THE INFLUENCE OF BODY MASS AND GENDER ON PRESSURE DISTRIBUTION AND DISCOMFORT DURING PROLONGED DRIVING.

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INTRODUCTION

With urban population growth two noteworthy trends have emerged; people are driving greater distances to work [1] and more people are being defined as overweight (BMI ≥ 30) [2]. Associations between driving time/distance and musculoskeletal disorders have been documented in the literature [3]. Seat pressure measures provide information associated with local blood flow [4] and probability of developing local ischemia and discomfort [5,6]. Stature and gender have been shown to influence pressure distribution [7,8], which can be used to asses risk of discomfort development during driving. No study has investigated how body mass may influence pressure distribution and driver discomfort during prolonged driving.

METHODS

Twelve male and female participants between 1.7 ± 0.03 m were matched for body mass and assigned to a light (54.9 ± 2.5 kg), moderate (66.0 ± 2.1 kg) or heavy (83.6 ± 0.7) body mass group. Participants completed a 2 hour in lab driving simulation. Seat pan and back pressure distribution data were collected at 4Hz (X2, XSensor Technologies, Calgary, AB). Mean seat pan and seat back peak total pressure and area were recorded. A three-way mixed general linear model (GLM) (body mass, gender, time) was used to determine significance ($\alpha = 0.05$). A Tukey HSD *post hoc* ($\alpha = 0.05$) followed when signficance was found.

RESULTS AND DISCUSSION

All body mass groups displayed an increase in total and normalized (PPA) pressure from 0 to 120 minutes. Body mass was found to significantly elevate the total pressure placed on the seat pan and seat back during driving. When normalized to contact area, only the heavy body mass group displayed significantly elevated total seat pan pressure per unit area (PPA) compared to the other body mass groups (Table 1). Elevated seat pan PPA was attributed to inadequate seat pan size. The heavy body mass group could not distribute mass over the same relative area as the lighter body mass groups (Figure 1).

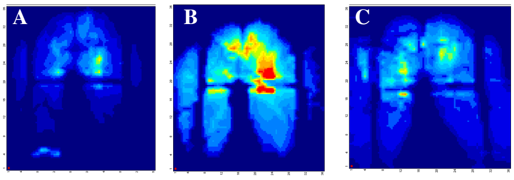

Figure 1: Seat pan pressure profile of a typical light (A), Moderate (B) and heavy (C) body mass group during prolonged driving.

With prolonged exposure, the heavy body mass group may be placed at increased risk of developing ischemia and buttocks region discomfort [5,6].

Females displayed lower peak right ishial tuberosity (IT) PPA with no significant difference in left IT PPA relative to males. Increased adipose stores in the buttock region [9] and gender specific interactions with the accelerator pedal may have allowed females to unload their right IT PPA pressures during driving. With associations between peak IT pressure and discomfort documented in the literature [5], females and males likely progress through different discomfort pathways.

CONCLUSIONS

Heavy populations (BMI ≥ 30) are at increased risk of developing buttocks region discomfort during prolonged driving with current seat pan design. Females produce asymmetric normalized peak IT pressures profiles while driving, identifiying gender as a potential risk factor in the development of discomfort during prolonged driving.

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Table 1: Mean (standard deviation) pressure distribution data across120 minutes of driving, grouped according to body mass and gender.

	Pressure Measure	Light	Moderate	Heavy	Males	Females
Seat Pan	Total (mmHg)	27,358 (4,072)^{xxx}	30,506 (1,376)^{xxx}	44,493 (588)^{xxx}	33,566 (7,693)	34,672 (9,745)
	Total area (cm^2)	1,013 (85)^{†,a}	1,154 (140)^{†,b}	1,397 (116)^{†,c}	1,131 (185)^{‡,a}	1,245 (198)^{‡,b}
	Total PPA (mmHg/cm^2)	27.1 (4.3)^{xxx}	26.8 (4.1)^{xxx}	31.9 (4.2)^{xxx}	29.7 (5.0)	27.5 (4.2)
	(L) IT total (mmHg)	1,115 (898)	1,080 (1,108)	2,153 (1,366)	1,370 (1,332)	1,528 (1,111)
	(R) IT total (mmHg)	934 (884)	746 (759)	1,224 (1,152)	1,346 (1,162)	590 (361)
	(L) IT area (cm^2)	10.6 (6.8)	10.6 (8.6)	18.9 (10.4)	12.9 (10.3)	13.5 (8.5)
	(R) IT area (cm^2)	9.5 (6.6)	8.5 (5.5)	11.6 (8.9)	12.7 (8.8)	7.1 (8.4)
	(L) IT PPA(mmHg/cm^2)	97.3 (17.8)	88.6 (21.9)	107.9 (19.2)	95.2 (21.2)	100.7 (20.2)
	(R) IT PPA(mmHg/cm^2)	85.4 (27.4)	74.2 (27.2)	97.8 (16.3)	94.5 (23.0)^{‡,a}	77.1 (23.1)^{‡,b}
Seat Back	Total (mmHg)	6,495 (1,963)^{†,a}	8,512 (795)^{†,b}	10,681 (1,694)^{†,c}	9,287 (1,412)^{‡,a}	7,838 (2,813)^{‡,b}
	Total area (cm^2)	479.3 (115.0)^{†,a}	587.1 (53.3)^{†,b}	727.9 (88.0)^{†,c}	637 (85)^{‡,a}	560 (165)^{‡,b}
	Total PPA (mmHg/cm^2)	13.5 (1.6)	14.5 (1.2)	14.7 (1.2)	14.6 (1.0)	13.9 (1.7)

‡ = *significant difference at* $p < 0.05$, † = *significant difference at* $p < 0.001$; a,b,c Tukey post hoc ($\alpha = 0.05$). xxx ~ interaction with time.