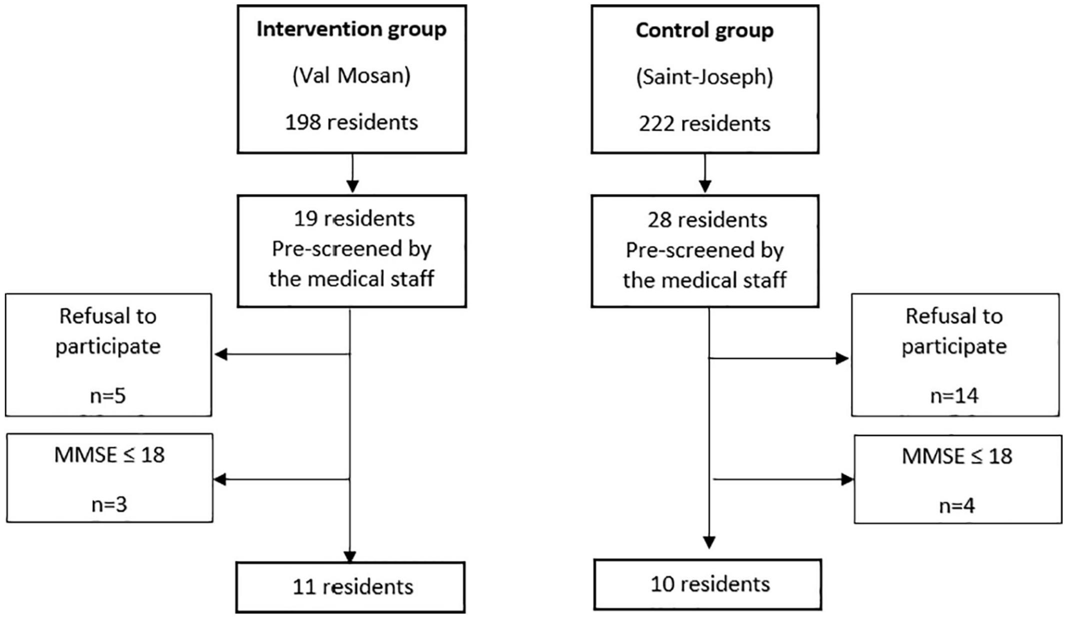

Fig. 3. Flow chart of the study.

Table 1
baseline socio-demographic characteristics of the participants included in the study.

Variables	Intervention group (n = 11)	Control group (n = 10)	p-Value
Age (years)	70 (66–73)	84.5 (78.5–88.8)	0.002
Gender (men)	7 (63.6%)	4 (40%)	0.29
MMSE (/30)	25.6 ± 3.80	27 ± 2.94	0.56
BMI (kg/m^2)	23.9 ± 3.32	25.3 ± 2.95	0.42
SPPB (/12)	7 ± 2.28	4.1 ± 2.23	0.08
Grip strength (kg)	16.9 ± 10.4	11 ± 8.96	0.21

Legend: MMSE = Mini Mental State Examination; BMI = Body Mass Index. Note that the adherence rate to the intervention was high (i.e. 88.2%). In addition, 4 participants have completed all sessions (i.e. adherence rate: 100%) and the lowest adherence rate was 70%.

4. Discussion

The positive effects of GAMotion on physical capacity, motivation and quality of life among nursing home residents observed in the present pilot study go in the same direction than the results obtained with the previous version of the giant exercising board game.

