

## Recreational cyclists: The relationship between low back pain and training characteristics

SAMANTHA J. SCHULTZ\* and SUSAN J. GORDON‡

School of Public Health, Tropical Medicine and Rehabilitation Sciences, James Cook University, Townsville, Australia. [susan.gordon2@jcu.edu.au](mailto:susan.gordon2@jcu.edu.au)

\*Denotes undergraduate student author ‡Denotes professional author

---

### ABSTRACT

*Int J Exerc Sci* 3(3): 79-85, 2010. This study investigated the relationship between low back pain (LBP) and training characteristics in recreational cyclists. Purposive sampling was used to recruit sixty-six recreational cyclists from nine cycling clubs. Participants completed a survey reporting training characteristics and LBP behaviour during a usual week of cycling. This included percent of time spent cycling in three common riding positions, cycling terrain, average cycling pace, number of gears, days per week cycled and number of cycling events per year. Fifty percent reported LBP during or after cycling or smoking and LBP. Cyclists who reported LBP cycled significantly further in a usual week of cycling than cyclists who did not report LBP ( $p=0.022$ ). An odds ratio indicated that people who cycle 160 km or more per week are 3.6 times as likely to experience LBP compared with people who cycle less than 160 km per week (OR=3.6, CI=1.29-10.15). Preference for riding with the hands on the brakes approached significance with respect to LBP reports ( $P=0.06$ ). No other significant relationship between LBP and training characteristics was identified. In order to reduce the risk of LBP recreational cyclists who report LBP should consider decreasing cycling distance to less than 160 km per week.

KEY WORDS: Bicycling; injury prevention; cycling; low back pain.

### INTRODUCTION

In Australia, cycling has increased in popularity with approximately one million people cycling for recreation, to work or to destinations in inner cities (1). Although cycling is a low impact activity, low back pain (LBP) has been reported by 2.7-50% of recreational cyclists (3,14,17).

It has been suggested that an extremely low handlebar position (10) or riding in the drop position, with the hands positioned on the lowest part of the handlebars (14) contributes to LBP in cyclists. Hence suggestions to prevent LBP have been made regarding handlebar height (15)

however no published studies have examined the relationship between handlebar height, riding position and lumbar spine posture with respect to LBP.

Research investigating lumbar posture and LBP in cyclists has provided two scenarios in relation to symptom production. Salai et al. (14) investigated pelvic tilt in cyclists and found an inclination towards hyperextension at the lumbo-pelvic junction in those who reported LBP. Intervention (N=40) by inclining the saddle anteriorly by 10-15°, for six months, resulted in greater flexion of the lumbar spine on the pelvis and eradicated LBP in 72% of participants and reduced the

frequency of LBP in 20% of participants (14). Burnett et al. (2) recruited 18 subjects to participate in a pilot study examining whether differences in spinal kinematics exist in cyclists with and without chronic LBP. Spinal kinematics was calculated using an electromagnetic tracking system and abdominal and back muscle activity was recorded with electromyography. Subjects were requested to ride in one of two different riding positions; being on the drops or on the aero bars (similar to the brake position with arms stretched further forward). The results of this study identified a trend toward increased flexion and axial rotation of the lower lumbar spine with a loss of co-contraction of the multifidus muscle in nine cyclists with non-specific chronic LBP (2). Furthermore, increased upper lumbar spine rotation and flexion was reported to be associated with no back pain (2). However, these findings were not statistically significant, possibly due to the various cycling positions and small sample size.

