

Analysis of the use of Kinect technology as a therapeutic alternative to improve physical capacities in older adults

Análisis del uso de la tecnología Kinect como alternativa terapéutica para mejorar las capacidades físicas en los adultos mayores

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Abstract

The present study aims to describe the efficacy of Kinect technology for the therapeutic rehabilitation of geriatric patients by conducting and analyzing a 8-session therapeutic program based on this technology in which 12 study subjects participated, 8 Male subjects and 4 female subjects, within the physical capacities, the muscular strength was evaluated in the Daniels scale of the flexion of the hip, knee, shoulder and elbow and the goniometry of the flexion / extension of these same members. A greater elasticity and mobility were observed by female subjects apart from a greater increase in the range of motion in the same period of time than Male subjects, with respect to muscle strength, it was not possible to demonstrate a significant advance so the effectiveness of Kinect therapy in this area still shows contrasts in its results. Objective: to describe the efficacy of kinect technology for the therapeutic rehabilitation of elderly patients by carrying out and analyzing a therapeutic program. Methodology: analysis of the results obtained after several sessions of application of the games of the Xbox 360 console with Kinect control.

Resumen

El presente estudio tiene como objetivo describir la eficacia de la tecnología Kinect para la rehabilitación terapéutica de pacientes geriátricos mediante la realización y análisis de un programa terapéutico de 8 sesiones basado en esta misma tecnología en el que participaron 12 sujetos de estudio, 8 sujetos masculinos y 4 sujetos femeninos, dentro de las capacidades físicas, la fuerza muscular se evaluó en la escala de Daniels de la flexión de cadera, rodilla, hombro y codo y la goniometría de la flexión / extensión de estos mismos miembros. En los sujetos femeninos se observó una mayor elasticidad y movilidad además de un mayor aumento en el rango de movimiento en el mismo período de tiempo que los sujetos masculinos, con respecto a la fuerza muscular, no fue posible demostrar un avance significativo por lo que la efectividad de la terapia Kinect en esta área todavía muestra contrastes en sus resultados. Objetivo: describir la eficacia de la tecnología kinect para la rehabilitación terapéutica de pacientes de la tercera edad mediante la realización y análisis de un programa terapéutico. Metodología: análisis de resultados obtenidos tras diversas sesiones de aplicación de los juegos de la consola Xbox 360 con control Kinect.

Kinect, Rehabilitation, Physical capacities

Kinect, Rehabilitación, Capacidades físicas

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Introduction

Physiotherapy aims to improve the quality of life of the human being who suffers from certain diseases both in the prevention of degenerative diseases as it happens in the elderly, for the WHO the term older adult refers to any person, whether male or female over 60 years. Although this is seen simply as a legal limit, there may be many physical and biological factors that can alter the characteristics of an elderly person, such as degenerative diseases caused by bad habits such as sedentary lifestyles that cause loss of mechanical functions, fragilization due to osteopenia, progressive deterioration of the qualities of tendons and ligaments, alteration of collagen, decrease in joint flexibility and alterations of spinal statics [8] causing the decrease or loss of movement, either by pathology or disuse [3], in Mexico alone according to data from the National Institute of Statistics and Geography (INEGI) in 2020 there are more than 15 million people aged 60 years or older of which 52% have some limitation or disability representing 0. 63% of the total Mexican population, in Morelos they represent 8% of the total population of the state.

The integration of physical activity in the elderly for the prevention of pathologies and the improvement of physical capacities can be tedious for the elderly since the therapy turns out to be repetitive and boring. [1] Therefore, the implementation of technology such as the "Kinect" as an inclusive therapeutic alternative, since it works with body gestures, in addition to motivating and generating interest in the older adult through competition, fun and physical activity.

Development

An analysis was made about the acceptance and benefits that this type of therapeutic alternative generates. The research was developed in the rehabilitation area of the ISSFAM (Social Security Institute for the Mexican Armed Forces) home where 25 elderly residents attend, of which 12 elderly adults decided to participate voluntarily in the project (5 dependent for mobility and transportation, 7 independents for daily life activities) (see table 1). The games "dance central 2" and "Kinect sports" were used to achieve an approach and interaction of this group with technology.

