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The impact of bicycling on PSA levels: a narrative review

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Abstract

Background: Cycling is a widely popular form of physical activity that may influence serum prostate-specific antigen (PSA) levels, a key biomarker used in the detection and monitoring of prostate diseases. However, it remains unclear whether cycling has an effect on PSA concentrations.

Aim: The aim of this review was to evaluate the effect of cycling on serum PSA levels and to identify factors that may influence changes in PSA after exercise.

Material and methods: A narrative review of PubMed literature focused on the effects of cycling on PSA levels in adult men.

Results: The findings were heterogeneous. Several studies reported small and transient increases in PSA levels, particularly when blood samples were collected immediately after prolonged or intensive cycling. In contrast, other studies found no significant changes in PSA concentrations. Factors such as timing of blood sampling, exercise intensity, and participant characteristics were identified as key determinants of PSA variability.

Conclusions: Cycling does not appear to have a consistent or clinically significant effect on PSA levels. However, transient increases may occur under specific conditions. PSA results should therefore be interpreted with caution in individuals who have recently engaged in physical activity. Further research with standardized protocols is needed to clarify this relationship.

Key words: prostate-specific antigen, PSA, cycling, physical activity, exercise, prostate

1. Introduction

Prostate-specific antigen (PSA) is one of the most frequently used biomarkers in the screening and monitoring of prostate diseases, especially prostate cancer [1]. Although PSA testing remains a key role in clinical practice, its interpretation poses difficulties because PSA levels can be affected by numerous factors such as benign prostatic hyperplasia (BPH), ejaculation, prostatitis, urological procedures, prostate examination or physical activity [2,3]. These variables may potentially lead to false-positive results and unnecessary diagnostic interventions.

Among the various forms of physical activity that may influence PSA levels, cycling seems to be particularly relevant [4–6]. The potential association between cycling and elevated PSA levels has been attributed to direct mechanical pressure on the perineal region and microtrauma induced by contact with the saddle [6]. Additionally, pelvic muscle contraction can compress the prostate and prostatic venous plexus, facilitating the release of PSA into circulation [4].

Available studies have examined the relationship between cycling and PSA levels; however, the results remain heterogeneous. Although some authors have reported temporary elevations in PSA levels following prolonged or intensive cycling [5,7,8], others have observed no significant changes in PSA concentration after comparable forms of exercise [6,9,10]. Furthermore, differences in study design, participant characteristics, cycling duration and intensity, and the time of blood sampling may affect the observed PSA responses and partly explain the heterogeneous results reported in the literature.

A previous systematic review and meta-analysis published in 2015 [11] summarized the available evidence and suggested that cycling does not significantly affect PSA levels overall. However, the limited number of available studies, differences in study design, and the publication of newer studies show that the issue remains inconclusive. Moreover, current clinical guidelines do not provide clear recommendations regarding cycling prior to PSA testing.

Given these uncertainties, a comprehensive and structured synthesis of the existing literature is warranted. The aim of this review is therefore to evaluate current evidence on the effect of cycling on serum PSA levels, to identify potential factors contributing to inconsistent findings, and to discuss the clinical relevance of these observations for everyday urological practice.

2. Research materials and methods

2.1. Data collection.

This narrative review of PubMed literature was conducted using the following terms: (“prostate-specific antigen” OR “PSA”) AND (“cycling” OR “bicycling” OR “bike riding”). In addition, reference lists of relevant previously published systematic review and meta-analysis particularly Jiandani et al. 2015 [11] was screened to identify further eligible studies. All publications underwent an initial assessment followed by full-text evaluation. Studies were included if they evaluated the effect of cycling on serum PSA concentrations in adult men. Articles unrelated to PSA variability or not involving physical activity were excluded. This methodological approach was adopted due to the limited number of available studies.

2.2. A.I.

AI was utilized for two specific purposes in this research. Text analysis of clinical reasoning narratives to identify linguistic patterns associated with specific logical fallacies.

