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ORIGINAL ARTICLE

Comparison of sagittal lumbar curvature between elite cyclists and non-athletes

Comparaison du rachis lombaire sur le plan sagittal entre cyclistes d'élite et sujets non sportifs

J.M. Muyor[a,*], P.A. López-Miñarro[b], F. Alacid[c]

[a] *Faculty of Education Sciences, Nursing and Physiotherapy, Laboratory of Kinesiology, Biomechanics and Ergonomic (KIBIOMER), University of Almería, Ctra. Sacramento s/n., 04120 La Cañada de San Urbano, Almería, Spain*
[b] *Department of Physical Education, Faculty of Education, University of Murcia, Campus de Espinardo, 30100 Murcia, Spain*
[c] *Department of Physical Activity and Sports, Faculty of Sport Sciences, Catholic University San Antonio de Murcia, Guadalupe, 3007 Murcia, Spain*

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Cycling;
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Summary
Objective. — To compare sagittal lumbar curvature in several positions between elite cyclists and non-athletic subjects.
Methods. — A total of 60 elite male cyclists and 68 age-matched sedentary controls (mean age: 21.91 ± 2.86 years) participated in the study. Lumbar curvature was measured with a Spinal Mouse® during relaxed standing, maximal trunk flexion in sitting with knees flexed, during a sit-and-reach test, and while sitting on the bicycle with upper-, middle-, and lower handlebar positions.
Results. — The cyclists exhibited a significantly greater lumbar flexion than non-athletes ($P < 0.008$) in the postures evaluated. However, no significant differences were found between athletes and non-athletes while standing. On the bicycle, in all three handlebar positions, the cyclists showed a greater lumbar curvature than did the controls (25.33°, 26.02° and 28.47° in cyclists versus 22.27°, 23.04°, and 25.25° in sedentary subjects, respectively).
Conclusions. — Cycling produces specific adaptations in lumbar curvature when trunk flexion postures are achieved. Cyclists exhibit greater lumbar flexion than non-athletes in maximal trunk flexion and while sitting on the bicycle. However, cycling training does not appear to influence standing lumbar curvature.

* Corresponding author.
E-mail address: josemuyor@ual.es (J.M. Muyor).

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MOTS CLÉS
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Posture

Résumé
Objectif. — Comparer la courbure lombaire dans plusieurs postures entre cyclistes d'élite et sujets non sportifs.
Méthodes. — Un total de 60 cyclistes et 68 sujets sédentaires (groupe témoin), d'âges similaires (moyenne d'âge : 21,94 ± 2,86 ans) ont participé au test en laboratoire. La courbure lombaire a été mesurée avec un Spinal Mouse® en position assise, détendue, flexion maximum du tronc en position assise avec les genoux fléchis, sur le test sit-and-reach et assis sur le vélo avec prise en haut du guidon, prise au niveau moyen du guidon, et prise au niveau du bas du guidon.
Résultats. — Les cyclistes ont démontré une flexion lombaire significative et plus grande que le groupe contrôle ($p < 0{,}008$) dans les postures évaluées. Cependant, on n'a pas trouvé de différences dans la posture position debout. Sur le vélo, dans les trois prises du guidon (haut, moyen et bas), les cyclistes ont montré une courbure lombaire plus grande que le groupe témoin (25,33° ; 26,02° ; 28,47° chez les cyclistes ; 22,27° ; 23,04° ; 24,25° dans le groupe de sujets sédentaires).
Conclusions. — Le cyclisme produit des adaptations spécifiques de la courbure lombaire quand on réalise des postures de flexion du tronc. Les cyclistes ont montré une flexion lombaire plus grande que les non sportifs en posture assise sur le vélo. On peut en conclure que l'entraînement en cyclisme ne paraît pas influer sur la courbure lombaire en position debout.

1. Introduction

Sagittal spinal curvature may adapt gradually to sports during long-term intensive training. Exposure to years of intense training may influence sagittal spinal curvature and range of motion by increasing the spine's exposure to particular mechanical loading [1].

Previous studies have examined sagittal spinal curvature in athletes such as young ballet dancers [2], female rhythmic gymnasts [3,4], skiers [5,6], Roman and freestyle wrestlers [7], soccer players [8], rowers [9,10], paddlers [11—13], recreational weight lifters [14,15], and volleyball players [16]. Other studies have evaluated heterogeneous samples of athletes who differ in their chosen sport of participation [17—21]. These studies reported that spinal curvature may be influenced by the specific and repetitive movements and postures of each sport, although only a few studies have compared athletes to a control group. Moreover, these prior studies have only evaluated standing or sitting but not trunk flexion positions or posture during training sessions.

Sports with a predominance of forward-bending postures (skiing, elite Greco-Roman and freestyle wrestling, and rowing) have been associated with greater thoracic kyphosis in standing [5,7,16]. However, ballet dancers [2] and rhythmic gymnasts [3] have shown reduced thoracic kyphosis and lumbar lordosis. These changes have been associated to specific and repetitive postures during training. The principal posture in cycling is sitting on the bicycle. Usabiaga et al. [22] found that a cyclist's position involves a change from lumbar lordosis in standing to lumbar kyphosis while sitting on a bicycle. Slumped sitting has been associated with greater intradiscal pressure in the lumbar spine [21,23,24]. Moreover, prolonged sitting has been associated with creep deformation in the lumbar viscoelastic tissues [25]. Cyclists spend a large amount of time training on their bicycles to elicit a physiological training effect, and this training may influence lumbar spinal curvature [26,27].

Rajabi et al. [28] found significantly greater standing thoracic curvature in cyclists than in sedentary subjects. Several studies have evaluated spinal posture on bicycles. Ashe et al. [29] analyzed the influence of upright versus flexed posture on cardiovascular and ventilatory variables in untrained cyclists. Usabiaga et al. [22] evaluated lumbar curvature in different cycling positions on several types of bicycles. However, no analysis of other positions was made in these studies. Kolehmainen et al. [30] analyzed the influence of handlebar height during cycling on the cervical and thoracic spine, but no analysis of the lumbar spine was performed.

Because the lumbar curvature in cyclists has not been extensively analyzed in the research literature, the purpose of this study was to compare sagittal lumbar curvature in several positions between elite cyclists and non-athletic subjects.

2. Materials and methods

2.1. Participants

A total of 60 elite male cyclists and 68 age-matched sedentary controls, from 18—27 years old (mean age: 21.91 ± 2.86 years), participated as volunteers in this study. The characteristics of the subjects are shown in Table 1. The inclusion criteria for the cyclists were as follows:

- volume training between 2—4 hours/day;
- frequency of 4—6 days per week;
- a mean experience in cycling training of greater than 4 years.

Table 1 Descriptive characteristics of elite cyclists and control subjects.

	Cyclists group ($n = 60$)	Control group ($n = 68$)
Age (years)	22.95 ± 3.38	20.88 ± 2.34
Stretch stature (m)	1.77 ± 6.01	1.78 ± 6.35
Body mass (kg)	71.62 ± 9.64	74.04 ± 10.14
BMI (kg/m^2)	22.61 ± 2.53	23.22 ± 2.55