

A Descriptive Analysis of Motor Transitions Used by Older Adults Stand up from Prone Decubitus

Cristian D áz Escobar¹, Jaime Ocaranza Ozimica², Claudia Astroza Correa³, Lorena Llach Fernandez⁴

¹ Physical Therapist (PT) and Physical Educator (UMCE Santiago, Chile), Professor at Bernardo O'Higgins University (UBO). Santiago, Chile.

² PT, MD©, Director of PT Undergraduate Program at Bernardo O'Higgins University (UBO). Santiago, Chile.

³ PT (UMCE Santiago, Chile).

⁴ Statistic at Valparaiso University, MD, professor at Bernardo O'Higgins University (UBO). Santiago, Chile.
lao_cristian@yahoo.es, jaime.ocaranza@gmail.com, lorenallach@gmail.com

Abstract - Objective: From the functional perspective of human movement, we analyzed transitions made by older adults (OA) when going from prone decubitus to standing position and the time taken to perform this action, due to the inability, in a high percentage of this population, to independently incorporate after suffering a fall.

Design and sample: Cross-sectional observational studies, in which 119 functionally independent OA were evaluated, being 3 of them finally excluded. Each of the 116 participants (mean age: 72.5 ± 6.48) were video recorded standing 3 times from the floor. In the visual analysis of each performance we used a graphical battery of 10 positions classified by letters, which allowed us to establish sequences of positions in the transitions from prone to standing. The incorporations were timed. **Results:** The sample had 11 different bipedal incorporation strategies, with a higher concentration of transitions in sequences of 3 positions, highlighting as principals: RIJ (upright trunk - four supports - Bear Walk), RIB (upright trunk - four supports- squatting) and RIK (upright trunk - four supports - squatted kneeling or half kneeling). Regarding the average time of incorporation, the subjects under 70 required less than 4 seconds, the group between 70 and 79 had times under 5 seconds and the OA over 80 required more than 5 seconds ($p < 0.05$), which indicates that as the OA get older they would require more time to stand up from the floor and with the analysis of mean differences we corroborated ($p < 0.05$) that there is a significant difference. **Conclusions:** Based on the OA group studied, results show that acquiring the standing position from the most prone sequences using 3 motor positions, highlighting the RIJ strategy, had a good applicability (see appendix 1). As for the time of incorporation, it was shown that OA would require more time to incorporate themselves from the floor to standing position. With all, is important recollected more research to implement future preventive therapies for important syndrome in OA such as falls and its aftermath.

Index Terms - Older adults, standing up, prone decubitus, motor pattern.

1. Introduction

According to Rao (2005), falls in older adults (OA) are a major geriatric syndrome [1]. According to Césari (2002), Shanti (2005) and Rubenstein (2006) they cause morbidity, immobility and mortality in this population [2-4]. Moreover, both Tinetti (1993) and Knight (2000) establish that a major sequel of falls, is the decline in functional independence on OA, because of the fear of the possibility of falling again [5,6]. One of the origins of this fear, comes in a high fraction

of this population from failing to independently stand up after falling and requiring external assistance.[5].

VanSant (1988) and Ulbrich (2000), among others, have studied the motor transitions used by humans when standing from the supine position [7-10]. Astroza (2007), made a functional description of this motor action, based on positions, strategies and patterns. Rodriguez (2008) [11] and Diaz (2011) [12] continued this line of research analyzing the transitions between the supine and the standing position in different age groups.

However, the biped position can also be achieved from other decubitus such as prone.

Prat (2007) stands that public health policies in developed and developing countries have focused part of their activities on the improvement of clinical interventional programs in order to address, in the coming years, the progressive growth of the older population [13]. These approaches focus on changing lifestyles, improving health services and promoting social, employment and educational integration of OA, throughout the improvement of the health staff's knowledge and increasing the research development in this matter [14], in order to recover, maintain and/or improve the functional capabilities of OA, seeking on their autonomy in activities of daily living (ADL), which should to be enduring over time [15, 16].