Assistance in refining the academic English language of the manuscript, ensuring clarity, consistency, and adherence to scientific writing standards. AI were used for additional linguistic refinement of the research manuscript, ensuring proper English grammar, style, and clarity in the presentation of results. It is important to emphasize that all AI tools were used strictly as assistive instruments under human supervision. The final interpretation of results, classification of errors, and conclusions were determined by human experts in clinical medicine and formal logic. The AI tools served primarily to enhance efficiency in data processing, pattern recognition, and linguistic refinement, rather than replacing human judgment in the analytical process.

3. Research Results

3.1. Characteristics of included studies.

A total of 11 studies, specifically investigating the effect of cycling on serum prostate-specific antigen (PSA) levels, met the inclusion criteria and were included in the final analysis. The characteristics and main findings of the included studies are summarized in Table 1. The studies varied considerably in terms of sample size, participant age, cycling duration and intensity, type of cycling activity, and timing of blood sample collection. Most investigations were conducted in adult male populations, mainly middle-aged or older men, what corresponds to the group most frequently undergoing PSA testing in clinical practice. The included studies involved different types of cycling activity, ranging from recreational cycling to long-distance races. Additionally, PSA measurements included total PSA (tPSA) and, in several studies, free PSA, with blood samples collected either immediately after cycling or following a resting period.

3.2. Studies reporting PSA increase after cycling.

Several studies included in the present review reported a transient increase in PSA levels following cycling, particularly after prolonged or intensive exercise. The observed elevation was generally gentle and most often associated with long-distance cycling or immediate post-exercise blood sampling.

One of the most frequently cited studies by Mejak et al. (2013) [5] showed a significant increase in total PSA levels after long-distance recreational cycling (55–160 km) in men aged over 50 years. The observed increase was relatively small and was associated with both cycling distance and age, with older participants tending to exhibit greater PSA elevations.

Similarly, Heger et al. (2016) [8] reported significant increases in both total and free PSA following a 53 km cycling effort. PSA concentrations were measured before and immediately after the ride, and the observed elevations, although statistically significant, were temporary. The authors suggested that prolonged saddle pressure and acute physical exertion may explain these short-term PSA fluctuations.

Earlier physiological evidence provided by Oremek and Seiffert (1996) [4], based on standardized bicycle ergometer exercise lasting 15 minutes, also indicated that physical exertion may lead to temporary increases in PSA levels. In this study, serum PSA concentrations were measured before and immediately after the controlled exercise session, and a quantifiable rise in PSA was observed in a large proportion of participants. The magnitude of the increase appeared to be depended on age and was more pronounced among patients with higher baseline PSA values. Although the exercise protocol did not involve long-distance cycling, the findings suggest that even relatively short physical exertion can influence serum PSA concentrations. These results support the concept that short-term physiological or mechanical factors related to exercise can contribute to transient PSA changes.

Additional evidence from controlled exercise studies further supports the possibility of PSA elevation following physical exertion. Kindermann et al. (2011) [12] reported significant increases in both total and free PSA following cycling ergometer testing, with PSA levels typically returning to baseline within 48 hours. However, the study population consisted of older men with elevated baseline PSA levels and enlarged prostate, which may limit the direct applicability of these findings to healthy individuals.

More recent data by Lunacek et al. (2022) [7] demonstrated that, although the majority of participants did not exhibit clinically meaningful changes in PSA following cycling, isolated cases (two individuals) of pronounced PSA increases were observed. This observation highlights the heterogeneous nature of PSA responses to exercise and suggests that individual susceptibility may play a role in post-cycling PSA variability.

3.3. Studies reporting no significant PSA changes after cycling.

In contrast to the studies described above, several investigations did not demonstrate significant changes in PSA levels following cycling. These studies suggest that, under certain conditions, cycling may not considerably influence serum PSA concentrations.

