

# Development and testing of the Prev'Quedas game for older adults in the community: a descriptive study

*Desenvolvimento e testagem do jogo Prev'Quedas para pessoas idosas da comunidade: estudo descritivo*  
*Desarrollo y prueba del juego Prev'Quedas para personas mayores de la comunidad: un estudio descriptivo*

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## ABSTRACT

**Objectives:** to develop and test a board game for fall prevention in older adults in the community. **Methods:** a descriptive study, carried out through the use of game design elements (narrative, mechanics, aesthetics and technology), the Health Promotion Model, assessment by experts and testing with older adults. For assessment, the Concordance Index was used, considering it greater than 80%. **Results:** three prototypes and the final version were developed. The game's narrative was based on promotion model, comprising individual aspects, benefits and barriers in behavior to prevent falls. The mechanics outlined goals and rules. Aesthetics encompassed layout and illustrations. The technology involved board, cards, pin, roulette and instruction manual. The game was assessed by 36 experts and 31 older women from the community, with a Concordance Index of 93.22% and 99%, respectively. **Conclusions:** the game developed and tested was considered an adequate educational strategy for fall prevention.

**Descriptors:** Old People; Community; Accidental Falls; Educational Technology; Game.

## RESUMO

**Objetivos:** desenvolver e testar um jogo de tabuleiro para prevenção de quedas em idosos da comunidade. **Métodos:** estudo descritivo, realizado através da utilização dos elementos do *design* de jogos (narrativa, mecânica, estética e tecnologia), do Modelo de Promoção da Saúde, da avaliação por especialistas e testagem com pessoas idosas. Para avaliação, utilizou-se o Índice de Concordância, considerando-o maior que 80%. **Resultados:** desenvolveram-se três protótipos e a versão final. A narrativa do jogo foi embasada no modelo de promoção, compreendendo aspectos individuais, benefícios e barreiras no comportamento para prevenção de quedas. A mecânica delimitou objetivos e regras. A estética abrangeu *layout* e ilustrações. A tecnologia envolveu tabuleiro, cartas, pino, roleta e manual de instrução. O jogo foi avaliado por 36 especialistas e 31 idosos da comunidade, com índice de concordância de 93,22% e 99%, respectivamente. **Conclusões:** o jogo desenvolvido e testado foi considerado uma estratégia educacional adequada para prevenção de quedas.

**Descritores:** Pessoas Idosas; Comunidade; Acidentes por Queda; Tecnologia Educacional; Jogo.

## RESUMEN

**Objetivos:** desarrollar y probar un juego de mesa para la prevención de caídas en ancianos de la comunidad. **Métodos:** estudio descriptivo, realizado mediante el uso de elementos de diseño de juegos (narrativa, mecánica, estética y tecnología), el Modelo de Promoción de la Salud, evaluación por expertos y testeo con ancianos. Para la evaluación se utilizó el Índice de Concordancia, considerándose mayor al 80%. **Resultados:** se desarrollaron tres prototipos y la versión final. La narrativa del juego se basó en el modelo de promoción, que comprende aspectos individuales, beneficios y barreras en el comportamiento para prevenir caídas. La mecánica delimitó objetivos y reglas. La estética abarcó el diseño y las ilustraciones. La tecnología involucró tablero, cartas, pino, ruleta y manual de instrucciones. El juego fue evaluado por 36 expertos y 31 ancianas de la comunidad, con un Índice de Concordancia de 93,22% y 99%, respectivamente. **Conclusiones:** el juego desarrollado y probado fue considerado una estrategia educativa adecuada para la prevención de caídas.

**Descriptor:** Personas Mayores; Comunidad; Accidentes por Caídas; Tecnología Educacional; Juego.

## INTRODUCTION

About a third of older adults living in the community fall every year, and approximately half of those suffer recurring falls. Falls are defined by unintentional contact with the support surface, resulting from the change of position of individuals to a level lower than their initial position. Among the injuries present in older adults, the fall is one of the main causes of morbidity and mortality in the world<sup>(1-2)</sup>.

