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Original Research

Screening for Incidence and Effect of Pelvic Floor Dysfunction in College-Aged Athletes

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Background

Pelvic floor dysfunction (PFD) occurs when muscles of the pelvic floor become weakened, impaired, or experience tension leading to a variety of complications. Due to the reactive nature and high demands of many sports, athletes are at increased susceptibility and of particular interest concerning PFD.

Hypothesis/Purpose

The purpose of this study was to explore the prevalence of PFD among college-aged athletes, assess how PFD impacted athletic performance, and identify contributing factors for increased likelihood of PFD in athletes.

Study Design

Cross-Sectional Study

Methods

All fully active LVC NCAA Division 3 athletes were recruited for screening for PFD using the Cozean Pelvic Dysfunction Screening Protocol and were surveyed on their self-knowledge of PFD. Athletes who scored ⩾ 3 on this tool completed an additional survey, created by the investigators, to identify the impact PFD had on their athletic performance and personal life and were then randomly assigned to one of three investigators to undergo a noninvasive coccygeal assessment to determine underactive, overactive, or normal pelvic floor muscle (PFM) activity.

Results

Fifty-three Division III male and female athletes between the ages of 18-25 years old participated in the study. Statistically significant differences were found between Cozean scores and demographic factors of age (p <0.001), gender (p <0.05), self-knowledge of PFD (p <0.001), and sport (p <0.001) among all participants that contributed to the increased likelihood of PFD. Thirteen athletes scored ⩾ 3 on the Cozean with the 92.3% experiencing under/over active PFM activity and the majority indicating that PFD significantly impacted their athletic performance and quality of life.

Conclusion

The results indicate that older female NCAA Division III college athletes who participate in swimming and who possess self-knowledge of PFD are more likely to experience PFD. Additionally, these athletes are likely to encounter a significant impact on their athletic

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performance and quality of life. These results provide preliminary evidence on the need of PFD awareness and assessment among college athletes.

Level of Evidence

Level 3b

INTRODUCTION

The pelvic floor and its associated musculature function to support and stabilize surrounding structures, aid in sexual function, act as a sphincter, assist in lymphatic return, and affect posture and breathing mechanics.[1] The pelvic floor musculature (PFM) is deeply interconnected with the rest of the human anatomy and functions similarly to other skeletal muscles.[2] As a result, injury or dysfunction can occur. Pelvic floor dysfunction (PFD) occurs when the structures of the pelvic floor are weakened, tense, or impaired, leading to a variety of symptoms and complications.[3] Common symptoms of PFD include, but are not limited to, urinary (most common) or anal incontinence, pelvic pain, and sexual dysfunction.[4,5] To treat PFD, physical therapists use manual therapy, strengthening, and conditioning through exercise prescription to mitigate pain and other symptoms.[6] Pelvic floor physical therapists treat a variety of other conditions including general PFM (classified as underactive or overactive), endometriosis, vaginismus, pelvic organ prolapse, and pre/post-natal care to name a few.[7]

Athletes are of particular interest when it comes to PFD. Rebullido, et al. found that high-impact sports involving jumping, landing, or running show the highest prevalence rates of urinary loss among young female athletes.[8] Additionally, Rodríguez-López, et al. found that female professional athletes carry a three times greater chance of experiencing urinary incontinence (UI) in comparison to non-active women.[9] Due to the reactive nature and high demands of college athletics, college athletes are theoretically more susceptible to PFD and associated incontinence. Consequently, an overall prevalence of PFD has been reported to be seen in as high as 33% of athletes including 45% in females and 14.7% in males.[5] Aside from the physical aspects of PFD, athletes may also experience embarrassment or anxiety commencing a domino effect that leads to a decline in athletic performance and overall quality of life (QoL).