The World Health Organization (1985) determined that when OA have an adequate level of functional adaptability and personal satisfaction, despite the aging process, they can be classified as healthy people [17]. When these people, according to the Chilean Ministry of Health (2003), have the ability to execute actions required in daily life without difficulty, they are said to have an appropriate functional independence [16]. However, Rao (2005), Shanti (2005) and Fleming (2008), state that despite the level of autonomy that OA may have, the risk of falling increases with age [1,3,18] and according to Tinetti (1993) when falling occurs, a high percentage of these people have difficulty standing up alone[5]. This situation has led authors like Astroza (2007), Rodriguez (2008) and Diaz (2011) to stand on the importance of advancing in the study of functionality on OA, as well as on falls and independency in rising [10-12].

According to Caballero (2000), the significance of falls lies on the fact that they are considered one of the main causes of injury, disability and death in OA [6]. Gac (2003) and other authors state that, falls occur because of various causes among which, at an intrinsic level, highlights: loss of depth perception, decreased visual acuity and accommodation, impaired body balance and proprioception, increased reaction times, decreased muscle strength, gait disturbance, inactivity and cognitive impairment, and in the extrinsic, causes such as: the lack of lighting and safety features at home, the use of prostheses or assistive devices, inappropriate footwear, adverse reactions to polypharmacy and psycho-tropics. Finally, the above factors generate a constant need of studying the elements related to falls and the necessity of establishing periodical assessment, prevention and treatment programs in OA [4-6,11,19-21].

Tinetti(1993) states that the incapacity to stand up is not always because of the injuries caused by this situation, since people with physical indemnity have also presented difficulty standing, requiring someone's assistance [5]. This incapacity is a sequel called by Caballero (2000) "Post Fall Syndrome". Rao (2005) and Rubenstein (2006) define it as "Post Fall Anxiety Syndrome", which involves a set of short and long-term consequences, affecting the psychic, cognitive and emotional state of the person, resulting in attitudes and behaviors that restrict or reduce their physical and social activities [1,4,6]. This situation results in a self-protective immobility, losing the ability to perform basic and instrumental daily living activities. There is also a loss of self-esteem and confidence on their capacities. This feeling is accentuated at older ages, with predominance in females, people with previous decrease in mobility and those with alterations in balance and gait tests [6]. Therefore, Caballero (2000) states that fear is the main psychic consequence in this syndrome and it would have a higher presence in those OA that remain on the floor for long periods without receiving any assistance. However, some OA that have not fallen, also modify their actions and habits because of the fear of living this experience, changing their attitude towards the environment and their future, which leads them to a gradual decline on their overall condition until disability [6].

The ability to autonomously rise from the floor was considered by VanSant (1988) as a significant action in the physical independence of people [7] which starts from the birth, through actions so-called moving patterns that would enable to gradually overcome the force of gravity, until conquering standing [22]. According to Marsala (1998), these patterns would be stereotyped movements that would allow comfortable, efficient and economical actions, as in this case would be standing up [23]. However, both Escobar (1996) and Comollonga (2002) argue that these patterns can be modified over time as a result of adaptive processes influenced by various factors, being aging one of them[24,25]. In the specific case of rising from the floor, Tinetti (1993) warns about the possible influence that the initial position in which the pattern is performed might have and/or the spatial position

of the individual when standing and the use of external elements as furniture or the assistance of others [5]. VanSant (1990), stated that over the years the inherent movements in this action become asymmetric and dissimilar [22]. This condition was observed by Astroza (2007) when comparing OA who performed regular and supervised physical activity, versus sedentary subjects [10].

Among the studies focused on standing from supine, Astroza (2007) defined the positions, strategies and standing patterns that could help to describe and standardize ways in which a person can stand up [10]. However, VanSant (1988) and Prat (2007) state that either children, adults or OA could role in order to move from a supine to prone decubitus to initiate the standing movement [7,13]. Therefore, studying the movements from prone to standing position, analyzing the positions, strategies and motor transitional patterns in OA, is an undescribed action that sets part of this research and focuses on structuring effective supports in the prevention of falls and the consequences associated with the complications outlined in the post-fall syndrome.

Due to the above is that the main purpose of this study, based on the description of body positions, motor transitional strategies, motor transitional patterns and motor performance* in OA, aims to consolidate the bases that could allow future therapeutic interventions through preventive strategies that, not only seek to reduce the incidence of falls in this population, but also in their ability to correctly respond to them.