In older adults, this disease begins the so-called cycle of fall, which begins with the fall and, as a primary consequence, the fear of falling. The cycle concludes with the loss of functional capacity and, therefore, greater susceptibility to further falls<sup>(3)</sup>. The fall has a significant impact on older adults' quality of life, their families and high cost in the use of health services<sup>(2)</sup>.

Factors that predispose to falls involve extrinsic conditions related to the environment and intrinsic conditions related to the natural or pathological process of aging<sup>(4)</sup>. Extrinsic conditions account for about 80% of the causes of falls; therefore, educational resources aimed at prevention through teaching and learning strengthening and perception of risks have proved to be effective tools in reducing fall rates and fall risks<sup>(5-6)</sup>. Studies conducted with older adults have described benefits in the use of board games as an educational strategy, showing that this approach is efficient, allowing critical reflection of players regarding healthy aging processes, characteristics that favor autonomy and independence and the promotion of self-care to improve one's own quality of life<sup>(7-8)</sup>.

From this perspective, games enable an innovative approach for a multidisciplinary team, especially for nurses<sup>(9)</sup>. Board games, as a means of health promotion, favor self-care, considering that older adults' education allows the identification of factors that favor fall risk, in addition to representing an opportunity that allows the solution of doubts regarding this issue

It is noteworthy that the present game can potentially contribute to encouraging social interaction, exchanges of experiences and deepening knowledge about fall prevention. Furthermore, it can provide moments of collective learning among the participants, as well as minimize the recurring situation of falls.

## OBJECTIVES

To develop and test an educational game for preventing falls in older adults in the community.

## METHODS

### Ethical aspects

The research complied with the ethical and legal principles recommended by Resolution 466/12 of the Brazilian National Health Council, which regulates research involving human beings, obtaining a favorable Opinion from the Research Ethics Committee.

### Study design, period and location

This is a descriptive and exploratory study, which consisted in the development and testing of an educational technological product such as a board game. Recommendations for creating

games were used following game design, which establishes and defines four essential elements for creating a physical or virtual game, namely: narrative, mechanics, aesthetics and technology<sup>(10)</sup>.

The narrative corresponds to the story told in the game, addressing how each step happens. Mechanics defines the procedures, rules and objective to be achieved. Aesthetics understands appearance, and from it, players can understand the purpose and immerse themselves in the game's history. Finally, technology represents the medium that allows the existence of the game<sup>(10)</sup>.

In this research, A physical board-type game was developed, which allows the professional to approach older adults, as it fosters interaction between players through creativity, the exchange of experiences and information<sup>(11)</sup>. Game development and testing was carried out from January to October 2020.

### Population and sample; inclusion and exclusion criteria

In the game development, experts were selected by intentional non-probabilistic sampling through the *Plataforma Lattes* (resume platform) of the Brazilian National Council for Scientific and Technological Development (CNPq - *Conselho Nacional de Desenvolvimento Científico e Tecnológico*). The following criteria were analyzed for expert selection: degree (at least specialist); and time of working experience in the area related to the topic of interest (have professional assistance/research/teaching experience in the health area of older adults/gerontology/geriatrics and in the development and design of games or educational technology for a minimum period of five years).

Experts were invited through formal contact by invitation letter via e-mail. Upon acceptance, they received the Informed Consent Form (ICF) and a link, with PDF files of the board game.

Invitations to participate were sent to 152 professionals. After the 15-day period, 54 professionals accepted and answered the invitation. Of these, 18 incompletely filled out the assessment instrument, thus, 36 made up the final sample. There is no consensus on the ideal number of experts, however, when comparing with other studies, it is observed that the number of experts who participated in this analysis was similar<sup>(12-14)</sup>.

The board game testing occurred with older adults of a non-profit association located in the municipality of Fortaleza, Ceará. This was founded on June 22, 1962 and has a social assistance program for older adults in situations of social risk, which aims to promote human development, the rescue of citizenship and the pursuit of quality of life based on principles of solidarity, commitment, integration, union, credibility, respect and unity. The choice of this service is justified by the fact that it has the participation of more than 270 older adults registered, from the most diverse locations in Fortaleza, in addition to promoting weekly activities, in person, aimed at promoting the health and independence of this population.

