

HEAD MOVEMENT DURING STATIC AND DYNAMIC BALANCE ASSESSMENTS IN YOUNG AND OLD ADULTS

Lauren M. Wedam and Ge Wu
The University of Vermont, Burlington, VT, USA
Email: ge.wu@uvm.edu

INTRODUCTION

Balance assessments are often administered in clinical settings as a quick screen to determine fall risks among elders. To date, research on the role of head position in balance maintenance has addressed the pitch angle of the head during gait, and has demonstrated a significant difference between younger and older adults. We do not know whether these results apply during static and dynamic functional tasks such as those included as part of a fall risk screen in a clinical setting. This study aimed to examine head movement in young and older subjects during two common clinical assessments for fall risks. It was hypothesized that elderly subjects would have a greater downward pitch angle than younger subjects during both tasks; and the downward pitch angle would be positively correlated with the performance of these two tasks.

METHODS

Ten young adults (aged 18-30 years) and fourteen community dwelling elders (aged 65 and above; 7 with and 7 without a history of falls) participated in the study. Subjects were asked to complete a Functional Reach Test (FRT) and a Timed Up and Go Test (TUGT) under two separate conditions, six to ten trials each condition, for a total of 12 to 20 trials. Condition 1 (standard) was to complete both tests with the standardized instructions without any constraints to head position, and condition 2 (with target) was to complete both tests while keeping their head up by looking at a target placed at eye level. An on-body motion tracking sensor with an accelerometer and gyroscope (Microstrain, USA) was used to measure the pitch angle of the head during each task. The sensor outputs and the TUGT time were collected by the sensor software at a sampling frequency of 50Hz. The FRT measurements were collected by the principle investigator using a standard tape measure and a visual marker. Maximum and minimum pitch angle of the head were calculated for each condition of the FRT and the TUGT. Group means and standard deviations were calculated for each age cohort. Student t-tests were conducted to determine group differences in pitch angles with a confidence interval of 95%.

RESULTS

The group means and standard deviations of the maximum, minimum and range of head pitch angle are shown in Table 1. For the TUGT, the t-test indicated significant group differences in the maximum downward pitch angle and the range of head pitch angle under each test condition ($p < 0.012$, see Table 1). In particular, the older subjects had significantly larger range of head movement and tilted their head downwards significantly more than the young. During the standard test condition, the minimum pitch angle of the older subjects was below neutral position, indicating that their head was primarily tilted downwards, whereas the younger subjects moved their head around the neutral position. Moreover, the maximum downward head pitch angle was correlated with the TUGT time ($cc = 0.429$). The more the head was tilted downwards, the longer the time needed to complete the task.

For the FRT, the t-test indicated significant group differences in the minimum downward pitch angle ($p < 0.002$) under each test condition. Surprisingly, younger subjects displayed a much larger range of head movement than older subjects under both test conditions. However, despite this broad range of head movement, the minimum downward pitch angle of younger subjects remained close to and above neutral head position, with older subjects tilting their heads primarily downward or below neutral during each testing condition. There was also a correlation between minimum downward pitch angle and FRT distance ($cc = 0.468$). The more the head was positioned at or near neutral, the farther the maximum reach.

DISCUSSION

The results of this study support the hypothesis that elderly subjects have a greater downward pitch angle than younger subjects during static and dynamic balance tests. This is consistent with previous studies that have investigated head pitch angle during walking activities. Because head orientation provides a frame of reference for upright posture, the increased downward tilt of the head in elders during static and dynamic activities could potentially reduce their ability to maintain a balanced upright posture and thus increase the risk of falls. In addition, the results of this study demonstrate that the downward pitch angle of the head is positively correlated with the performance of static and dynamic balance tests. Thus, it is important to control for head position during these clinical balance tests.

ACKNOWLEDGEMENTS

Special thanks to Linda Martinez, Millie Szyszka, and Kim Porter of the Visiting Nurse Association of Vermont Adult Day Program for their assistance with subject recruitment and space allocation for test trials.

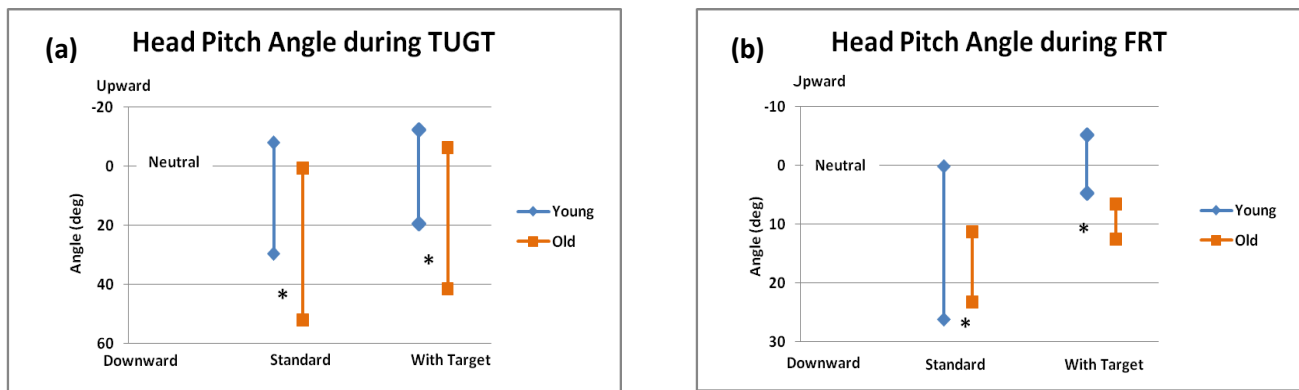


Figure 1: Mean maximum and minimum pitch angle for (a) the TUGT and (b) the FRT, with and without visual target, for young and older subjects. Symbol * indicates significant group difference.

Table 1: Means and standard deviations of maximum, minimum, and range of head pitch angles (in degrees). Positive values indicate a downward tilt from the neutral position. P value is for group comparison.

Test	Variable	Condition 1			Condition 2		
		Young	Old	p	Young	Old	p
TUGT	Max pitch	30±11	52±12	0.000	20±6	41±13	0.000
	Min Pitch	-8±9	1±11	0.027	-12±9	-6±7	0.059
	Range	37±13	52±15	0.012	32±11	19±8	0.003
FRT	Max pitch	26±24	23±9	0.359	5±10	10±7	0.025
	Min Pitch	0.24±7	11±8	0.000	-5±10	7±6	0.002
	Range	26±24	12±11	0.054	10±5	6±4	0.028