Crawford et al. (1996) [6] evaluated PSA levels in participants of a four-day, 250-mile cycling event and found no significant increase in serum PSA after prolonged endurance

activity. The study include a large cohort of male participants and obtained PSA measurements before and after completion of the multi-day event. Despite the considerable physical effort involved, PSA values remained within clinically acceptable ranges. Notably, this absence of PSA increase occurred despite sustained saddle pressure and repetitive mechanical stimulation over several consecutive days of cycling.

Similarly, Herrmann et al. (2004) [10] investigated the effect of intensive mountain bike racing on serum PSA levels. The study evaluated male participants competing in a mountain bike marathon, representing a form of high-intensity endurance exercise involving prolonged saddle pressure and substantial physical strain. PSA concentrations were measured before and after the race, and no statistically significant changes in total PSA levels were observed following the event. In spite of the demanding nature of the competition and the considerable mechanical stress associated with mountain biking, no statistically significant post-race changes in total PSA concentrations were observed.

In contrast to the competitive and endurance cycling events described above, Luboldt et al. (2003) [13] investigated PSA responses under controlled exercise conditions. The author examined the effect of a 90-minute cycling session in men aged 50–74 years and reported no meaningful differences in total or free PSA levels after exercise. Importantly, PSA measurements were performed both before and after cycling under controlled conditions, further supporting the absence of a clinically relevant effect.

Comparable findings were reported by Saka et al. (2009) [9], who examined PSA responses in endurance cyclists following prolonged cycling activity. In this study, both total PSA (tPSA) and free PSA (fPSA) concentrations were measured before and after exercise. The authors observed no statistically significant changes in either biomarker after cycling, indicating that prolonged physical exertion did not result in measurable alterations in serum PSA levels. These results suggest that even sustained endurance cycling does not necessarily lead to increases in PSA concentrations. Overall, these studies indicate that cycling does not uniformly result in increased PSA concentrations and that, in many cases, PSA values remain stable despite prolonged or intensive physical activity. Importantly, the absence of change was observed for both total and free PSA, suggesting that cycling did not influence the relative distribution of PSA fractions in the circulation.

Collectively, these studies indicate that cycling, even when prolonged or performed under competitive conditions, does not uniformly result in measurable modifications in serum PSA concentrations.

3.4. Methodological factors influencing PSA response.

The variability of findings across the included studies appears to be largely influenced by methodological differences. Factors such as cycling duration, exercise intensity, participant characteristics, and, most importantly, the timing of blood sampling played a significant role in the observed PSA responses. Studies that measured PSA immediately after cycling, often within minutes of completing the exercise, were more likely to report increases in PSA levels [4,5,8], whereas investigations with delayed blood sampling often observed no significant changes.

Differences in cycling duration and exercise intensity may also contribute to the heterogeneity of results. The reviewed studies included a wide range of cycling protocols, from short controlled exercise sessions lasting approximately 15 minutes to prolonged endurance events covering more than 250 miles over several days. Such variability in physical exertion may influence the degree of mechanical stimulation of the prostate and the physiological stress experienced during cycling, which has been shown to induce minor and transient changes in PSA levels in response to physical exercise [14].

In addition, differences in study design should be considered. Some investigations were conducted under controlled laboratory conditions, while others evaluated participants during real-world competitive or recreational cycling events. Finally, variations in participant characteristics, particularly age and baseline PSA levels, may further contribute to the inconsistent findings reported in the literature. In particular, differences in the age distribution of participants and baseline PSA values may be especially relevant, as older individuals with higher baseline PSA levels may be more susceptible to exercise-related PSA changes.

3.5. Reference to previous evidence and the 2015 meta-analysis.

Previous evidence investigating the relationship between cycling and serum PSA levels remains limited and heterogeneous. A systematic review and meta-analysis conducted by Jiandani et al. (2015) [11] synthesized the available data and concluded that cycling does not appear to have a significant overall effect on PSA levels. However, the number of included studies was relatively small, and considerable differences in study design, participant characteristics, and exercise protocols were noted.