As the research continues to amass regarding PFD, there are still many areas within the field that are severely understudied. To begin, a limited number of PFD studies include men as subjects. When men are included, the studies often feature a smaller number of male participants compared to females.[9] This is concerning considering the similarities in clinical presentation between males and females. A second area lacking research is the impact PFD may have on an athlete's performance and QoL. One meta-analysis found an association between UI and lower quality of life (QoL) scores.[10] However, this study had limitations as it solely focused on UI without considering other PFD symptoms or diagnoses. Additionally, many studies included in the meta-analysis were at high risk of bias as individuals prone to developing UI are also at risk for comorbidities that might negatively impact QoL.[10]

The purpose of this study was to explore the prevalence of PFD among college-aged athletes, assess how PFD impacted athletic performance, and identify contributing factors for increased likelihood of PFD in athletes.

METHODS

In this cross-sectional study data were collected from participants through an in-person screening to provide a comprehensive overview of the characteristics and behaviors of the selected population. This approach was chosen to describe the current status of Lebanon Valley College (LVC) athletes rather than attempting to determine causation of PFD or provide information about changes over time. As typical in descriptive studies, a survey was deployed to collect demographic information and data on the prevalence of PFD. The institutional review board (IRB) at LVC, IRB (#2023-12), approved this study.

Participants were recruited by convenience sampling through electronically messaging all twelve men's and all thirteen women's LVC NCAA Division 3 sports teams. Athletes were encouraged to attend one of three screening sessions that were being held throughout the course of one day at the LVC athletic Field. In order for a participant to be included in the study, they were required to be a current LVC student and a fully participating, NCAA Division 3 varsity team member. There were no restrictions on participant playing vs. bench time when determining inclusion criteria for this study. Individuals were excluded from the study if they were not a current LVC student, not a fully participating NCAA Division 3 varsity team member, or if they played a sport in a previous year of college but were not fully participating at the day/time screenings were completed. Informed consent was obtained at the beginning of the screening process.

The screening process had two parts. The first part served to gather demographic information and a Cozean Pelvic Dysfunction Screening Protocol (Cozean) score from all participants. Characteristics such as age, sex assigned at birth, self-identified gender, sport team participation, participant's general knowledge of PFD/PFM (assessed on a 0-10 scale) were obtained via a demographic survey questionnaire. The Cozean score was obtained from administrating the Cozean survey. The Cozean survey was established in 2018 by Nicole Cozean and Jesse Cozean and includes ten questions regarding signs and symptoms of PFD (Appendix A).[11] If applicable, the participant checks the box next to the related statement and the sum of the total number of boxes checked equals a score (0-10). The Cozean was utilized in this study as there is a 91% specificity

indicating possible PFD in individuals who score greater than or equal to 3 at the end of the survey.[11]

Due to the specificity noted above, the second part of the screening process was administered only to participants who scored 3 or greater on the Cozean. The second screening sought to obtain individual participant ratings, on a 0-10 scale, of the impact PFD had on their athletic performance and personal life and if the influence of PFD made them feel embarrassed, anxious/worried, annoyed, and/or frustrated. This data was obtained from administration of an additional survey drafted by the investigators (Appendix B).

All participants who completed the second screening were then randomly assigned to one of three investigators to undergo a coccygeal motion palpation (CMP) assessment. These three investigators were trained by a Certified Pelvic Rehabilitation Practitioner and an American Board of Physical Therapy Specialties Certified Women's Health Specialist physical therapist to identify the contraction, release, and lengthening of pelvic floor muscles through this objective, external, and noninvasive assessment. The CMP is a valid screening assessment that has been previously found to have a 94% sensitivity and 79% specificity in identifying underactive, overactive, or normal PFM activity.[12] To begin the CMP, participants were placed in a seated position. Next, external palpation of the PFM occurred by the investigator placing the palmar side of their hand over the base of the participant's sacrum and informing the participant that the tip of their coccyx would be palpated by the investigator's finger tip. Following this, participants were verbally instructed to initially contract, then bear down, and then to do nothing to their PFMs. As the participant completed each command, the investigator determined whether the participant was presenting with underactive, overactive, or normal PFM activity. Overactive PFM activity was determined if minimal movement with contraction and lengthening occurred due to the muscles being in a hypertonic state. Underactive PFM activity was determined if increased movement with contraction and lengthening occurred due to the muscles being in a hypotonic state. Normal PFM activity was determined if no indications of a hypertonic or hypotonic state were present. It is important to note that all determinations of participant PFM activity by the three investigators were confirmed from a second CMP assessment completed by the Certified Pelvic Rehabilitation Practitioner and an American Board of Physical Therapy Specialties Certified Women's Health Specialist physical therapist. All assessors were in agreement with the determinations of participant PFM activity to be used for scoring and comparisons.