Body Position (BP): location or arrangement that the body adopts in space at a given time, relative to a reference axis.

Motor Transition Strategy (MTS): Sequences of positions that allow the transition between decubitus and standing position.(See Appendix 2).

Motor transition pattern (MTP): Transition Strategy repeated under the same or similar stimulus.

Motor performance in the transition (MPT): Runtime used for transition between decubitus and standing position.

2. Methods

Study Design: Observational – Descriptive, through a cross sectional research.

Sample: At the beginning 119 subjects aged 60 years or older (average age: 72.5 (\pm 6.48) participated. They were self-sufficient according to the Functional Assessment of Older adult's instrument in Chile (EFAM) [15], with no obvious sensory limitation and medical supervision in case of requiring any type of medicine. From the group of OA that was evaluated: 56 belonged to Integrated Centers for OA and 60 to a Sports Center (the final sample was determined by compliance of the exclusion criteria, remaining 116 subjects).

Each participant was informed about the purpose of the study, and was later asked to sign the required consent to participate in the study.

Exclusion criteria: To present any physical or medical condition, acute or chronic, regardless of its origin, that could

restrict the execution and/or test performance, mental condition that would not allow a correct understanding of the instructions, medical indication of not doing physical activity, to experience dizziness or loss of stability in the course of the test, chest pain or any other signs or symptoms that could compromise the normal development of the test. Because of the above, 3 subjects did not finish the test, 2 having pain in a specific area (knee or wrist) and 1 for fear to fall during the test, while no external assistance was allowed.

Method: The study was based on the original protocol established by Astroza (2007), and later used by Rodriguez (2008) and D áz (2011) [10-12]. Before starting the test each subject should remain seated and resting at least 10 minutes. Meanwhile the Personal file was filled in, to then control their weight, height and blood pressure. This last parameter was required as an exclusion criterion [10]. After this, they were moved to the shooting area, which had rubber surface of 1.80 m. x 2.40 m (Airex mats of 1.8 m x 0.8 m x 0.012 m, fixed to the ground and to each other with transparent tape) and instructions were given before acquiring the initial prone decubitus position.

Three standings were simultaneously shot in 2 planes. The video recorders (Sony ® DCR-SX45B - Samsung ® H300), with their tripods (WF ® WT 330A - Sakar ®TR-2L), were set at 2,95m from the edge of the mat for the frontal plane and the 3.65m for the sagital plane. This is in reference to a projection from the edge of the lens to the ground. The height of the center of the lenses was set at 1.25 m from the floor. With the help of a chronometer (Accusplit ® 605e), we registered the time on each attempt when going from prone decubitus to a final stable standing position. The initial prone position required that the upper limbs were alongside the trunk and the head resting on the ground as was most comfortable. The final standing position was considered stable when the subject was straight up in the anatomical position without movement.

Once the person acquired the starting position, the researcher located next to him, proceeded to apply the test asking "READY". If the response was affirmative, the "GO" order was given. In that moment the person should stand as fast as possible. Once the person was in a stable standing position he was asked "Any problem? Can you continue?" If the answers were satisfactory they proceeded to complete the 3 attempts. On each trial, up to 1 minute of resting was allowed if the person had any physical difficulty such as dizziness or discomfort. After this time, the test was suspended.

For the video observation we used a battery of positions developed by the physiotherapist Cristian D áz, based on the original one created by Astroza et al (2007). Appendix 1. The battery used in this study shows 10 positions that could possibly be required in the motor transitions between prone and standing position.

Statistics: Excel software was used to plot the average time used in the movements when rising from the prone to standing position. The SPSS-17 program was used to compare

the average time (ANOVA) when standing , which allowed us to determine that there is a statistically significant difference in the motor transition from prone to standing position in the different groups (p-value of 0,05 or less was considered statistically significant). Alongside this, it was possible to establish a direct relationship between age and the time the OA used to stand, highlighting the RIB motor strategy as the best in this action, according to the time required to stand.

3. Results

The Total Sample (TS), consisting of 116 OA (mean age: 72.5 + 6.48), divided into groups according to age ranges, had no significant differences with respect to weight, height and body mass index (BMI). Table 1 shows the averages and standard deviations per group.