In comparison, the findings of the present review are consistent with these earlier observations, as both increases and no significant changes in PSA levels were reported across

individual studies. Importantly, several more recent investigations published after 2015 have provided additional insights, highlighting the potential role of factors such as exercise intensity, timing of blood sampling, and individual susceptibility in influencing PSA responses to cycling. These findings suggest that, despite the overall neutral effect reported in the meta-analysis, transient PSA elevations may still occur under specific conditions.

Table 1. Characteristics and main findings of studies investigating the effect of cycling on serum PSA levels

Author (Year)	Study type	Sample size	Population	Cycling / exercise protocol	PSA timing	Main finding	Category
Oremek & Seiffert (1996)	Experimental	301	Male outpatients	15-min bicycle ergometer test	Before and immediately after race	PSA increased (age-dependent)	Increase
Crawford et al. (1996)	Observational	260	Men aged 30–72 years	4-day, 250-mile cycling event	Before and after multi-day cycling event	No PSA increase	No significant change
Luboldt et al. (2003)	Experimental	33	Men aged 50–74 years	13-mile tour / 90 min cycling	Before and after controlled cycling session	No changes in tPSA, fPSA or %fPSA	No significant change
Herrmann et al. (2004)	Observational	42	Healthy male mountain bikers	120-km off-road mountain bike race	Before and after race	No changes in tPSA, fPSA or cPSA	No significant change
Lippi et al. (2005)	Experimental	143 (69 cyclists, 31 skiers, 43 controls)	Professional cyclists, cross-country skiers, sedentary controls	Regular strenuous exercise with/without cycling	Before and after exercise	No differences in PSA or fPSA between groups	No significant change

Author (Year)	Study type	Sample size	Population	Cycling / exercise protocol	PSA timing	Main finding	Category
Saka et al. (2009)	Observational	58 (34 cyclists, 24 controls)	National-team cyclists and healthy male volunteers	Rigorous bicycling / 300-km effort	Before and after endurance cycling	No changes in tPSA, fPSA or f/t PSA ratio	No significant change
Kindermann et al. (2011)	Experimental	21 (treadmill subgroup n=15)	Older men with elevated PSA and BPH	1-h cycling ergometer; subgroup also 1-h treadmill	Before and immediately after exercise, with follow-up at 48 h	Significant PSA rise after cycling and smaller rise after treadmill; usually back to baseline within 48 h	Increase
Mejak et al. (2013)	Observational	129	Healthy men aged 50–71 years	Recreational ride, 55–160 km	Before and within 5 min after cycling	Mean tPSA increase of 9.5% (0.23 ng/mL); associated with age and distance	Increase
Jiandani et al. (2015)	Systematic review & meta-analysis	8 studies / 912 participants	Adult men across included studies	Cycling exposures from 15 min to 4-day events	Not applicable	No significant overall effect in meta-analysis; evidence limited by small, varied studies	No significant change
Heger et al. (2016)	Experimental	14	Healthy men aged 49–57 years	53-km ride (~150 min)	Before and immediately after cycling	Transient increases in tPSA and fPSA	Increase
Lunacek et al. (2022)	Randomized study	101	Healthy men aged 20–80 years	1-h stationary cycling vs rowing	Before and after exercise	Average tPSA rose modestly (+8.8%); clinically irrelevant	Mixed / mostly no clinically relevant change

4. Discussion

The present review demonstrates that the relationship between cycling and serum prostate-specific antigen (PSA) levels remains inconclusive. While several studies have reported modest and transient increases in PSA following cycling, others have found no significant changes in PSA concentrations. Overall, the available evidence suggests that cycling does not consistently lead to clinically relevant elevations in PSA levels. This inconsistency highlights the complexity of the issue and the need to interpret available findings in the context of existing evidence.