Data were transferred from paper format into IBM Statistical Package for the Social Sciences (SPSS) version 28 for analysis. In order to examine the results thoroughly, the data were analyzed in two different subgroups. The first subgroup included all 53 participants, and the second only included participants who scored 3 or more on the Cozean. Data of all 53 cases were examined for normalcy and outliers prior to completing analyses. For both subgroups, Pearson correlation coefficients were calculated for the relationship between participant's age and Cozean score and a participant's indicated knowledge of PFD and Cozean score. Additionally, an independent-samples *t* test was calculated comparing the mean Cozean scores of those who identified themselves as male and those who identified themselves as female, and a one-way ANOVA comparing participants' Cozean score and their current sport involvement (swimming, football, and other) were calculated. Effect sizes for statistically significant outputs were determined by computing the coefficient of determination (r^2) for Pearson correlation analyses (r^2 values < 0.25 and ⩾ 0.09 indicate a moderate effect), Cohen's D for independent-samples *t* test (⩾ 0.80 indicates a large effect), and eta squared (η^2) for one-way ANOVA analysis ($\eta 2$ values < 0.25 and ⩾ 0.09 indicate a moderate effect).[13] The hypotheses were tested based on the statistical significance criteria of a pre-established (a priori) probability alpha (α) level of α = .05.

RESULTS

The age range of participants was between 18-25 years-old. All participants individually responded that their sex assigned at birth and identified gender were identical. Therefore, the participants were composed of 37 males and 17 females. Participants identified they were currently playing the following sports: football (31), swimming (14), track and field and cross country (3), dance (2), tennis (1), golf (1), and soccer (1). Due to the decreased number of participants in sports, the demographic variable of sport was categorized into three main groups; football, swimming, and other. The average of participant knowledge of the pelvic floor was 2.68/10. Lastly, 24.5% of the participants scored ⩾ 3 on the Cozean. Table 1 outlines participant demographics.

Concerning the first subgroup, a moderate positive correlation was found ($r(51) = .391$, $p < 0.001$), indicating a significant relationship between age and Cozean score (Table 2). Older participants tended to score higher on the Cozean. The effect size (r^2) is 0.153, indicating a moderate effect.

A significant difference in Cozean scores between the males and females was found ($t(51) = -3.959$, $p < 0.05$) (Table 3). The effect size was calculated for this analysis and found to be large ($d = 1.81$).

A significant difference in Cozean scores was found among the sport categories ($F(2, 50) = 8.288$, $p < 0.001$). A moderate effect size for the Analysis of Variance model was calculated ($\eta^2 = 0.249$). Tukey's HSD was used to determine the nature of the differences between the sports. This analysis revealed that participants who played football scored lower ($M = 1.29$, sd 0.82) than participants who played swimming ($M = 2.86$, sd 1.61), indicating a higher frequency of PFD symptoms in swimming athletes as compared to football athletes. Participants who played all other sports ($M = 2.5$, sd 2.0) were not significantly different from either of the other two groups (Table 4).