Thanks to the Kinect motion sensor developed by Microsoft studios we can have a more natural interaction between people and technology due to its interface with movement commands (dance movements, jumping, throwing a punch, hitting a racket, kicking a ball) that are captured by infrared signals that the device sends and are read by the RGB (Red, Green and Blue) camera, on the other hand it captures the voice with an integrated microphone and a modern software with a customized processor that facilitates control and recognition by users making it a more inclusive tool.

Patient	Gender	Age	Height	Weight	Cause of disability
1EM	Male	84	1.76	83	Physiological loss due to age, degenerative diseases (osteoarthritis), inactivity.
2RG	Male	79	1.57	64	Poor surgical management of left lower limb, inactivity and physiological loss due to age.
3MG	Male	68	1.69	75	Bullet impact in spinal cord at L3 and L4.
4TC	Male	78	1.73	89	Physiological loss due to age, renal insufficiency, diabetes, muscle weakness.
5MS	Male	76	1.52	62	Physiological loss due to age, ischemic stroke.
6DT	Male	72	1.68	79	
7FE	Male	65	1.55	82	
8LC	Female	66	1.62	74	
9ST	Female	64	1.58	77	
10MF	Male	68	1.71	88	
11VC	Female	75	1.61	62	
12MC	Female	71	1.56	71	

Table 1 Patient characteristics

Methodology

Method: analysis of results obtained after several sessions of application of the Xbox 360 console games with Kinect control:

Research focus: this research is focused on older adults and their physical activity, we seek to know how this type of innovative technique helps to improve their physical capabilities (specifically the ranges of joint movement and muscle strength per segment), what are the advantages in applying this technique as a rehabilitation method and see if the results have sufficient relevance to be able to substantiate its effectiveness.

Types of research

- Inductive: the behavior and the way in which people performed the activity were observed.

- Casi-experimental: where we worked on new ways of doing physical activity and motivating people regardless of their limitations or conditions.
- Explanatory: we seek to know if the sedentary lifestyle in this type of people is caused simply by the deterioration caused by old age or if other external factors cause this situation in the elderly.

Levels of research

- Exploratory: the aim is to analyze the phenomenon of sedentary lifestyles and identify how it can become a public health problem.
- Descriptive: the main reasons for sedentary lifestyles and how they affect health are described.
- Relational: we sought to identify how sedentary lifestyles degrade the physical and cognitive condition of older adults.

Modalities of the research

The research was mainly in the field applying this method of physical activation but we also relied on the principles of exercise physiology thanks to books and articles where they focus on the benefits of physical activity in people and the physiological changes it can cause in people

Population and sample

The study was conducted in 12 elderly people (8 men and 4 women) where 5 of them were with high physical limitation so they have to be in wheelchair the other 7 did not have severe physical limitations, but they were not in optimal conditions to perform physical activity.

Variables

Variables	Conceptual definition	Operational definition
Age	Time that a person or other living being has lived, counting from birth.	64 years - 84 years
Gender	The set of people or things that have common general characteristics.	Male and female

Mobility range	It is the maximum angle described between two segments of the body with a reference plane, which is realized by means of joints, that is, it is the number of degrees through which a joint is able to move.	Goniometry
Strength	Muscular strength is the capacity to generate intramuscular tension in the face of resistance, regardless of whether or not movement is generated. In other words, it is the ability to lift, push or pull a given weight in a single movement with the help of the muscles.	Daniels's scale
Play	Play is an activity that has an end in itself, that is, the individual performs the activity itself in order to achieve the objective, which is to be pleasurable.	Kinect sports and dance central 2

Table 2 Variables

Hypothesis

"Exercises performed through video games will generate a significant change in the participants' ranges of motion and strength due to the fact that it will encourage regular and continuous physical activity".

Materials

- Vivid bright projector: a projector was used to make the image clearer and easier to see for the participants as well as making the activity more interactive and interesting.