These observations are broadly consistent with previous evidence. A systematic review and meta-analysis by Jiandani et al. (2015) [11] concluded that cycling does not appear to have a significant overall effect on PSA levels. However, the number of included studies was limited, and important differences in study design and methodology were noted. Since then, additional studies have been published, providing further insight into this topic. More recent investigations have confirmed that PSA responses to cycling may vary depending on specific conditions. For example, Heger et al. (2016) [8] demonstrated transient increases in both total and free PSA immediately after cycling, whereas Lunacek et al. (2022) [7] reported no significant overall changes, although individual cases of PSA elevation were observed. These newer findings not only support the heterogeneous nature of the available evidence but also suggest that the effect of cycling on PSA levels may be influenced by factors such as exercise intensity, timing of blood sampling, and individual susceptibility.

The differences between study results may be explained by several methodological and physiological factors. One of the most important factors is the timing of blood sampling. Studies that measured PSA immediately after cycling, typically within the first few minutes after exercise, were more likely to report temporary increases in PSA levels [4,5,8]. In contrast, studies in which blood samples were not collected immediately after exercise, or in which the timing of post-exercise sampling was not clearly defined, often found no significant changes [6,9,13]. Importantly, some evidence suggests that PSA levels may return to baseline within 24–48 hours after exercise [12], indicating that the observed increases are transient. In addition, the duration and intensity of exercise may also play an important role, as longer and more intensive cycling can lead to greater mechanical pressure on the prostate and increased physiological stress. Studies involving prolonged or high-intensity cycling, such as long-distance rides, were more likely to report transient increases in PSA levels [5,8]. In contrast,

shorter or controlled exercise sessions were less frequently associated with measurable changes in PSA concentrations [13]. This suggests that the magnitude of physical exertion may influence the extent of PSA response. Furthermore, differences in study design should also be considered, as some studies were conducted under controlled conditions, while others were based on real-life cycling events. Controlled studies allow for better standardization of exercise intensity and duration, but may not fully reflect real-world conditions. In contrast, studies based on actual cycling events involve more variable and less predictable conditions, which may influence PSA responses. Finally, differences in participant characteristics should also be taken into account. Most studies included either healthy individuals or trained cyclists, whereas others involved older men with elevated baseline PSA levels or enlarged prostate. These differences may influence the observed PSA response, as individuals with higher baseline PSA levels or underlying prostatic conditions may be more susceptible to exercise-related changes [12]. Taken together, these findings suggest that the variability in reported results is likely driven by a combination of methodological and physiological factors rather than the effect of cycling alone.

From a clinical perspective, the available evidence suggests that cycling does not have a consistent or clinically significant effect on PSA levels. However, transient increases in PSA may occur, particularly when blood samples are collected immediately after exercise. Therefore, it may be reasonable to advise patients to avoid vigorous physical activity, including cycling, for at least 24–48 hours before PSA testing in order to minimize the risk of false-positive results. Although current clinical guidelines do not provide specific recommendations regarding physical activity prior to PSA testing, this precaution may be particularly relevant in individuals with elevated baseline PSA levels or those undergoing diagnostic evaluation for prostate disease.

Several limitations of the present review should be acknowledged. First, the number of available studies investigating the effect of cycling on PSA levels remains limited. In addition, the included studies differed considerably in terms of study design, participant characteristics, and cycling protocols, which makes direct comparison difficult. There was also a lack of standardization in key methodological aspects, particularly regarding the timing of blood sampling after exercise. Furthermore, many studies included relatively small sample sizes, which may reduce the reliability of their findings. Finally, most studies were observational or experimental in nature, with a limited number of high-quality controlled trials available.

5. Conclusions

In conclusion, the available evidence suggests that cycling does not have a consistent or clinically significant effect on serum PSA levels. Although transient increases in PSA may occur, particularly following intensive or prolonged exercise, these changes appear to be temporary and influenced by factors such as the timing of blood sampling and individual characteristics. Overall, the current findings indicate that PSA measurements should be interpreted with caution in the context of recent physical activity. Further well-designed studies with standardized protocols are needed to better understand the relationship between cycling and PSA levels.

Disclosure

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