

# Driver Distance From the Steering Wheel: Perception and Objective Measurement

## ABSTRACT

**Objectives.** This study assessed the accuracy of driver perceptions of the distance between the driver's nose and the steering wheel of the vehicle as a factor in considering driver disconnection of an airbag contained in the steering wheel for preventing injury to the driver in an accident.

**Methods.** A cross-sectional survey of 1000 drivers was done to obtain perceived and objective measurements of the distance between the driver's nose and the steering wheel of the vehicle.

**Results.** Of 234 drivers who believed that they sat within 12 inches of the steering wheel, only 8 (3%) actually did so, whereas of 658 drivers who did not believe that they sat within 12 inches of the wheel, 14 (2%) did so. Shorter drivers were more likely than taller ones to both underestimate and overestimate their seating distance.

**Conclusions.** Considerable misperception of drivers' distance from the wheel indicates that drivers should objectively measure this distance. (*Am J Public Health.* 1999;89:1109-1111)

Maria Segui-Gomez, MD, MPH, Jonathan Levy, BA, Henry Roman, MS, Kimberly M. Thompson, ScD, Kathleen McCabe, MPH, and John D. Graham, PhD

Driver-side airbags, mandatory in the United States since 1984,<sup>1</sup> are designed to mitigate head and upper torso injuries to the driver in frontal crashes of motor vehicles. Despite the overall protective effect of airbags,<sup>2</sup> they can cause fatal and nonfatal injuries if the driver's head, neck, chest, or arms are too close to the deploying airbag.<sup>3-6</sup> As of November 1, 1998, 48 driver deaths in the United States had been attributed to airbags.<sup>7</sup> Of these deaths, 26 were of females and 2 were of males whose height was 64 inches or less.<sup>7</sup> Although some data indicate that women of small stature are more likely to be injured by airbag systems,<sup>3</sup> evidence suggests that such systems reduce their overall risk of death by 9.5%.<sup>2</sup>

Widely publicized information about these airbag-induced injuries has led to significant public concern.<sup>8-9</sup> A new US government regulation allows drivers who are at risk of airbag-induced injuries to disconnect their airbags. Eligibility criteria for airbag disconnection via an on-off switch include driver-attested inability to operate a vehicle while maintaining a 10-inch distance from the center of the steering wheel to the center of the driver's chest.<sup>10</sup> Eligibility criteria for airbag deactivation in the absence of a switch include a driver body height of 54 inches or less.<sup>11</sup>

Both the decision to disconnect an airbag and the burden of assessing the eligibility to do so fall on the driver. Studies reporting measured distances between the driver and the steering wheel indicate that 0% to 14% of men and 0% to 30% of women sit within 12 inches of the steering wheel when driving a vehicle and that 0% of men and 5% of women sit within 10 inches.<sup>12-15</sup> In contrast, a telephone survey found that 32% of women and 16% of men believed that they sat within 12 inches of the steering wheel.<sup>16</sup> These studies used different definitions of distance from the steering wheel, and none compared perceived and measured distances. However, the studies collectively suggest that drivers may misperceive their distance from the steering wheel.<sup>17-20</sup>

We investigated the frequency of such misperception and explored the factors that characterize drivers who are more likely to misperceive their seating distance from the steering wheel. In doing this, we put special emphasis on shorter drivers (including

women) because they were thought likely to represent the largest proportion of individuals who sit too close to the wheel.<sup>15</sup>

## Methods

During the summer of 1997, trained interviewers asked drivers refueling at 15 randomly selected gasoline stations in the Boston metropolitan area to participate in the study. Criteria for participation included completion of a survey instrument and measurement of the driver's nose-to-steering wheel seating distance during the refueling stop.

The survey instrument contained questions about driver and vehicle characteristics as well as about the driver's perceptions regarding airbags. Drivers participating in the survey were asked, "When driving, how far do you think you sit from the steering wheel (in inches measured from the bridge of your nose to the wheel)?" After instructing the driver to take his or her normal driving posture, the interviewer made manual measurements of the distance from the bridge of the driver's nose to the center of the steering wheel (in accordance with the measurements reported in the then-current literature<sup>12-14,16</sup>). The interviewer also collected information about airbag equipment and driver seat-belt use.

For statistical analysis, drivers were categorized as short (<64 inches), medium (>64-70 inches), and tall (≥70 inches) on the basis of the height quartiles of the survey sample. Proximity of a seated driver to the steering wheel was defined as a distance of 12 inches or less,<sup>12-14,16</sup> although we conducted a sensitivity analysis with alternative definitions of proximity as 14 and 16 inches.

To compare perceived and measured distances of drivers from the steering wheel, we computed the Pearson correlation coefficient and the diagnostic test values of perceived distances, consisting of sensitivity (and false-negative results, defined as a real

The authors are with the Harvard School of Public Health, Boston, Mass.

Requests for reprints should be sent to Maria Segui-Gomez, MD, MPH, Harvard School of Public Health, 718 Huntington Ave, Boston, MA 02115-5102. (e-mail: msegui@hsph.harvard.edu).