- Xbox 360 was the ideal console for the research due to its easy access and simple software that allows easy operation.
- Kinect motion sensor: the most vital tool of the research thanks to its motion detection capability.
- Dance central 2 game: a dance game with different levels that adapt to the players' needs.
- Kinect sport game: a sports game with several mainly competitive activities ideal to encourage interest.
- Attendance logbook: used to keep track of attendance.
- Goniometer: it is an essential tool for the evaluation of joint ranges at the beginning and end of the research.
- Daniels’s scale: it is a highly adaptable scale that provided us with information about the participants' muscle strength at the beginning and end of the research.

Procedure

A physical evaluation was made to each participant in which aspects such as ranges of motion and muscle strength in both lower and upper limbs were taken into account, once the measurements were made the results were emptied in a record that will serve later to make a comparison, in the case of people in wheelchairs the evaluation in lower limbs is omitted since we only work with upper limbs. For the evaluation of muscular strength we used the Daniels scale which is divided into 6 levels of physical capacities, in our investigation most of the participants were between level 3 and 4, in the goniometry all the participants presented limitations in both limbs, but their range of movement is functional.

The older adults were divided into groups of 2 to perform these activities, which consisted of two phases:

1. Adaptation to body movement by means of the Kinect.
2. Playing the game

Once they adapted to the use of the technology, the game was performed with a duration between 5-20 min depending on the game they decided, where they followed the specific body patterns of each game.

Results

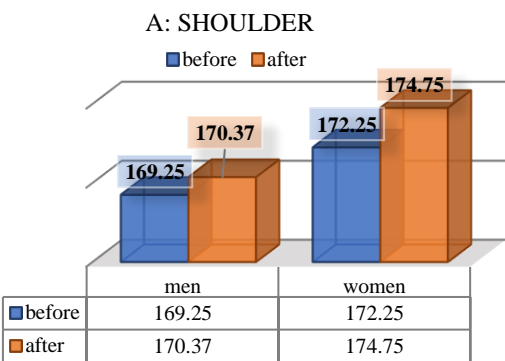
Statistically significant differences ($p < 0.05$) were observed in the pretest and posttest knee goniometry results between men and women.

The men's knee goniometry in the first assessment was 2.33 which improved to a score of 2.66, while the women started with a score of 6.5 and this improved to a score of 8.25, reflecting a much more accentuated increase in the female group in spite of having had better knee goniometry scores from the beginning (see table 3).

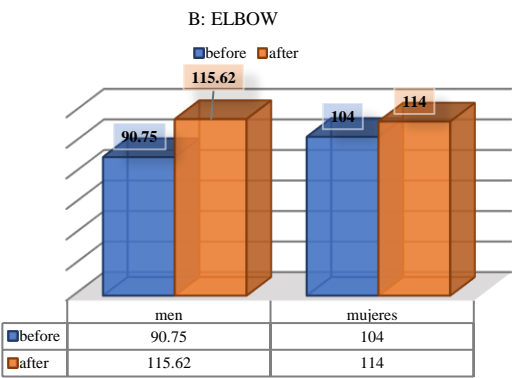
	Men		Women		All	
	Before	After	Before	After	Before	After
Elbow	90.75 ± 45.92	115.62 ± 15.96	104 ± 39.99	114 ± 22.46	95.16 ± 42.67	115.08 ± 17.33
Shoulder	10.25 ± 5.25	11.37 ± 4.59	13.25 ± 2.98	15.75 ± 1.25	11.25 ± 4.71	12.83 ± 4.30
Hip	3.66 ± 3.05	4 ± 3	7 ± 2.94	7.75 ± 3.40	5.57 ± 3.25	6.14 ± 3.57
Knee	2.33 ± 1.57	2.66 ± 1.57	6.5 ± 1.29 #	8.25 ± 1.5 #	4.71 ± 2.56	5.85 ± 3.28
* All data are expressed as mean ± standard deviation.						
# Different from men, $p < 0.05$						