More specifically, the experimental group displayed a greater improvement in Tinetti score ($p < 0.0001$), Timed Up and Go ($p = 0.02$), SPPB ($p < 0.0001$), knee extensor isometric strength ($p = 0.04$), grip strength ($p = 0.02$) and symmetry of steps ($p = 0.04$) compared to the control group. An increase in the total Tinetti score had already been highlighted in our previous study on giant board game and corroborates the results of Mulasso et al. in 2012 (Mulasso et al., 2015). This team conducted a 9-month study using a multicomponent exercise program consisting of muscular strengthening, balance and mobility exercises (i.e. the same component of physical fitness as in the GAMotion) in 85 women aged 83 ± 7.5 years and demonstrated a significant improvement of the Tinetti score in the experimental group compared to the control group (Mulasso et al., 2015). The improvement of the Timed Up and Go was also expected since a recent meta-analysis performed among community-dwelling older adults concluded that supervised physical activity intervention induce a reduction in Timed Up and Go time by 0.92 s for participants in the treatment group compared to those in the control group (Chase et al., 2017). Then, improvement in SPPB score observed in our study confirm the results of Voukelatos et al. conducted among 386 physically inactive people aged 65+ years living in the community (Voukelatos et al., 2015). The intervention group received a self-paced, 48-week walking program and increased his SPPB score ($p = 0.04$) compared to the control group (Voukelatos et al., 2015). The improvement in knee extensors muscle strength, through specific strengthening programs (Gudlaugsson et al., 2012; Krist et al., 2013) or more general exercises (Hauer et al., 2017), as observed in our study, has already been demonstrated in elderly populations. Finally, our positive results on the symmetry of steps are encouraged by another study carried out by Ahn et al. (Ahn et al., 2019). In this study performed on 50 men, aged 71.8 years, the authors proposed a 8-week program (2 sessions of 30 min per week) consisting of stretching, strengthening and balance exercises and observed an improvement in the quality of walking (Ahn et al., 2019). The positive results observed can be explained, among other things, by the variety of exercises proposed in the GAMotion (i.e. the 4 main component of physical fitness). Indeed, in their systematic review of 2013, Cadore et al. have shown that a program composed of various exercises (i.e. balance, walking, strengthening) is more effective than a program containing only one type of exercise concerning the functional capacities of the older adults (Cadore et al., 2013) .

Then, the experimental group displayed a greater improvement in 3 domains of the EQ-5D (i.e. mobility, self-care, usual activities: $p < 0.0001$) compared to the control group, supporting the notion that promoting physical activity in the elderly may have an impact beyond physical health. Similar results had been shown with the first version of our giant board game (Mouton et al., 2017) and are not surprising because a meta-analysis concluded a positive association between physical activity and some quality of life domains among older individuals (Vagetti et al., 2014).

Finally, the experimental group displayed a greater improvement in intrinsic motivation ($p = 0.02$) compared to the control group. It is admit that motivation for physical activity tends to decrease with age (M.Sabisto, 2011). Nevertheless, it is suggested that intrinsic motivation is the more predictive form of regulation supporting long-term exercise adherence (Teixeira et al., 2012). Therefore, the GAMotion, by its playful approach, may have played a crucial role to overcome the barriers to physical activity, to promote physical activity, avoid prolonged periods of sitting and prevent autonomy decline among residents.

Although the main strength of this pilot study was the high level of

Table 2
Effects of the intervention on physical capacity, motivation and quality of life.

