

BICYCLE SEAT INTERFACE PRESSURE: RELIABILITY, VALIDITY, AND INFLUENCE OF HAND POSITION AND WORKLOAD

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INTRODUCTION

Bicycle seat discomfort and perineal (i.e., crotch) pathologies such as saddle sores and pudendal neuropathy are reported to influence between 35-81% of bicyclists following short and long distance rides (e.g., Schrader et al., 2002). Bicycle seat pressure is thought to be a major extrinsic risk factor for seat injuries (e.g., Schwarzer et al., 2002) and while a few researchers have examined solutions for reducing seat pressure through variations in saddle design (Spears et al., 2003) and riding position (Schrader et al., 2002), the reliability, and validity of the pressure measurements have not been reported. The purpose of this study was to examine the validity and reliability of bicycle seat interface pressure measurements using a commercially available pressure-sensing mat designed for bicycle seats. A second objective was to establish baseline pressure measurements for females and males during stationary bicycling under different workload and hand position conditions.

METHODS

Nineteen recreational cyclists (9 female, 10 male) completed two separate identical bicycle ergometer trials at 118 W in the top and drop handlebar positions and at 300 ± 82.4 W in top handlebar position (Figure 1). Seat pressures were sampled at 5 Hz via a computer interface module connected to a pressure-sensing mat designed for

bicycle seats (FSA, Vista Medical Ltd). The pressure mat was 1.0 mm thick and consisted of a 27.9 x 34.3 cm flexible lycra material that contained a matrix of 768 piezoresistive sensors. Mean pressures were calculated as the average of all sensor values and peak pressures as the highest individual sensor value recorded for each condition. Pressure values were calculated over the total, anterior, posterior, left, and right side of the pressure-sensing matrix. A grid on the pressure-sensing mat was used to position the horizontal and vertical midlines of the mat over the horizontal and vertical midlines of the seat (Figure. 1).

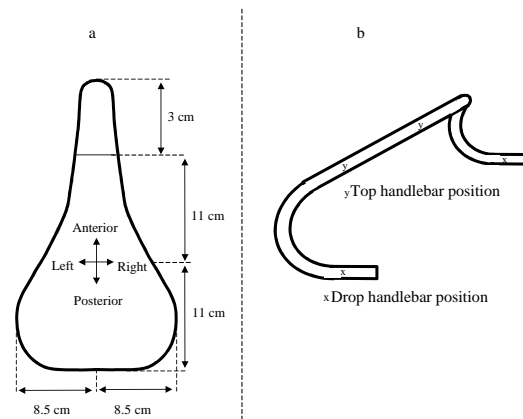


Figure 1: (a) Top view of bicycle seat dimensions and (b) hand positions tested.

By systematically positioning the mat over the seat in this manner, mean and peak pressures for each region of the seat could be measured. The validity of the pressure system was examined through the relationship (Pearson r) between known static seat loads and the sum of seat

pressures. Within and between trial reliability was examined with Intraclass correlation coefficients (ICC). Main effects and interactions for average mean and peak pressures were examined with a two-factor condition (high workrate top, low workrate top and drop handlebar position) by gender (male and female) ANOVA with repeated measures and follow-up comparisons on the condition factor. The probability of a Type I error set at 0.05.

RESULTS AND DISCUSSION

The relationship (r) between seat loads and the sum of seat pressures was 0.97 ($p = 0.001$). Within trial ICC ranged between 0.90 and 0.99 and the between trial ICC values ranged between 0.78 and 0.96. Because univariate analyses revealed similar results for all seat regions, only mean pressures for the total seat region are reported (Table 1). Mean pressures were on average 24% greater in the 118 W top than 300 W top handlebar condition, and in comparison to the 118 W drop handlebar condition, mean pressures were 9% greater. Mean pressures for the 118 W drop condition were 16% greater than values for the 300 W top handlebar condition. The gender comparison revealed that male pressure values were greater (18%), and a significant interaction ($p = 0.02$) revealed that female values were not influenced by hand position (Table 1).

It can be observed from Table 1 that when participants moved from a top to drop handlebar position, seat pressure decreased and when participants pedaled at a higher workrate, seat pressure decreased. Weight shifts from the seat to handlebars and pedals, respectively, may account for the pressure changes observed (Stone & Hull, 1995). It may be that a lower center of gravity in females, however, decreases their capacity to shift weight to the handlebars, thereby reducing their capacity to decrease seat pressures. In conclusion, pressure measurements were found to be reliable during pedaling and valid statically. Additionally, the results indicated that workrate and hand position were factors influencing seat pressure and that males and females responded differently to adjustments of these factors.

REFERENCES

- Schrader, S.M. et al. (2002). *J Androl*, **23**, 927-934.
 Schwarzer, U. et al. (2002). *J Urol*, **41**, 139-143.
 Spears, I.R. et al. (2003). *Med Sci Sports Exerc*, **35**, 11620-1625.
 Stone, C., Hull, M.L. (1995). *J Biomech*, **28**, 365-375.

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Table 1: Mean seat pressures (mean \pm SD; kPa) for males ($n = 9$) and females ($n = 10$) riding at two different workloads and handpositions

Variable	Tops 118 W	Drops 118 W	Tops 300 W
Male ^c	19.3 (2.2)	17.2 (1.4)	14.6 (3.0)
Female	15.3 (1.7)	14.4 (1.7)	12.0 (1.8)
All subjects	17.4 (2.8) ^a	15.9 (2.0) ^b	13.3 (2.8)

^a $p < 0.05$. Significantly greater than 118 W drop and 300 W top handlebar conditions. ^b $p < 0.05$.

Significantly greater than 300 W condition. ^c $p < 0.05$. Mean of all values is significantly greater than female values

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