Table 3 Goniometry score of the patients by sex

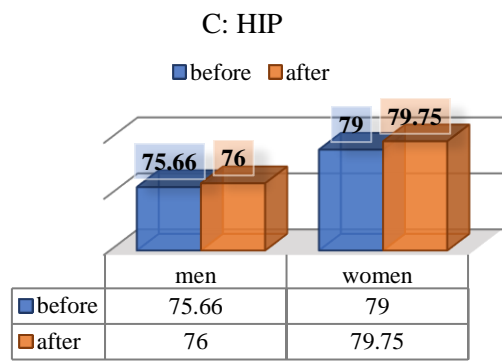
Likewise, in a clinical manner, general improvements are observed in the goniometry results (score obtained based on our own scoring units related to the goniometry of knee extension and minimum and maximum knee flexion within the scores achieved by all patients) in the 4 joint groups evaluated between the first evaluation prior to the beginning of the therapeutic plan and the last evaluation made at the end of the therapeutic plan, presenting a notable increase in their ranges of mobility, which vary between 3 and 6 degrees of increase. (see graphics 1-4)



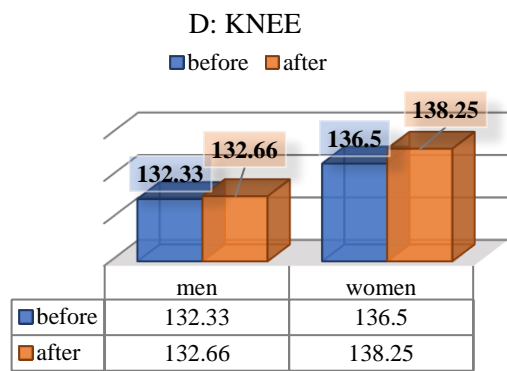
Graphic 1 Shoulder goniometry



Graphic 2 Elbow goniometry



Graphic 3 Goniometry hip



Graphic 4 Knee goniometry

No statistically significant differences were found in the muscle assessment results; however, there was an improvement of at least one point on the Daniels scale in 50% of the study subjects (6 of 12 patients).

Of the 6 study subjects who showed at least one point of improvement on the Daniels scale, 3 were male and 3 were female, however, of the 8 male study subjects in this study only 3 showed improvement (37.5 %) while of the 4 female study subjects 3 showed improvement (75 %). (see table 4)

	Gender	Age	Wheelchair	Hip flexor	Knee flex/ext knee	Shoulder flexor	Elbow flex/ext.
1 EM	M	84	Yes			3	4
2RG	M	79	Yes			3	3
3MG	M	68	Yes			3	4
4 TC	M	78	Yes			4	4
5MS	M	76	Yes			3	3
6DT	M	72	No	3	4	4	4
7 FE	M	65	No	4	4	3	3
8 LC	F	66	No	4	4	4	3
9 ST	F	64	No	3	3	3	4
10MF	M	68	No	4	4	3	4
11VC	F	75	No	3	3	4	3
12MC	F	71	No	3	3	4	4

Table 4 Strength in Daniels scale before and after the therapeutic plan

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Conclusion

The 12 study subjects showed an extremely positive result both in the improvement of ranges of motion and muscle strength, as well as the interest in performing the activities through the Kinect, since they are activities that generate attention due to their innovation, fun and creativity, and do not fall into monotony, which was the main reason why the adults in the nursing home stopped going to therapies and/or performing physical activities.

Regarding the ranges of motion of the study subjects, they increased up to 10 percent with respect to their original range prior to the study.

Knee goniometry in relation to men and women, before and after the therapeutic plan, showed a greater elasticity and mobility on the part of women as well as a greater range of movement in the same period of time, a fact that has already been evidenced by previous studies pointing out this greater mobility of women in relation to men. Regarding muscle strength, there was a lower response in the Daniels scale in 50% of the patients (6 of 12) of one point according to the mentioned scale, however 1 of the 12 subjects showed improvement in more than one item.

The study showed that the therapeutic alternative with Kinect alone is not such an effective therapeutic tool to increase muscle strength because it did not generate sufficient muscular stress to increase the strength of the extremities; however, it is a good therapeutic alternative to increase ranges of motion.

The study could be improved by carrying out the same study with more time and sessions to observe if it is really possible to increase muscular strength or if the scope of this therapeutic method is limited to increasing the ranges of movement.

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