

# COMPARATIVE LUMBAR SPINE ACCELERATION DATA DURING DAILY AND DYNAMIC ACTIVITIES, TASKS OF DAILY DRIVING, AND LOW SPEED LATERAL VEHICLE IMPACTS

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## ABSTRACT

The purpose of this study was to determine and compare acceleration data measured at the lumbar spine for nine subjects undergoing a battery of tests that included daily and dynamic activities (DDAs), tasks of daily driving (TDDs), and low speed, far side vehicle-to-vehicle lateral impacts (LVIs). A single tri-axial gravity sensing accelerometer was affixed to the lumbar spine and directly quantified lumbar accelerations for the same subjects doing multiple tasks; vehicle accelerations were also captured when applicable. Each subject also underwent multiple low speed far-side lateral vehicle-to-vehicle impacts in a laboratory setting. The target vehicle was initially stationary; the bullet vehicle impacted the target vehicle at the front passenger side door at pre-impact speeds ranging from 2.5 to 5.5 mph. Peak lateral and resultant accelerations were determined. Results include lumbar peak accelerations grouped by task category. Peak lateral lumbar accelerations for all DDAs, TDDs, and LVIs were 5.44 g, 1.35 g, and 4.92 g, respectively. Peak resultant lumbar accelerations for all DDAs, TDDs, and LVIs reached magnitudes of 8.52 g, 2.95 g, and 5.02 g, respectively. All reported accelerations include the effect of gravity. These values are comparable to data previously reported in the literature for similar DDAs.

**Keywords:** volunteer testing, lumbar, linear acceleration, vehicle impact, driving tasks, daily activities

## INTRODUCTION

Occupant accelerations in low speed vehicular impacts have been primarily documented in rear-end or frontal crashes, not laterally-directed impacts. Further, likely because the low back is well supported by the seatback in low speed rear end impacts, the majority of this previous research has neglected to measure the occupant lumbar accelerations [1]. Occupant kinematics in lateral impacts will differ, however, and it is valuable to compare the lumbar accelerations experienced in these impacts with those experienced during non-injurious daily and dynamic activities (DDAs) and tasks of daily driving (TDDs).

Previous studies have reported the lumbar accelerations experienced by volunteers while participating in DDAs such as sitting into a chair, being dropped while in a seated position or onto a mattress while supine, walking, running, and jumping off a step [2-5]. However, these activities were conducted primarily in either vertical or anterior-posterior directions, not in a lateral direction. Previous studies of non-impact driving tasks have measured occupant lumbar or seat accelerations during hard braking or mounting a curb with either one or both front tires, but none of these driving activities produced significant lateral vehicle motions [6,7].

While previous DDA lumbar acceleration data has been compared to that reported for rear end low speed vehicle impacts, this data was recorded for different human volunteers [2]. The few studies that have measured lumbar accelerations of volunteers and/or PMHS in lateral vehicle impacts did not also compare