A moderate positive correlation was found ($r(51) = .431$, $p < 0.001$), indicating a significant relationship between participants who indicated increased knowledge of PFD and

Table 1. Participant Demographics *N* = 53

Demographic	Frequency	Percentage
Age		
18	3	5.7
19	11	20.75
20	11	20.75
21	11	20.75
22	12	22.64
23	4	7.55
25	1	1.89
Sex		
Male	37	69.81
Female	16	30.19
Sport		
Football	31	58.49
Swimming	14	26.42
Tennis	1	1.89
Cross Country/Track and Field	3	5.66
Soccer	1	1.89
Dance	2	3.77
Golf	1	1.89
Cozean Score		
0	6	11.32
1	20	37.74
2	14	26.42
3	5	9.43
4	5	9.43
5	1	1.89
6	2	3.77
Self-knowledge about PFD		
0	11	20.75
1	10	18.89
2	8	15.09
3	4	7.55
4	3	5.66
5	11	20.75
6	4	7.55
7	2	3.77

Table 2. Pearson Correlation Between Age and Cozean Score

		Cozean Score
Age	Person Correlation	.391
	Sig. (2-tailed)	0.004
	N	53

Cozean score. The effect size (r^2) is 0.186 indicating a moderate effect.

For the second subgroup, 13 out of the 53 participants (25%) scored 3 or greater on Cozean. Of the 13, 53.8% had underactive PFM and 38.5% had overactive PFM, as assessed by the CMP, for a total of 92.3% of the second subgroup population. No statistical significance was found amongst the demographic variables with the second subgroup of participant analysis. Of this subgroup, 69% felt embarrassed, anxious/worried, and annoyed, while 61.5% felt frustrated. In addition, 69% reported that PFD had a discernible effect on their athletic performance and 77% indicating a negative impact on their personal life.

DISCUSSION

Data analysis of the subgroup including all 53 participants showed that the factors of age, sex, sport, and self-knowledge were significant in a participant scoring ⩾ 3 on the Cozean. Despite the participant age range of 18 to 25, there was still a notable difference in older participants exhibiting higher scores on the screening tool. These findings highlight and advance the importance of age as a significant factor in predicting PFD.[14] For healthcare clinicians, this relationship has practical implications when conducting pelvic dysfunction screenings on college-aged athletes. Previous research has linked increased age to pelvic floor dysfunction in both males and females.[15] This finding demonstrates that trends continue to exist in younger populations.

In this study, gender differences did impact Cozean scores. This was consistent with prior research as it highlights that gender must be considered in the context of PFD screening.[16] The large effect size suggests that this distinction is not due to chance. It is important to note that this study was able to identify this difference when the number of male participants was double the number of females. This factor helps to fill a major gap in PFD research in a

Table 3. Gender Independent-Sample t Test Statistics

Levene's Test for Equality of Variances					Significance	
	F	Sig.	*t*	df	One-Sided *p*	Two-Sided *p*
Equal variances assumed	22.656	<0.001	-3.959	51	<0.001	<0.001

Table 4. ANOVA Statistics for Sport

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	27.219	2	13.610	8.288	<0.001
Within Groups	82.101	50	1.642		
Total	109.321	52			

male population.[17,18] Medical providers should be aware of these gender-based differences when evaluating and addressing PFD in athletes.

A key element identified in this study was the impact an athlete's sport may have on their PFM. The analysis revealed that participants who played football scored significantly lower on the Cozean compared to those who participated in swimming. This result suggests that not all sports have an equal impact on Cozean scores indicating that physical activity and demand of sport plays a factor in PFM health.[19,20] These results necessitate further research into the specific factors within each sport that may influence PFD. Such research could have implications for coaching and athlete development, as well as interventions aimed at raising awareness of symptoms of PFD dysfunction within the sporting community.

Another key element in the first subgroup of data analysis was the significant relationship between a participants' self-indicated knowledge of PFD and their Cozean score. This moderate effect size suggests that those who have greater knowledge of the pelvic floor tended to achieve higher scores on the Cozean. This is consistent with a prior study that investigated the impact of education and knowledge on symptoms of PFD.[4] These results underscore the critical role of patient education and awareness in the context of pelvic dysfunction. By healthcare providers and clinicians providing education to patients, they are more likely to self-identify symptoms.[21] This may lead to earlier detection and management of pelvic dysfunction should it be present.[22] By equipping providers with the tools to educate patients, there is an aim to facilitate early symptom recognition and encourage individuals to seek medical assistance at an earlier stage and mitigating the development of chronic issues.