Additionally, it is a belief in the cycling community that intensity, frequency and duration of training may influence the prevalence of non-traumatic injuries in cyclists including reports of LBP (4). However, a search of the literature using a systematic approach identified only three papers investigating overuse injuries, including LBP, and training characteristics in recreational cyclists. Of these, two studies reported low prevalence of LBP in cyclists, 2.7% (17) and 16% (7), with no conclusions available regarding training characteristics and LBP. Wilber et al. (18) investigated overuse injuries including LBP and training characteristics in recreational cyclists from northern and southern California. They reported that male cyclists

who cycled 104.4 miles per week (168 kilometres (km)) were significantly more likely to report LBP than cyclists who cycled 77.1 miles (124 km) per week ( $p < 0.05$ ) (10). In addition, cyclists who reported less number of gears on the cycle (13 gears compared to 15 gears;  $p < 0.05$ ) were significantly more likely to report LBP. However, no significant relationship between diet, education, cycling equipment and attire, and hazards encountered when cycling and LBP was identified. Other factors, which may contribute to LBP, include age related degeneration of lumbar joints and discs (5,12) and a history of cigarette smoking (8).

In the last decade bike design has advanced and cyclists have adopted more aerodynamic riding positions. Further the increase in popularity of recreational cycling and no available information in the Australian context warrants investigation of training characteristics in relation to LBP in recreational cyclists. The current study modified the survey of Wilber et al. (18) to specifically investigate the relationship between LBP and training characteristics in recreational cyclists.

## METHODS

### *Participants*

Ethics approval for this study was granted by the Human Research Ethics Committee of James Cook University, Townsville. Cyclists aged 18 years and over belonging to regional and metropolitan cycling clubs in Queensland were recruited by invitation.

### *Survey*

A survey was used to collect demographic information. It included questions from the survey of Wilber et al. (18) and other

questions considered pertinent to the aims of this study: 1) Individual and training characteristics (smoking history, years cycling, kilometres cycled per week, days cycled per week, cycling pace and number of cycling events per year), 2) Type of handlebars on the bike, 3) Number of gears on the bike, 4) History of traumatic injury to the lumbar spine in the past two years, 5) LBP during or after cycling within the past three or the past six months, 6) Any referred symptoms related to LBP the cyclist had experienced in the past six months, 7) An estimate of the percent of time spent cycling in different riding positions and 8) The type of cycling terrain. The survey was piloted with a group of six cyclists for clarity and appropriateness of the questions before a final survey was produced and employed in the study (13).

### *Procedures-Data collection*

An information letter and online survey were distributed to cycle club members via the cycle club's website and monthly online newsletter. Reminder e-mails were sent one month after the initial survey distribution. Information sheets inviting cyclists to participate in the study were also distributed during cycling events. Voluntary return of the completed survey constituted participant consent. Participants were instructed to complete the survey questions individually. In many instances the survey provided participants with a number of possible responses and participants were asked to choose the response that best described their circumstance. For example when asked to report the terrain in which they mostly cycled participants were asked to choose between 'mostly hilly', 'mostly flat' and 'flat with rolling hills'

### *Procedures-Data management*

For the purpose of this study, a recreational cyclist was defined as any individual who cycled regularly (at least once a week) and did not participate in more than 50 organised cycling events per year. Low back pain was defined as one or more episodes of pain or discomfort in the area of the low back, experienced during or after cycling within the last three to six months (18). Survey questions 9, 14 and 15 (see Appendix A) allowed confirmation of recreational and LBP status according to these definitions. Questions 13 and 16 allowed identification of those who had sustained a traumatic injury in the previous two years resulting in LBP and/or known lumbar spine pathology.

### *Statistical Analysis*

Statistical analysis was completed using Statistical Package for the Social Sciences (SPSS) Version 16.0 (16). As the numeric variables were non-parametric, median values and standard deviations have been presented. Mann-Whitney or chi-square tests were performed to determine significant differences between the training characteristics of cyclists with and without LBP. The level of significance was set at  $P < 0.05$ .

When significant differences were identified logistic regression was performed to adjust for potentially confounding variables. Odds ratios (OR) and confidence intervals (CI) were performed to provide meaningful interpretation of significant findings. When the lower 95% CI of the OR exceeded 1 the odds were significantly elevated, whereas when the upper CI of the OR was less than 1, the odds were significantly protective.