Participants were selected by convenience sampling. Initially, the researcher and the service coordinator separated the telephone numbers of older adults who participated most in the group, totaling 35. Then, the researcher, through telephone contact, invited them to participate in the research, scheduling the day and time for the meeting. Ten male and 35 female older adults were scheduled, however, only older adults attended, totaling 31. Afterwards, the researchers and older adults met at the marked location (non-profit

association). The inclusion criteria were applied and, after that, testing began. All older adults who attended the institution met the inclusion criteria and were part of the sample.

The following inclusion criteria were considered: being 60 years of age or older and having cognition preserved. For cognitive assessment, the Mini Mental State Examination (MMSE) was applied, considering differentiated cut-off levels for each educational level<sup>(15)</sup>. The older adults who composed the sample, according to their education, were classified as cognitively preserved. It is noted that no older adults were excluded from the research.

The sample of this step was composed of 31 older adults. There is no minimum and maximum number of participants described in scientific literature, however studies on educational technologies address around 30 participants<sup>(5,7,16)</sup>.

### Study protocol

For the game development and testing, the steps presented in Figure 1 were covered.

At each step of the study, a new prototype was developed, and the game, improved. In technology, prototype is a preliminary version of a new product<sup>(17)</sup>. This study relied on the development of three prototypes to achieve the final technology.

#### Step 1: Study object approach

This step happened from January to March 2020, resulting in prototype 1.

There were three visits at home specialized in board games and two visits to a game collector, in the municipality of Fortaleza, Ceará, to understand the types of games, their rules, layout, mechanics, colors, size and materials, key components, types and size of cards, pins, dice, role pieces, illustrations, language and instruction manuals.

After immersion with the games, the researcher began the theoretical deepening on falls. The content addressed in the game was based on the Ministry of Health rules and the three-dimensional model on fall prevention<sup>(5,18)</sup>. This was developed by the Elder Health Research Group at the *Universidade Federal do Ceará* (GEPESE), involving the creation of an interactive gerontechnology to prevent falls in older adults at home.

#### Step 2: Game improvement

This step took place from March to August 2020, in which the researcher incorporated the game design elements and the HPM for creating the game, composing prototype 2.

Thus, to subsidize the game organization and its use, HPM steps, a theory developed by Nola J. Pender<sup>(19)</sup>, were followed. The model can be used to implement health promotion actions, being able to assess the behavior that leads to health promotion by studying the relationship of three components: individual characteristics and experiences; feelings and knowledge about specific behavior; and desirable health promotion behavior<sup>(19)</sup>.

The first component, characteristics and individual experiences, refers to a previous behavior that must be changed in the face of an injury and its personal factors involved. The second component, feelings and knowledge about specific behavior, comprises the perception of benefits for care. The third component, feelings and knowledge about specific behavior, refers to the health promotion behavior that one wishes to achieve<sup>(19)</sup>.

Thus, the game's narrative was guided by the following questions associated with the HPM's first component, individual characteristics and experiences: have you fallen? Where did the fall occur? How did the fall happen? Was it inside or outside the house? Have you never fallen? Do you know anyone who fell? Did you receive any explanation about falls?

