

QUANTIFYING DAILY HEAD TURNS AND HEAD-TRUNK COUPLING IN HEALTHY ADULTS

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Objective: The head serves as a crucial hub for integrating information from different sensory systems, such as the vestibular, visual, and proprioceptive system, central to our spatial orientation. Despite the significance of head motion as a key marker in clinical tasks for evaluating motor control and functional impairments, a significant gap exists in studies that quantitatively analyze head rotations during real-life conditions. The study aims to establish a normative distribution of head kinematics during daily activities using small, unobtrusive inertial measurement units (IMUs).

Method: 21 participants (13F, mean (SD) age = 28 (4.7) yrs) wore three IMUs at the head (mastoid), neck (T2), and lumbar (L3) areas for seven days. Data collection involved tri-axial linear acceleration and angular velocity at 100 Hz. Calibration included sensor removal during certain activities and synchronization via shaking, nodding, and jumping. A custom MATLAB script processed all data.

Data Analysis: Raw angular velocity was filtered, and head turns were defined by peak yaw angular rate exceeding 15 °/s. Turns within 1/3s in the same direction were combined, excluding those less than 1/6s. Head-on-body and full-body turns were identified based on angular rates. Outcomes included the number of head turns, peak angular rate, angular displacement, and percentages of head-on-body and full-body turns.

Results: Participants averaged (SD) 5675 (2911) head turns per day, primarily characterized by angular displacement less than 10° and peak angular rate below 50°/s (Table 1). Full-body turns comprised 13%, with head-on-body turns constituting the majority at 87% of all turns. The average (SD) daily wear time amounted to 12 (5) hours.

Significance of Results: Head turns occur nearly ten times more frequently than full-body turns which suggests the importance of capturing head motion for comprehensive activity monitoring.

Conclusion: To our knowledge, this is the first study to measure head kinematics for a week in healthy individuals. The observed prevalence of head-on-body turns, suggests that head movements during daily life may provide important information that could guide clinical decisions related to diagnosis and rehabilitation.

Table 1. Turning and Physical Activity Measures

	Subjects
	n = 20 (12F)
	Mean (SD)
Age (<i>years</i>)	28 (4.7)
Wear Time (<i>hr</i>)	12 (5)
<i>Macro-level Physical Activity</i>	
Steps per day (<i>n</i>)	4814 (2823)
Steps per hour (<i>n/day</i>)	385 (264)
<i>Micro-Level Turning</i>	
Head Turns per day (<i>n</i>)	5675 (2911)
Head Turns per hour (<i>n/day</i>)	449 (229)
Average Amplitude (°)	30.8 (31.1)
Average Velocity (°/s)	56.6 (53.9)