**RESULTS**

A total of 70 cyclists responded to the survey (response rate of 20%). Four cyclists were ineligible and therefore were excluded from the study due to experiencing LBP as a result of a traumatic accident in the previous two years. Of the remaining 66 cyclists, 49 were male and 17 female. Twenty-three male and 10 female cyclists (Total N = 33) reported LBP during or after cycling (non-traumatic) within the last six months. Twenty-six males and seven females (total = 33) reported no low back pain (NLBP) during or after cycling. Participant ages ranged from 18-61 y.

Initial analysis revealed no significant relationship between LBP and NLBP groups for age (P=0.967) and gender (P=0.574). Further, as smoking has been reported to contribute to LBP (8), analysis was undertaken comparing smoking history and those with and without LBP. Of those participants with LBP, one cyclist smoked, five had ceased and 27 had never smoked. Similarly, in those with NLBP, one cyclist was a smoker, six had ceased and 26 had never smoked. A Chi-square test determined that there was no statistically significant difference between LBP and NLBP groups with respect to smoking history (P=1.00).

**Table 1:** Training characteristics of participants with low back pain (LBP) and no low back pain (NLBP).

Variable	NLBP (N = 33)	LBP (N = 33)	P-value
Cycling experience (y)	3.0 ± 7.4	6.0 ± 11.6	0.22
Distance cycled (km/wk)	150.0 ± 135.0	250 ± 131.0	0.02 *
Cycling frequency (days/wk)	4.0 ± 1.8	5.0 ± 1.4	0.29
Number of gears on cycle	20.0 ± 3.5	20.0 ± 2.2	0.72
Upright position (%)	35.0 ± 29.5	30.0 ± 24.1	0.31
Drop position (%)	20.0 ± 19.6	10.0 ± 13.7	0.72
Brake position (%)	33.3 ± 28.6	55.0 ± 27.2	0.06
Aero position (%)	3.3 ± 11.4	2.0 ± 8.8	0.96

Values represent the median±SD, \* Significant findings (P<0.05).

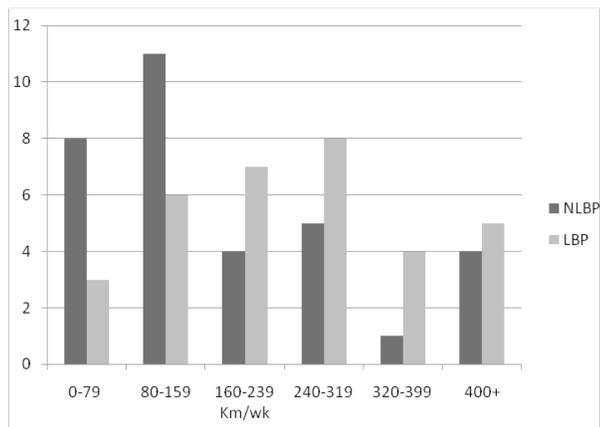
**Table 2:** Distribution of average pace, terrain and riding events per year for the LBP and NLBP groups.

Characteristic	Categories	NLBP (N=33)	LBP (N=33)	P-value
Pace (%)	<20	6.1	0	0.81
	21-25	6.1	9.1	
	26-30	39.4	36.4	
	31-35	45.5	48.5	
	36-40	9.3	6.1	
	Flat	42.4	18.2	
Terrain (%)	Hilly	6.1	6.1	0.19
	Flat with hills	12.1	24.2	
	Combination	39.4	51.5	
	0-9	68.8	39.4	
Events (%)	10-19	9.4	18.2	0.16
	20-29	9.4	24.2	
	30-39	3.1	9.1	
	40-49	9.4	9.1	
	50+	0	0	

As no statistical difference was identified between age, gender and smoking history in relation to LBP, further analysis of this data set did not require stratification for these variables. Response to questions regarding training characteristics and LBP and NLBP groups are summarized in Tables 1 and 2. A significant difference was found between the LBP and NLBP groups for km cycled per week and riding with the hands on the brakes approached significance (P=0.06; Table 1).