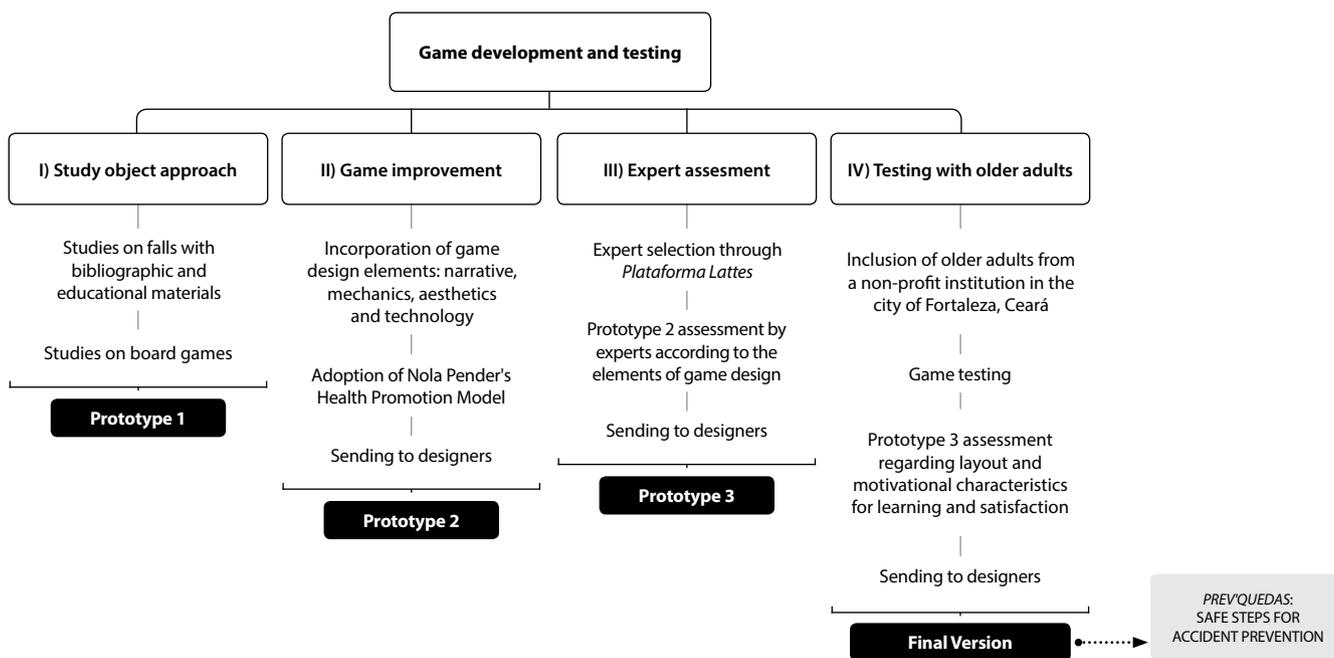


Figure 1 - Game development and testing

For the second component, feelings and knowledge about specific behavior, older adults were asked to identify during the game which factors could facilitate the occurrence of falls within the household and which safe ways should be adopted to prevent falls. Regarding the third component, desirable health promotion behavior, attitudes and behaviors were discussed with older adults in order to achieve the best fall prevention practices at home.

Thus, the objective is to present to older adults the extrinsic factors related to falls at home as well as prevention strategies. Moreover, the game is characterized as cooperative, as it enables learning in a pleasurable way without encouraging competitiveness<sup>(20)</sup>.

The educational game's strategy was to use written (affirmative) and non-verbal (images) communication, which has the following components: (I) The board represents the home with risks in each room; (II) Roulette moves the game; (III) The pin identifies the room; (III) The written and illustrated letters refer to the three components of Nola Pender's HPM; and (IV) Instruction manual.

The letters and instruction manual were developed by the Adobe Illustrator program (cc version 2018 23.0), and the illustrations, by the SketchUp program (version 2018).

### Step 3: Expert game assessment

This step happened from August to September 2020, resulting in prototype 3.

The collection instrument was developed by the researcher using an online questionnaire system called SurveyMonkey®, being linked to the researcher's account to ensure information safety.

The instrument was divided into ten chunks. The first presents the instrument's objective, the second, the demographic profile and professional characteristics. From the third to the eighth, there were 37 items related to the game design criteria: mechanics, narrative, aesthetics and technology. The last chunk is acknowledgments. The instrument was structured with objective and subjective questions, with spaces for placing Likert-type suggestions and responses: (1) Totally disagree; (2) Disagree; (3) Neither agree nor disagree; (4) Agree; (5) Totally agree.

### Step 4: Game testing with older adults

This step took place in the non-profit association for older adults mentioned above, in October 2020, resulting in the final version of the game.