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distance that was less than the perceived distance from the steering wheel), specificity (and false-positive results, defined as a real distance that was more than the perceived distance from the steering wheel), and positive and negative predictive values. Multivariate logistic regression analysis was used to determine the factors that predicted false-positive and false-negative results. Those factors evaluated included age, sex, height, seat-belt use, presence of a driver-side airbag in the vehicle, perception of an airbag as safe or not, year of the driver's vehicle, transmission type of the vehicle, and the interactions between sex and height, sex and perception of airbag safety, and height and perception of airbag safety.

**Results**

Of 1400 drivers who were approached for the survey, 1000 agreed to participate. Table 1 shows, by sex, the following characteristics of the survey population: age, height, seat belt use, perception of airbag safety, and presence of driver-side airbag.

Among the 892 subjects who estimated their seating distance from the steering wheel, the mean perceived distances were 18 inches (SD = 10) for women and 21 inches (SD = 9) for men. The mean measured distances from the wheel were 17 inches (SD = 2) for women and 19 inches (SD = 2) for men. The correlation between perceived and measured distance was 0.24 for the overall sample and varied between 0.2 and 0.3 after stratification by sex and height category.<sup>21</sup>

The percentage of drivers who sat within 12 inches of the steering wheel and perceived themselves as doing so (positive predictive value) was 3%, ranging from 0% for short and tall men and tall women to 6% for short women. The probability that drivers who sat within 12 inches of the wheel perceived themselves as doing so (sensitivity) was 53%, ranging from 45% for short women to 100% for women of medium height (Table 2).

The multivariate logistic regression models showed that only height and negative perceptions of airbags as safety devices had statistically significant ( $P < .05$ ) effects on the rates of false-positive and false-negative results. Shorter individuals (both men and women) were more likely to have both false-positive and false-negative results (odds ratios [ORs] = 1.5 and 1.9, and 95% confidence intervals [CIs] = 1.2, 2.0 and 1.3, 2.9, respectively). Drivers who did not perceive airbags as safe were much less likely to have false-positive results (OR < 0.001; 95% CI = 0.0005, 0.03). Sensitivity analyses for distances of 14 or 16 inches from the steering

**TABLE 1—Selected Characteristics of the Study Population by Sex: Boston, Summer 1997**

	Men (n = 476), %	Women (n = 523), %
Age, y		
15–24	11.8	16.0
25–64	81.3	81.1
65+	6.9	2.9
Height, inches		
≥56–≤64	2.9	52.4
>64–<70	43.7	42.8
≥70–≤79	53.4	4.8
Driver belted	62.2	65.6
Airbag not perceived as safe	32.0	41.9
Driver-side airbag	49.0	48.8

Note. The sex of one driver was not reported.

**TABLE 2—Perceived and Measured Distances to the Steering Wheel and Diagnostic Test Values by Sex and Height Categories (n = 892): Boston, Summer 1997**

Distance, <sup>a</sup> by Height	Measured Distance, <sup>a</sup> n		Diagnostic Test, %			
	≤12	>12	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
≤64						
Women						
≤12	5	81	45	64.0	6.0	96.0
>12	6	141				
Men						
≤12	0	4	NA	69.0	0.0	100.0
>12	0	9				
>64–<70						
Women						
≤12	2	55	100.0	72.0	4.0	100.0
>12	0	143				
Men						
≤12	1	35	50.0	81.0	3.0	99.0
>12	1	153				
≥70						
Women						
≤12	0	3	NA	86.0	0.0	100.0
>12	0	19				
Men						
≤12	0	49	NA	79.0	0.0	100.0
>12	0	185				

Note. The sex of one driver was not reported. NA = not applicable.

<sup>a</sup>Distance, both perceived and measured, given in inches.

wheel did not change the results. The results of these analyses are not shown.

**Discussion**

Drivers' misperceptions of their nose-to-steering wheel distance during operation of a motor vehicle are a potentially serious public health problem. Drivers with false-positive results for this variable may put themselves at greater risk of injury by inappropriately seeking permission to disconnect

their airbags, while those with false-negative results may not be aware of their risk of injury.

The main limitation of our study was that the definition of distance from the steering wheel in our survey differed from the current definition of a safe distance of 10 inches between the center of the driver's chest and the center of the steering wheel.<sup>10</sup> Although we cannot quantify the relationship between these definitions, they may be roughly equivalent. We believe that the current definition of a safe distance from the wheel would yield

rates of misperception similar to those that we observed.

Drivers (and especially shorter ones, regardless of their sex) can easily, and should be encouraged to, measure the distance between themselves and an airbag contained in the steering wheel of their vehicle. Our findings should be helpful to drivers contemplating disconnecting an airbag, to health and safety professionals who are asked about airbags, and to the federal agency granting permits to disconnect these devices. □

## Contributors

M. Segui-Gomez planned and supervised the data collection, performed the primary analysis of the data, and wrote the paper. J. Levy and H. Roman conducted a pilot study to test the survey questionnaire and assisted in the training of the interviewers. K. McCabe contributed to the data analysis. K. M. Thompson suggested the comparison of perceived and objective distances of seated drivers from the steering wheels of their vehicles. J. D. Graham planned and supervised the study. All of the authors contributed to the writing of the paper and are guarantors of the integrity of the study.

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