Table 1. Health Information According to Age group.

CHART 1	Nº	Height (m)	Weight (kg)	BMI
Total sample	116	1,58 (± 0,08)	64,6 (± 12,0)	25,95 (± 3,70)
60 to 69 years old	40	1,57 (± 0,07)	63,8 (± 11,80)	25,93 (± 3,71)
70 to 79 years old	60	1,59 (± 0,08)	65,8 (± 12,85)	25,94 (± 3,78)
80 and + years old	15	1,55 (± 0,06)	62,3 (± 7,72)	26,04 (± 3,30)

According to the valid positions used in this study , the number of positions required to stand from the prone decubitus , were primarily focused on strategies of 3 positions, exceeding the 83%, demonstrating a clear difference from the other sequences of 2, 4 and 5 positions, which is corroborated throughout a comparative analysis (p <0,05). See Figure 1.

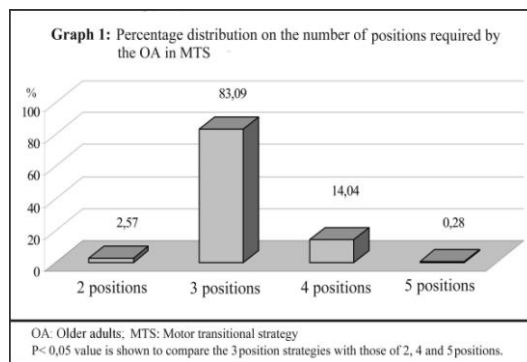


Figure 1. Percentage distributions on the number of positions required by the OA in MTS.

When asking the OA of the sample to stand from prone decubitus, 11 types of sequences were established to achieve this. With a higher concentration of 3-position strategies, highlighting: RIB (Upright trunk - four supports - squatting) RIJ (torso upright - four supports - Bear Walk) and RIK (Upright trunk- four supports - squatting kneeling or Half kneeling), see figure 2.

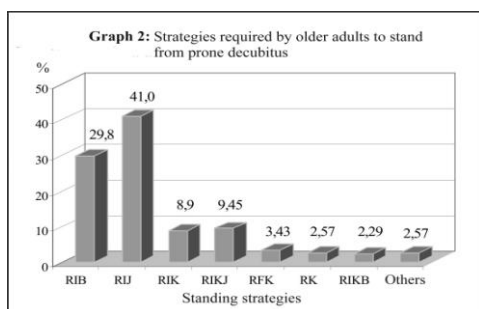


Figure 2. Strategies required by older adults to stand from prone decubitus.

75% of OA that were tested used one of the 7 types of motor transitional pattern established as potential for this research, among which, stands out (because of frequency of use) patterns: RIB (Upright trunk - four supports - Squatting) and RIJ (Upright trunk - four supports - Walk bear), see Figure 3.

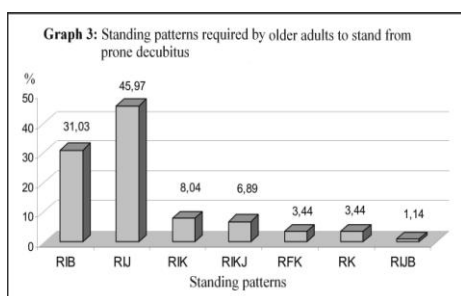


Figure 3. Standing patterns required by the OA to stand from prone decubitus.

Regarding the time required to achieve standing from prone position, there is a positive relationship between age and runtime, this means that as age increases in the OA the time needed also increases, which is confirmed through an ANOVA where ($p = 0.003$). There is also a significant difference when comparing the times used to stand as the 3 attempts were accomplished, stating that as the test was running times decreased, see Figure 4.

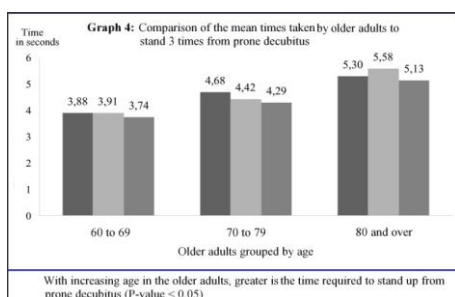


Figure 4. Comparison of the mean times taken by older adults to stand 3 times from prone decubitus (P value < 0.05).