Prototype 3 was tested with 31 older adults individually and up to a maximum of four, in a single meeting per person, in order to avoid agglomerations and respect social distancing due to the COVID-19 pandemic, as recommended by the Ministry of Health<sup>(21)</sup>.

After playing, older adults assessed the game through a printed instrument, prepared by the researcher, who analyzed layout aspects, a motivational characteristic for learning and satisfaction, in which the answers were marked by faces scale, corresponding to very dissatisfied, little dissatisfied, neutral, little satisfied and very satisfied. In addition to this, it had room for suggestions for technology improvement. It is emphasized that the instrument was completed by the data collection team.

The suggestions presented were analyzed by the researcher and duly adopted for the game, which returned to the designers, and, after modifications, resulted in the final product.

## Analysis of results, and statistics

Data from the participation of experts in assessment and testing with older adults were compiled and analyzed using descriptive statistics. From the data obtained from the ratings and assessments carried out, the concordance index (CI) between experts' and target audience's answers was verified. The CI = 80% agreement was considered so that assessment is adequate or excellent.

To verify if the instrument items obtained agreement greater than 80%, the Wilcoxon-Mann-Whitney test was performed with continuity correction, considering a significance level of  $p > 0.05$  and a proportion of 0.80 of agreement to estimate the CI's statistical reliability.

## RESULTS

### Game presentation and rules

The game called *Prev'Quedas* aims to provide information pertinent to older adults about fall risks. Regarding the number of players, according to the number of rooms present on the board (seven), the minimum participation of one and maximum of seven players was outlined. The presence of a health professional is necessary for game conduction and application, as well as the reading of the instruction manual, as the game is an educational resource to guide health education moments about falls with older adults.

The game contains the board with fall risks, cards about individual experiences, cards illustrated with the safe way to prevent falls from each room, pin, written letters, according to Nola Pender's HPM, a roulette and an instruction manual. The game board represents the compartments of a house with garage, living room, dining room, bedroom, bathroom, kitchen and service area. Each room presents different fall risks, such as carpets, wires, objects scattered on the floor, among others. There are seven illustrative cards corresponding to these compartments that demonstrate the safe way of how the home should be to prevent such aggravation. The roulette is composed of seven items, and each item corresponds to the room of the house. The color of the roulette represents the corresponding colors of each room.

It is noteworthy that the readings of all the letters, as well as the instruction manual, are carried out by health professionals and/or students. After going through all the rooms, health professionals will pick up the last card regarding the desirable health promoting behavior and will ask all participants: after playing, what behavior can you adopt to prevent falls inside your home? All players must answer the final question. There are no winners or losers because it is a cooperative game. The game ends after the response of each player.

The colors referring to the individual experience cards were red, yellow and green. The colors of the rooms and roulette were green, orange, yellow, pink (light and dark) and blue (light and dark). Having chosen the colors and textures, board detailing

began, applying the objects and their strategic location in each room covered in the game. It should be noted that the board is equipped only with fixed designs, the positions are not changed during the moves, in order not to change the meaning of the game in other matches.

The game board is 55 cm x 66 cm in size, made of 500-gram cardboard. The game has 17 cards written and are of size 10 x 8 cm. The illustrative cards (seven) of the safe rooms refer to the size of each room on the board. The roulette is 13 cm x 15 cm. The instruction manual has 16 pages, covering age group, participants, components, game preparation and way of playing.

The roulette has colors referring to each room of the house and was made with 500-gram cardboard. The letters were made with 500-gram coated paper, and each color represents a meaning. The green color refers to having no danger directly to older adults and contains the following question: do you know anyone who has already fallen? The color orange refers to attention: have you never fallen? And the red card is related to danger, in which it contains the following sentence: did you fall? The illustrated images are allusive to health professionals and/or health students who question what is written in them.

The cards have colors referring to each room of the house, and the images chosen to be on the front are objects that represent each room. The last letter features professional health characters, health students and game participants. The instruction manual was made of A4 bond paper.