	Intervention group n = 11			Control group n = 10				
Variables	PRE (T0)	POST (T1)	P Tnt T0-T1	PRE (T0)	POST (T1)	P Cont T0-T1	P Int vs Cont	BH correction
Physical capacity								
SPPB score (/12)	7,00 ± 2,28	9,55 ± 2,16	< 0,0001	4,30 ± 2,23	4,30 ± 2,50	0,66	< 0,0001	0.008
Tinetti score (/28)	25,82 ± 2,56	26,55 ± 2,12	0,04	21,20 ± 5,45	20,50 ± 5,30	0,17	< 0,0001	0.01
Timed up and go (sec)	11,99 ± 3,71	10,32 ± 2,61	0,10	22,67 ± 15,69	21,67 ± 14,00	0,29	0,02	0.05
Grip strength (kg)	16.83 ± 10.3	15.5 ± 9.79	0,69	10.91 ± 10.1	10.61 ± 9.18	0,92	0,277	0.12
Isometric strength: knee extensors (N)	212,90 ± 73,65	240,75 ± 62,08	0,03	196,53 ± 93,65	170,64 ± 79,63	0,01	0,04	0.07
Isometric strength: knee flexors (N)	170,24 ± 44,23	197,02 ± 50,60	0,004	137,29 ± 63,55	130,72 ± 64,53	0,17	0,02	0.06
Isometric strength: hip abductors (N)	193,29 ± 72,28	244,28 ± 56,09	0,01	166,71 ± 77,08	150,73 ± 61,29	0,05	0,002	0.02
Isometric strength: hip extensors (N)	163,67 ± 45,45	195,94 ± 46,19	0,04	129,25 ± 61,88	127,29 ± 59,72	0,60	0,01	0.04
Isometric strength: ankle extensors (N)	132,03 ± 86,79	287,92 ± 50,50	0,01	201,33 ± 93,46	182,01 ± 73,06	0,07	0,004	0.03
Walking speed (m/s)	0,92 ± 0,16	0,88 ± 0,31	0,72	0,93 ± 0,20	1,01 ± 0,17	0,04	0,44	0.13
Stride length (m)	1,08 ± 0,15	1,11 ± 0,13	0,46	1,03 ± 0,15	1,07 ± 0,09	0,19	0,45	0.13
Stride symmetry (arb. Unit)	210,82 ± 67,73	225,18 ± 99,44	0,37	165,00 ± 51,87	150,20 ± 34,69	0,14	0,04	0.09
Stride regularity (arb. Unit)	168,82 ± 67,70	186,00 ± 58,58	0,38	157,70 ± 62,75	180,90 ± 42,13	0,11	0,82	0.15
Motivation								
Amotivation	3,64 ± 3,01	3,18 ± 3,43	0,61	4,30 ± 3,16	4,20 ± 3,39	0,91	0,47	0.14
External	4,55 ± 4,55	3,73 ± 4,54	0,50	2,80 ± 4,61	1,10 ± 1,52	0,25	0,12	0.10
Introjected	4,27 ± 4,61	5,00 ± 4,80	0,65	3,20 ± 4,19	4,60 ± 3,10	0,09	0,83	0.17
Identified	7,64 ± 3,23	10,55 ± 1,64	0,01	8,10 ± 3,64	8,50 ± 7,78	0,23	0,10	0.09
Intrinsic	12,36 ± 3,17	14,73 ± 1,90	0,04	10,40 ± 4,79	11,60 ± 3,84	0,15	0,02	0.06
Quality of life								
Mobility	1,18 ± 0,41	1,18 ± 0,41	1,00	1,60 ± 0,52	1,60 ± 0,52	1,00	< 0,0001	0.18
Self-care	1,18 ± 0,41	1,18 ± 0,41	1,00	1,20 ± 0,42	1,40 ± 0,52	0,16	< 0,0001	0.19
Usual activity	1,27 ± 0,47	1,00 ± 0,00	0,08	1,50 ± 0,53	1,40 ± 0,52	0,56	< 0,0001	0.2
Pain/discomfort	1,64 ± 0,67	1,46 ± 0,69	0,16	1,60 ± 0,84	1,80 ± 0,65	0,32	0,27	0.11
Anxiety/depression	1,46 ± 0,52	1,55 ± 0,69	0,56	1,50 ± 0,53	1,50 ± 0,53	1,00	0,85	0.17

p-Value adjusted on age.
BH correction: Benjamini-Hochberg's false discovery rate.