Among the mostly required strategies when standing from prone decubitus, there are statistically significant differences ($p = 0.005$), when comparing the mean execution times, being RIB strategy the one that had best performance, which means that it takes less time to stand. See Figure 5.

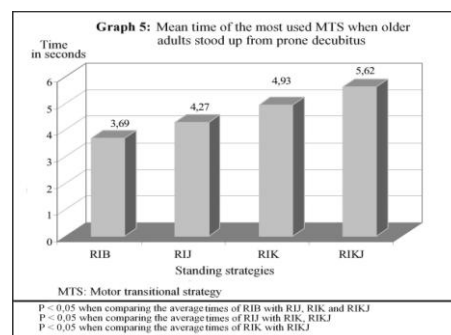


Figure 5. Mean time of the most used MTS when OA stood up from prone decubitus.

4. Discussion

Doing a functional analysis when OA stand up allows us to establish a recurrence in the use of positions, strategies and therefore motor patterns. These results confirm what Astroza (2007), Rodriguez (2008) and Diaz (2011) found [10-12], although the initial position differ in these studies, since the first ones start from supine decubitus and the present one does it from prone. Despite the above, the trend in this type of transitions remains to be the use of sequences of 3 positions, highlighting the RIB and RIJ strategies when standing from a prone.

The registration of the time taken to stand up was based on the findings of Creel and Col (2001), who suggested that it is possible to establish different levels of independence in functional activities [26]. In the present study we observed an average time of 4 seconds per rising movement and as the test was being performed, the time required decreased. This could be explained by factors such as familiarity with the test as it was repeated and/or the acquisition of greater sense of security as they were able to establish the level of risk that the test had for them.

Performance, expressed as the time taken to execute the action, is consistent with the findings of Ulbrich et al (2000) who suggest that as humans get old the time required to develop an activity is greater [9].

Under the functional look started by Astroza (2007) and that has continued to the present study, in which there is an analysis on the motor transitions between different decubitus and standing, considering the sequences of positions and of runtime, we believe that this test is a good alternative to assess the condition of OA in daily life activities.

The analysis on how to stand up suggest a tendency on the use of 3 position sequences, having a 78.7% of the sample used the sequences RIB, RIJ and RIK (Appendix 2). It is important to highlight that the difference between these strategies is determined by the last position used, inferring that these differences might be related to factors such as body stability, perception of safety and/or physical condition. These factors could be modified based on periodic interventional programs, directed and controlled by professionals

The therapeutic vision ought to be comprehensive and progressist, enhancing constantly the various proposals that

emerge from health policies in countries that are concerned about improving their population's lifestyle and health care, by improving and developing different areas on these topics. Among health priorities focused on OA life's quality, we can find the fall prevention programs. However, the inability to stand up after a fall is a sequel that ought to be addressed with a similar degree of attention, because of the relevance they have on people's functional independence. This situation was mentioned by Caballero (2000) and Rubenstein (2006), explaining the consequences that this impairment leaves on a psychic, cognitive, emotional and motor level in OA, resulting in an alteration of self-esteem, impaired self-sufficiency and finally depending on their environment [4,6]. Therefore, therapeutic procedures should focus on fitness and education, in order to prevent falls and prepare the OA to respond efficiently to these.

The idea of establishing strategies and motor patterns in the transition between the decubitus and standing position, is to structure a basis in order to allow the development of future interventional programs, mainly in the area of prevention, although more studies are necessary to improve this potential findings and research investigation line

Even though Escobar (1996) and Comollonga (2002) express that motor patterns are changeable over time due to constant adaptive processes that human have [24,25], both Rodriguez (2008) and Diaz (2011) determined that this type of motor sequences are repeated at different stages of life, on functionally independent subjects [11,12]. Therefore standing strategies could perfectly be taught and trained, not only in OA. However, questions remain, as how would the behavior of people with underlying diseases or motor disabilities be when the strategies involved are different to those seen on the studies that use this line of research [10-12]

According to Van Sant (1988) and Prat (2007), in some stages of life, people roll in order to stand up [7, 13] therefore uncertainty arises whether the most effective strategies are from supine or prone. The fact is that in older adults these types of motor transitions, independent from which decubitus, focus on sequences of 3 positions. Which ones would be the most appropriate in a therapeutic program is part of the objectives that remain to be elucidated. However, as indicated by Diaz et al. (2011), one should always take into account the individual characteristics, level of independence and fitness [12], before determining any specific therapeutic intervention.