The game logo contains a house (representing the home) and a symbol of a person falling (related to the fall). The game was called *Prev'Quedas*: safe steps for preventing falls (Figure 2). The term "Prev" refers to prevention, and the apostrophe symbol (') was used because it is a punctuation mark that indicates the deletion of letters in a word. The name was chosen by vote by GEPESEI members.

### Step 3: Expert game assessment

The educational game was assessed by 36 experts, being 18 (50%) nurses, 13 (36.11%) physiotherapists, 2 (5.55%) occupational therapists and physical educators and 1 (2.77%) computer engineer, among which 25 (69.44%) are female. Age ranged from 26 to 67 years ( $42.11 \pm 10.97$ ). Regarding the region, 17 (42.27%) are from the Northeast, 8 (22.22%), from the Southeast, 7 (19.44%), from the Midwest, 3 (8.33%), from the South and 1 (2.77%) from the North.

Regarding the field of activity, 22 (61.11%) work in teaching, 6 (16.66%), in care, 5 (13.88%), in research, 2 (5.55%), in the three areas and 1 (2.77%), in care and teaching, simultaneously. The mean experience time with older adults was 13.91 years ( $\pm 10.40$ ). Regarding title, 28 (77.77%) are experts, 36 (100%), masters and 28 (77.77%), PhD.

The game was assessed for mechanics, aesthetics, narrative and technology, presenting 96%, 98.12%, 90.13% and 88.66%, respectively, CI. The game presented an excellent CI, >90%, as well as p-value>0.05 in the Wilcoxon Test, since all the items assessed had an agreement greater than 0.80, thus allowing all elements to be accepted for the study. Thus, the overall mean agreement was 93.22%.



Figure 2 - Game logo

Experts' suggestions were change in the top view of the board, change in the floor of the board house, addition of a rocking chair, ladder, tools, wastebasket and clothesline. These were accepted by the researcher for game modifications, organized and passed on to the two designers, which gave rise to prototype 3 (P3) in physical game. Then, the game was tested with the target audience.

### Step 4: Game testing with older adults

Testing was performed with 31 older adults in the community, 15 (48.38%) widows, with a mean age of 74.74 years. It was observed that 16 (51.61%) have incomplete elementary school and 20 (64.51%) are retired. Regarding family income, 26 (83.87%) receive between 1 and 2 minimum wages. Regarding pre-existing diseases, 25 (80.64%) have hypertension, 14 (45.16%), diabetes and 6 (19.35%), osteoporosis.

Regarding fall history, 16 (51.61%) had fallen in the last 24 months, 24 (77.41%) had never been hospitalized for falls and 12 (38.70%) had sequelae after falls, such as shoulder and knee pain. When asked about falls prevention guidelines, 20 (64.51%) received and these were from nurses or nursing students.



Figure 3 - Same cards according to the characteristics of Nola Pender's Health Promotion Model

After the application of MMSE and sociodemographic data instrument, the game was tested. The game has been tested individually as well as up to four people per group. When played

individually, the game lasted around 30 to 40 minutes. In pairs, trio or quadruple, 20 to 30 minutes.

After the game, the assessment instrument was applied with older adults. The assessments were related to the layout and motivational characteristic for learning and satisfaction, which presented a CI of 100% and 98%, respectively. Thus, the game was considered adequate, obtaining a level of general agreement of 99%, with  $p > 0.05$  value in the Wilcoxon test.

There were suggestions regarding illustration replacement: garbage, rocking chair, steps, increase dog, coffee table, clothes-lines, cleaning products, fan and lamp. It was also requested to change the figure of sandal by shoe.

Suggestions were analyzed and accepted, resulting in the final version of *Prev'Quedas* (Figures 3, 4 and 5).



Figure 4 – Game's correct rooms for fall prevention



Figure 5 - Final version of the educational game

## DISCUSSION

The board game *Prev'Quedas* enables knowledge about falls and respects the different experiences and cultural context of

participants, essential characteristics to ensure success in educational strategy<sup>(7)</sup>. In board games, the missions and challenges stimulate various cognitive functions of the brain, such as visual acuity, spatial perception, attention, memory and quick decision-making.