adherence to the exercise intervention (88.2%), some limitations must be acknowledged. First of all, because of the pilot design, the sample size was small, thus limiting statistical power. This means that our conclusions should be interpreted and generalized with particular caution. However, even if the number of participants were rather small, significant results were found, encouraging further broader scale investigations Once again, these positive results should be interpreted with caution because of the risk of false positive due to the large number of comparisons performed on a small sample. To overcome this problem, we used the Benjamini-Hochberg's false discovery rate. In addition, a selection bias is possible since only subjects oriented and able to walk were eligible for the study. These subjects are not representative of all people living in nursing home. Then, the median age was significantly different between groups at baseline. Although our results have been adjusted on age, it is likely that subjects from the intervention group (i.e. younger) showed a better ability to improve the various parameters measured than the control group (i.e. older). Furthermore, the intervention only lasted 4 weeks, which may have limited the effects. In addition, the post-intervention effects have not been evaluated to assess whether the benefits of the intervention persist over time. Then, the lack of blind assessment can be considered as a possible bias. The investigators, knowing the subject assignment group, may have, even unintentionally, influenced the results of the assessments. Finally, the Hawthorne effect is a potential bias of this study because participants were aware that they were being assessed.

In conclusion, after a month of intervention using GAMotion, an improvement in functional capacity, quality of life and motivation for physical activity was observed in the experimental group compared to

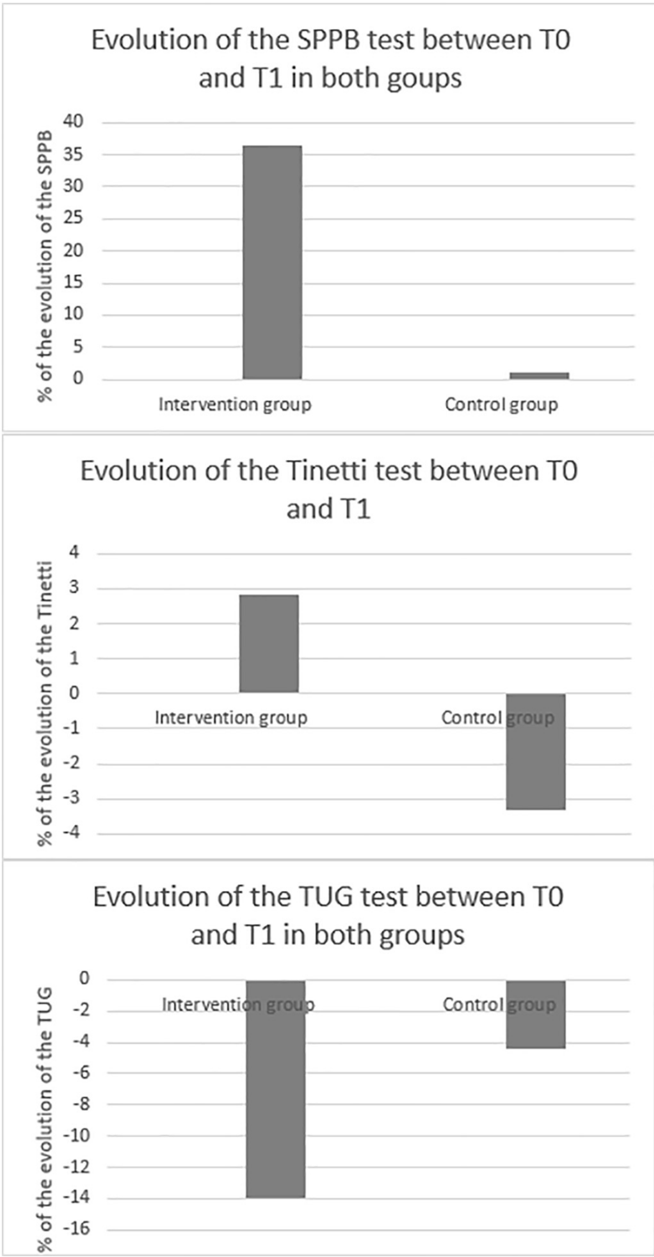

Fig. 4. Effect of the intervention (% of the evolution)on physical capacity.

the control group and these results confirm those obtained with the previous version of the giant exercising board game. Additional studies, including more participants and longer follow-up, are necessary to establish the effectiveness of such an intervention in nursing home setting.

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Declaration of competing interest

No conflicts of interest, financial or otherwise, are reported by any of the authors.

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