Therefore, it is to continue to deepen in the factors involved, not only in motor transitions between decubitus and standing, but also on those factors that influence falls and the ability of the OA to rise independently, in order to establish effective tools in the assessment, prevention and treatments for this population in particular.

5. Conclusions

Just as happened in other studies that involved standing from supine position, in this study where OA were asked to

stand up from prone decubitus, there is also a concentration in sequences of 3 positions. This was analyzed according to the functional perspective raised by Astroza since 2007.

We reaffirm the fact that OA require more time to execute motor actions as they age, as in this case, when moving from prone to standing position.

The preventative therapeutic programs focused on reducing the incidence of falls in OA, should consider among their goals, the sequels left by the inability to rise independently, and to teach strategies on how to stand up from decubitus. With respect to prone decubitus, we highlight the use of RIB and RIJ strategies for being the most requested among the OA that were evaluated and for requiring less execution time, reflecting efficiency in this action.

This study provides new fundamentals on the way that human beings stand up from the floor, through the analysis of positions, strategies and transitional motor patterns plus the time required to do this. Supporting the establishment of this test as an effective tool as a therapeutic alternative developed to measure motor functionality in OA.

Acknowledgements

To the physical therapists Leonardo Pereira, Gianfranco Capurro and Manuel Herrera for their cooperation in the investigation

References

- [1] Rao S.; *Prevention of falls in older patients*; American Family Physician Vol. 72, N°1; July 2005.
- [2] Cesari M., Landi F., Torre S., Onder G., Lattanzio F., Bernabei R.; *Prevalence and risk factors for falls in an older community dwelling population*; Journal of Gerontology Medical Sciences; Vol. 57, N°11, pp. 722-726; 2002.
- [3] Shanthi G., Krishnaswamy B.; *Risk factors for falls in elderly*; Journal of the Indian Academy of Geriatrics, 2; pp. 57-60; 2005.
- [4] Rubenstein L.; *Falls in older people: epidemiology, risk factors and strategies for prevention*; Age and Ageing 2006; pp. 37-41.
- [5] Tinetti, M., Liu W., Claus e.; *Predictors and Prognosis of Inability to Get Up After Falls Among Elderly Persons*. Jama, Vol. 269, Número 1, Enero 6, 1993.
- [6] Caballero J., Remolar M., Garc ía R.; *Programa de intervención sobre el Síndrome psicológico postcaída en el anciano*; Rev Mult Gerontol 2000; 10(4):249-258.
- [7] VanSant A. F. *Rising from a Supine Position to Erect Stance, Description of Adult Movement and a Developmental Hypothesis*. Phys Ther. Vol. 68, Número 2, Febrero 1988
- [8] VanSant A. F. *Age Differences in Movement Patterns Used by Children to Rise from a Supine Position to Erect Stance*. Phys Ther. Vol. 68, Número 9, Septiembre 1988.
- [9] Ulbrich Jessica, Rabeja Aarti, Neil B. Alexander. *Body Positions Used by Healthy and Frail Older Adults to Rise from the Floor*. Am Geriatric Soc 48:1626-1632, 2000.
- [10] Astroza C., Henriquez J., D áz C. *Análisis descriptivo de la transición desde Decúbito Supino a Posición Bipedal en Adultos Mayores activos y sedentarios*. Revista Kinesiología. Vol. 26 N° 3, pp. 3-12; Septiembre 2007.
- [11] Rodríguez C., San Juan A., Zavala J.; *Análisis Descriptivo de la Adquisición del Decúbito Supino Desde posición Bipedal en Niños, Adolescentes, Adultos Jóvenes y Adultos Mayores*. Kinesiología, Revista Oficial del Colegio de Kinesiólogos de Chile Vol. 27 N° 2, Junio 2008.