The different stages developed in this research contemplated the game design elements (mechanics, narrative, aesthetics and technology) adequately, since mechanics contemplated older adults' existing knowledge<sup>(22)</sup>. The choice of the HPM theoretical model facilitated the narrative, since it identified the individual characteristics, barriers and benefits in adopting a specific behavior towards fall prevention, making it possible to draw the game's story in a linear (identifying all risks in all rooms) or branched way (identifying risks in rooms that older adults have according to cultural reality)<sup>(23)</sup>.

The selection of an experienced designer ensured the proper aesthetics of the game for the target audience. In this regard, color palette, the adopted language, letter size and font of the letters were selected. The game in question was subsidized by a simple language. The colors used focused on standard colors, as found in other studies that developed games for older adults<sup>(7-8)</sup>.

Creativity in the development of educational strategies is an important tool to promote changes in attitudes and behaviors. Thus, the combination of images with statements allowed a clearer understanding of falls, since it demonstrated real situations and risks<sup>(24-25)</sup>.

The presence of health professionals/students allowed the discussion of interests among players. Elder care in fall prevention requires knowledge of the characteristics of each individual, which involves biological, sociocultural and psychological factors, which, in turn, influence beliefs, feelings and the adoption of health promotion behaviors, elements present in the HPM used in *Prev'Quedas*.

Although the use of the model is adequate during health education practices, there is a gap in the development of educational technologies based on HPM, especially for fall prevention in older adults. Thus, the importance of this study is observed, since, when using HPM in the game construction, professionals can encourage older adults to seek to comply with desirable health behaviors.

Developing games requires joint effort from professionals from different areas of knowledge to make technology more robust. This effort is in line with the understanding that multidisciplinary is fundamental and that the advancement and construction of knowledge can only be deepened from this<sup>(24)</sup>. In this context, game assessment by experts had the participation of individuals with diverse professional backgrounds, which favored a specialized and differentiated look at the<sup>(26-28)</sup> technology.

As for the global mean of agreement between experts and the target audience, the board game presented a high and positive valuation<sup>(5,29)</sup>. It is understood that a positive assessment was given by the steps taken during the approach to the theme, by hiring qualified professionals, use of a specific model for health promotion and use of reference programs to develop prototypes and the final technology.

## Study limitations

Regarding limitations, the research was carried out amidst the COVID-19 pandemic, which made it impossible for the game to be tested with as many participants as possible (seven). Another limitation to be highlighted refers to the choice of participants

for convenience, reiterating that the game testing results cannot be generalized to less structured educational conditions and also because it was tested only by women.

### Contributions to nursing

*Prev'Quedas* emerged as a playful educational resource for health professionals' care, especially nurses, contributing to the construction of knowledge in the health area of older adults, aiming at preventing and minimizing the damage caused by falls and strengthening the empowerment of older adults to care. Moreover, based on the results, it can be inferred that health professionals can act to strengthen knowledge about fall prevention, certifying them as an active agent in the aging process with quality of life<sup>(30)</sup>.

Nurses are health professionals who are close to older adults and their expertise in health care and health promotion practices makes it possible to develop interventions in order to reduce problems or minimize injuries of the population<sup>(31)</sup>. Therefore, this study can be a stimulator for the development of new technologies.

### CONCLUSIONS

It is noteworthy that the use of game design, applied in a pioneering way in nursing, associated with the theoretical model, enabled the development of an innovative game to prevent falls, and it can generate important impacts on the reduction of this problem, when used as a health education tool, and with the potential to become a virtual game.

Regarding assessments' results, the global percentage of agreement between the values attributed both by experts and by the assessment by older adults was considered adequate and above several previous studies on the construction of educational technologies (>0.90). The adoption of a theoretical model on the basis and use of the game made it possible to enhance and explain the individual experience of each player, as well as it may have favored adherence to a desirable health behavior to prevent falls.

It is suggested that efficacy studies be promoted to assess the effects of educational games to prevent falls with older adults of both sexes, with a maximum number of participants and in different scenarios.

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