KINEMATIC ANALYSIS OF THE GAIT CYCLE IN THE ELDERLY

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INTRODUCTION: The purpose of this work was to analyze the kinematics of the gait cycle (GC) of an elderly group living in a retirement home and without physical activity. We wanted to compare our values to the normal pattern of the GC and with other studies. Walking is very important for leading an independent life and is one of the most common activities used in physical programs for the elderly. This study is a first step to contribute to a better knowledge of our specific population.

METHODS: Fifty-four elderly persons (35 female and 19 male) were observed. We used a video camera to record the GC (right side) and the 'Peak 5 Measurement System' to calculate several kinematics variables: stride time (St) stance phase time (Stt), swing phase time (Swt), single-support phase time (Sst), double-support phase time (Dst), step duration (Sdt), stride length (Stl), step length (Spl), vertical displacement of the body (Dycg), cadence (C) and horizontal velocity of the body (Vxcg).The kinematics variables were measured for the whole group and were also related to sex, age, and problems (pathologies and/or gait disturbances). Pathologies were identified by the elderly person's assistant doctor, and gait disturbances were identified by video analysis of the recorded GC. All pathologies that could affect gait were registered, and the gait disturbances observed were lameness, walking with support (person or cane) and difficulty in walking in a straight direction.
To find statistically significant differences ($p<0.05$) we used χ^2 test (sex and problems; age and problems) and the Mann-Whitney test (Table 2).

RESULTS AND DISCUSSION:
Table 1 presents the mean and SD for age, height and weight.

Table 1 Mean and SD for age, height and weight

	Group	Sex		Age groups			Problems	
variables	(n=54)	female (n=35)	male (n=19)	65-75 (n=12)	76-85 (n=30)	> 85 (n=12)	without (n=7)	with (n=47)
Age (years)	80.6±6.8	80.7±7.2	80.5±6.1	71.1±3.1	80.9±2.3	89.4±3.7	79.4±3.1	80.8±7.2
Height (m)	1.52±0.10	1.47±0.07	1.62±0.06	1.54±0.08	1.53±0.10	1.49±0.11	1.66±0.05	1.50±0.09
Weight (Kg)	61.2±12.8	57.1±13.0	68.6±8.4	69.7±13.7	60.1±11.7	55.2±10.8	72.4±8.7	59.5±12.5

The main results for the kinematics variables are presented in Table 2.

Table 2 Main results (mean and SD) related to the sample

Variables	Group	Sex		Age groups (**)			Problems	
	(n=54)	female (n=35)	male (n=19)	65-75 (n=12)	76-85 (n=30)	> 85 (n=12)	without (n=7)	with (n=47)
St (s)	1.26±0.32	1.30±0.37	1.18±0.14	1.25±0.23	1.26±0.23	1.26±0.54	1.25±0.16	1.26±0.33
Stt (s)	0.85±0.22	0.90±0.25	0.79±0.12	0.82±0.20	0.85±0.21	0.91±0.27	0.79±0.11	0.87±0.23
Swt (s)	0.42±0.10	0.43±0.11	0.41±0.07	0.43±0.05	0.42±0.06	0.43±0.18	0.46±0.06	0.41±0.10 *
Sst (s)	0.42±0.08	0.42±0.09	0.42±0.05	0.44±0.09	0.42±0.07	0.41±0.08	0.46±0.05	0.41±0.08
Dst (s)	0.22±0.10	0.24±0.11	0.18±0.06 *	0.19±0.06	0.22±0.10	0.25±0.12	0.16±0.03	0.23±0.11 *
Sdt (s)	0.64±0.14	0.66±0.16	0.59±0.07	0.62±0.11	0.63±0.12	0.67±0.20	0.62±0.08	0.64±0.15
Stl (m)	0.95±0.39	0.83±0.35	1.16±0.38 *	1.09±0.32	0.97±0.42	0.75±0.31 *	1.35±0.20	0.89±0.38 *
Spl (m)	0.48±0.20	0.42±0.17	0.58±0.19 *	0.54±0.16	0.49±0.21	0.38±0.15 *	0.67±0.10	0.45±0.19 *
Dycg (m)	0.03±0.01	0.03±0.01	0.04±0.02 *	0.03±0.01	0.03±0.02	0.03±0.01	0.04±0.01	0.03±0.01 *
C (steps.min^{-1})	97.96±17.28	95.4±19.2	102.7±12.2	99.0±16.1	98.4±16.2	95.9±21.9	97.5±11.1	98.0±18.1
Vxcg (m.s^{-1})	0.78±0.37	0.67±0.32	0.98±0.38 *	0.86±0.28	0.81±0.41	0.62±0.34 *	1.07±0.17	0.73±0.38 *

* Mann-Whitney ($p<0,05$); ** we compare only the two extreme age groups to find statistically significant differences.

A high incidence of pathologies and gait disturbances was observed (87%), confirming the tendency to a large number of health problems in the elderly related to the decline of organic functions (Robert, 1995). The presence of polipathologies was also observed.

Comparing the results with the normal pattern of the GC, the whole group presents an increase of Stt and Dst (7%) and a decrease of Swt (7%). As expected and consistent with other studies (Batista and Castro, 1994; Serrão and Amadio, 1994; Perry, 1987, Whittle, 1996, Winter, 1990, Woo et al., 1995), we observed an increase of St, Stt, Dst, Sdt and a decrease of Swt, Sst, Stl, Spl, Dycg, C and Vxcg. Nevertheless, the absolute values of the sample tend to be more expressive, suggesting more difficulties in walking.

The differences in kinematics variables related to sex (see Table 2) can be explained by a greater significant ($p<0.05$) incidence of problems among the females. That could also explain men's greater cadence (however not significant) than females, which was not observed in other studies (Du Chantier, 1970, cit. Winter, 1991; Finley and Cody, 1970, cit. Winter, 1991; Molen and Rozendal, 1972, cit. by Winter, 1991).

As far as age is concerned, we didn't find a statistically significant association between age groups and problems (pathologies and/or gait disturbances). We observed that deviations from the normal gait tend to be greater in the oldest group, however, related to the two extreme groups, we found only Stl, Spl, and Vxcg, statistically significant.

Greater differences were found for the group with problems (see Table 2) suggesting deviations in gait pattern from normal gait (Stt≈69%; Swt≈33%; Dst≈18%). The group without problems presents a pattern similar to normal gait (Stt≈63%; Swt≈37%; Dst≈13%).

CONCLUSIONS: Our study suggests that normal gait patterns could be present in the elderly. The differences could be explained by the presence of pathologies

and/or gait disturbances as stated by Perry (1987), as we observed for the female group and the group with problems.

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