Significant differences were identified in the median km cycled per week for participants with NLBP (150 ± 35 km, interquartile range (IQR) =235) and for participants with LBP (250 ± 131 km, IQR=228) (P=0.02). Representation of self-reported km cycled per week in Figure 1 indicates a change in LBP reports once cyclists complete more than 160 km per week. An odds ratio indicated that people who cycle 160 km or more per week are significantly more likely to experience LBP compared with people who cycle less than 160 km per week (OR=3.6, CI =1.3-10.2). No significant differences were evident between LBP and NLBP groups for cycling experience, cycling frequency, number of gears on the cycle and riding position. A post -hoc power calculation based on an effect size of 0.63 (calculated according to the presence or not of LBP) indicated that

with this sample size the study achieved greater than 74% power (13).



**Figure 1:** This figure represents the prevalence of lower back pain (LBP) as a function of weekly cycling distance. Subjects were separated into two groups: No LBP (NLBP) and LBP.

## DISCUSSION

Australian recreational cyclists who report cycling 160 or more km per week are significantly more likely to report LBP. This concurs with the findings of Wilber et al. (18) that American recreational cyclists who cycled an average of 104.4 miles per week (168 km) were significantly more likely to report LBP.

It has been suggested that sustaining one riding position over a long duration, pushing hard with big gears on the bike for prolonged periods and prolonged climbing of hills, gluteal, hamstring and back muscle fatigue contributes to LBP in cyclists (11). However, this study did not find a statistically significant difference between the number of gears on the cycle, riding terrain or riding position and LBP reports.

Females are reported to be at greater risk of spinal injury than males due to anatomical differences in trunk muscle size as well as a combination of trunk coactivity patterns (9). This study did not find any significant

difference in training characteristics between genders with respect to LBP reports. Degeneration of the lumbar spine in people aged 40 y and over has been reported (5) and may possibly contribute to the cyclists LBP as opposed to their training characteristics. However, this study did not find any significant relationship between age and LBP. Future studies with a larger sample may identify significant findings between age, gender and LBP and training characteristics of recreational cyclists.

However there are a number of the variables, which were not considered in this study or the study by Wilber et al. (18) which may be potential confounders to the findings regarding mileage cycled and should be included in future research. These include intensity of training, anthropometric variables especially with respect to bike set-up and favoured cycling position at onset of LBP, which would be best, investigated using a prospective design.

Professional cyclists vary their training frequency and intensity when preparing for events. However, there is no evidence to suggest that during an increased training phase cyclists alter the proportion of time they spend in each riding position. The recreational cyclist may also vary training frequency and intensity. It is possible that some participants in this survey may have experienced LBP within the last three months while undergoing an intense training period or they may have been in a light training phase when survey data was collected. While no relationship was identified between frequency of cycling and LBP, the speed and gear setting may contribute to LBP and hence future studies

should consider these parameters related to intensity of cycling as possible confounders.

Recreational cyclists with LBP reported more time riding on the brake levers (50%) than those with NLBP (36.7%). In comparison to upright and drops cycling positions, riding on the brake levers results in a mid position of the lumbar spine. It has previously been suggested that end range lumbar positions are the cause of LBP in cyclists (2, 14) hence cyclists with LBP may report a preference for the mid-position brake lever position to unload the lumbar spine and reduce their LBP. This study did not set out to account for changes in riding position as a consequence of developing LBP while cycling. It is therefore unclear from the survey data which cycling position may have been linked to the initial onset of LBP.

Geographic location did not allow the investigators to measure the height and weight of all survey respondents and self-reports may be unreliable. Collection of anthropometric data would have provided further detail regarding the general health of the cyclist. It would also have allowed derivation of an indicator of obesity, such as body mass index, and consideration of the relationship between obesity and LBP (6) in recreational cyclists. Additionally, clarification of riding position related to LBP would identify if cyclists who reported experiencing LBP during or after cycling had altered their riding position to relieve their LBP. This additional information should be collected in future studies regarding risk factors for LBP in recreational cyclists. A prospective study investigating the riding positions of people who commence cycling and subsequently develop LBP may provide more

information on the relationship between training characteristics and LBP in recreational cyclists.