Analysis in the second subgroup concluded that 12 of the 13 participants who scored ⩾ 3 on the Cozean had an over/under active PFM on external palpatory confirmation testing. This indicates that the Cozean screening tool accurately identified those at an increased likelihood of having PFD, achieving a 92.3% accuracy rate in identifying those with PFD based on the 10 screening tool questions.[11] With the Cozean having a 91% specificity, the current data reinforces the screening tool's effectiveness in correctly identifying individuals with conclusive PFD among those who scored ⩾ 3.[11]

In regards to the 13 individuals who scored ⩾ 3 on the Cozean, no significant difference between demographic variables and Cozean scores was found. This could indicate that regardless of gender, sport, age, and self-knowledge of PFD, individuals experience a similar impact of symptoms or likelihood factors associated with PFD. However, it is important to note that while impact is similar, the prevalence may vary.

Aside from physical symptoms, athletes with PFD experience a strong psychological component thus impacting their mental health.[23] These effects were truly self-determined, as at that time during the screening process, there was no hands-on evidence to provide determination of PFD. Based on these results, there is evidently a strong psychosocial factor that has a negative impact on quality of life. From the athlete's perspective, negative feelings about their symptoms may lead to a poor societal image, diverting attention away from their athletic performance, which was also shown to be impacted by the results of this study.

The above findings can be very beneficial to understand with application to future athletic screenings. Factors such as age, sex, sport, and self-knowledge must be considered, as these were found to be related to Cozean scores. If athletes experience symptoms of PFD, it can be reassuring for them to know that this is not uncommon and that deficits can be addressed with pelvic floor interventions.[24] As noted, addressing the psychological component of PFD is vital in ensuring that coaches/trainers are advocating for mental health. This reassurance could decrease anxiety or fear of being socially outcasted due to PFD.

Limitations to this study which should be considered when interpreting the results include the method of convenience sampling, potential reporting bias, and lack of private setting for external examination. A convenience sampling method was used due to time and geographic constraints. As a result, the sample is not representative of the entire population of collegiate athletes (only Division III athletes) and generalizability may be diminished. The recruitment method led to an unequal distribution of participants across the various sports studied, and some sports were not included at all, further limiting generaliz-

ability. The validated Cozean survey used to collect data included questions of a private nature related to symptoms of PFD. The inherently sensitive nature of these questions may have led to underreporting or misrepresentation of symptoms due to social or self-image pressures. This potential bias could impact the accuracy and completeness of the data collected. Finally, the absence of a private setting during the data collection process may have contributed to the potential reporting bias mentioned above. Although this is the standard of care, a private setting for the external palpation was unavailable for the completion of this study. As a result, participants may have felt uncomfortable, distracted, self-conscious, anxious, stressed, or embarrassed when providing their responses which could have influenced the accuracy of the data. By ensuring a more private, confidential, supportive, and safe treatment/assessment area may lead to more honest and accurate responses.

This study has highlighted the need for future research regarding PFD and how it affects college-aged athletes. As topics surrounding the PFM are sensitive in nature, future screenings, similar to the assessments completed in this study, should be conducted in a private setting. Utilizing separate rooms or using curtains would improve this investigation by increasing privacy to help ensure that participants feel comfortable and relaxed. This would enhance the accuracy of participant responses. Additionally, an increase in the number and variety of participants in a similar study would amplify the findings and improve upon generalizing results. Lastly, while personalized treatments, education, and interventions used to treat PFD are already known to be effective, a future study could assess the impact of a generalized recommendation of 3-4 exercises for the broad categories of either underactive or overactive PFM.

CONCLUSION

The results of the current study demonstrated that older female NCAA Division III college athletes who participate in swimming and who possess self-knowledge of PFD are more likely to experience PFD. Additionally, these athletes are likely to encounter a significant impact on their athletic performance and quality of life. These results provide preliminary evidence on the need of PFD awareness and assessment among college athletes.

CONFLICTS OF INTEREST

The authors report no conflicts of interest.

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SUPPLEMENTARY MATERIALS

Appendix A

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Appendix B

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