In summary, this study identified a significant difference between self-reported km cycled per week and LBP in recreational cyclists. Those cyclists who reported riding an average of 160 km or more per week were significantly more likely, in fact 3.6 times more likely to report LBP than those who rode less km. Agreement between this study and that of Wilber et al. (18) indicate that 160 km per week is a critical value in preventing LBP in recreational cyclists. Future research regarding the relationship between LBP and training characteristics in recreational cyclists should include information about bike set-up, the training phase of the cyclist and the cyclists' anthropometric measurements.

### ACKNOWLEDGEMENTS

No external funding or research contract was involved in this study. The project was funded by the Discipline of Physiotherapy, James Cook University, Australia.

### REFERENCES

1. ABS: 2008 year book Australia: sports and physical recreation (Internet). Australia: Australian Bureau of Statistics; cited 2008 Jun 10. Available from: <http://www.abs.gov.au/Ausstats/abs>. 2008.
2. Burnett AF, Cornelius MW, Dankaerts W, O'Sullivan PB. Spinal kinematics and trunk muscle activity in cyclists: a comparison between healthy controls and non-specific chronic low back pain subjects - a pilot investigation. *Man Ther* 9(1): 211-219, 2004.
3. Dannenberg AL, Needle S, Mullady D, Kolodner KB. Predictors of injury among 1638 riders in a recreational long-distance bicycle tour: cycle across Maryland. *Am J Sports Med* 24(6): 747-753, 1996.

## CYCLING: LOW BACK PAIN AND TRAINING

4. Dettori NJ, Norvell DC. Non-traumatic bicycle injuries: a review of the literature. *Sports Med* 36(1): 7-18, 2006.
5. Fujiwara A, Tamia K, Yamato M, An HS, Yoshida H, Saotome K et al. The relationship between facet joint osteoarthritis and disc degeneration of the lumbar spine: an MRI study. *Euro Spine J* 8(5): 396-401, 1999.
6. Kaila-Kangas L, Leino-Arjas P, Riihimaki H, Luukkonen R, Kirjonen J. Smoking and overweight as predictors of hospitalization for back disorders. *Spine* 28(16): 1860-1868, 2003.
7. Kulund DN, Brubaker CE. Injuries in the bike centennial tour. *Phys Sports Med* 6(6): 74-78, 1978.
8. Leboeuf-Yde C. Smoking and low back pain: a systematic literature review of 41 journal articles reporting on 47 epidemiologic studies. *Spine* 24(14): 1463-1470, 1999.
9. Marras WS, Davis KG, Jorgensen M. Spine loading as a function of gender. *Spine* 27(2): 2514-2520, 2002.
10. Mellion MB. Common cycling injuries: management and prevention. *Sports Med* 11(1): 52-70, 1991.
11. Mellion MB. Neck and back pain in bicycling. *Clin Sports Med* 13(1): 137-164, 1994.
12. Paajanen H, Erkintalo M, Parkkola R, Salminen J. Age-dependent correlation of low-back pain and lumbar disc degeneration. *Arch Orthop Trauma Surg* 116(1-2): 106-107, 1997.
13. Portney LG, Watkins MP. *Foundations of Clinical research Applications to Practice* (3<sup>rd</sup> Ed). Pearson Prentice Hall, New Jersey.
14. Salai M, Brosh T, Blankstein A, Oran A, Chechik A. Effect of changing the saddle angle on the incidence of low back pain in recreational bicyclists. *Br J Sports Med* 33(6): 398-400, 1999.
15. Silberman MR, Webner D, Collina S, Shiple BJ. Road bicycle fit. *Clin J of Sport Med* 15(4): 271-276, 2005.
16. *Statistical Package for the Social Sciences (SPSS). SPSS for Windows Version 16.0.* Chicago:SPSS Inc., 2009.
17. Weiss BD. Nontraumatic injuries in amateur long distance bicyclists. *Am J Sports Med* 13(3):187-192, 1985.
18. Wilber CA, Holland GJ, Madison RE, Loy SF. An epidemiological analysis of overuse injuries among recreational cyclists. *Int J Sports Med* 16(3): 201-206, 1995.