Original Article

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Urinary incontinence and risk factors among Croatian female athletes - a pilot cross-sectional observational study

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Abstract: *Introduction:* Urinary incontinence (UI) in female athletes (FA) is a globally concerning but neglected topic in Croatia. The purpose was to examine the occurrence and severity of UI in Croatian FA and occurrence-associated factors. *Methods:* In May 2022, an anonymous online survey collecting general sports characteristics and the Incontinence Questionnaire-Urinary Incontinence Short Form (ICIQ-UI SF) were sent to individual FA. Obtained data were analysed with the PSPP program: chi-square test, t-test and analysis of variance with a defined significance level of $p < 0.05$. *Results:* The presence of UI in the total sample of 70 FA competing in 12 different sports is 24.3 %: 8 (29.6 %) handball players, 3 (42.9 %) tennis players, 2 (40 %) water polo players, one (14.3 %) synchronised swimmer, seven soccer players (14.3 %), one weightlifter (50 %) and the only swimmer (100 %). According to ICIQ-UI SF, in 70.59 % of FA with UI, a small amount of urine leaks approximately once a week or less often, mainly after urination and dressing up (35.29 %). The UI interference with quality of life is mild (70.59 %) and moderately severe (29.41 %), and the UI severity is slight (47 %) to moderate (53 %). Smokers report UI to a greater extent ($\chi 2(1, n = 70) = 4.666$, $p < 0.05$), while other sports and FA characteristics did not yield significant findings. *Conclusions:* UI is present in a quarter of examined Croatian FA, with mild to moderate severity. It mildly interferes with the quality of life and seems to be associated with smoking. Our findings contribute to preserving women's health in sports and apply to UI assessment in FA and counselling on smoking cessation as a proven UI risk.

Keywords: athlete, female, physical therapy speciality, urinary incontinence

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INTRODUCTION

Urinary incontinence (UI) describes the complaint of involuntary loss (leakage) of urine, typically related to bladder or pelvic floor muscle dysfunction [1]. UI symptoms substantially affect health-related quality of life and are associated with considerable personal and societal expenditure [1]. It is often characterised by symptoms of stress UI [2], the complaint of involuntary leakage during effort or exertion [3]. UI occurs in both sexes [1]; however, its prevalence is far higher in females [1], affecting one-third of adults [3]. Although a significant and sensitive problem discussed globally, UI in females is a relatively neglected topic in Croatia. Considering those, as mentioned earlier, personal and social sequels and the impaired quality of life, the problem of UI in females as a more vulnerable group should be approached with particular attention.

A particularly vulnerable group of females for the emergence of UI are athletes. Evidence implies that sports practice increases the prevalence of UI [2], with athletes having a 177 % higher risk of presenting UI than sedentary females [4]. Considering the goals and nature of competitive sports, athletes are under continuous physical and psychological exertion. In terms of the female body, physical effort and labour are risk factors for UI because of increased intra-abdominal pressure generated during highly demanding physical activity, thus overloading the pelvic organs and predisposing them to UI [4]. The combination of increased intra-abdominal pressure, neuromuscular fatigue, and overloaded pelvic floor musculature due to strenuous training might lead to involuntary urine leakage in female athletes [5], and that could be the reason for the incontinence prevalence ranging from 10.88 % to 80 % [2].

Regarding sports-related factors, UI in female athletes is related to the training volume and body impact [2]. Females participating in an organised exercise involving high-volume training to compete are potentially at risk of developing UI, while organised exercise undertaken without the intent to compete is safe for maintaining urinary continence [6]. High-impact sports increase the risk for UI [5], with a 1.9-fold prevalence over medium-impact activities and a 4,59-fold prevalence over low-impact activities [2]. Still, outside the context of sports, personal factors related to health and lifestyle are also known to influence the occurrence of UI in females, which, combined with sports-related elements, further increases the risk. The most significant risk factors for UI in young to middle age females are parity, childbirth, age, obesity, previous deep abdominal surgery (i.e. gynaecological interventions, abdominal trauma) [7,8], diabetes mellitus, cigarette smoking [8], caffeine consumption [4] and oral contraceptives use [9]. Obesity and diabetes are distinctly rare characteristics of female athletes; however, oral contraceptives are widespread, ranking between 20 and 70 per cent [10]. Although there is no data concerning female athletes, the prevalence of cigarette consumption among females, in general, is very high [11], assuming that it is somewhat less in athletes, given the prerequisite of a healthy lifestyle.

Abdominal injuries in athletes range in severity from abdominal strains to internal bleeding [12], and intra-abdominal injuries, most commonly occurring in a collision or contact sports, may require surgery, particularly for more severe traumas involving the liver, kidney, or spleen [13]. Musculoskeletal trauma or injuries are most often seen in athletes; however, the increase in female rate is specifically related to body structure and can be attributed to intrinsic factors such as ligamentous laxity, hormonal influences, biomechanical alignment, and intercondylar notch width [14]. Their surgical treatment depends on the severity and the impossibility of conservative treatment until complete recovery. In general, surgical care is associated with inevitable anaesthesia, where it is necessary to emphasise that impairment in bladder function and urination control are significantly higher in female patients receiving spinal anaesthesia than those receiving general anaesthesia [15].

The existence and risk factors for developing UI in female athletes are indisputable and confirmed by empirical evidence. UI occurrence is reported in many sports and may interfere with everyday life or training, leading female athletes to change or compromise their performance or risk compromising it [2]. Considering its sequels, the possible existence of UI or the risk of the onset of UI in female athletes must be addressed promptly. Given that the UI issue has not been observed in Croatian female athletes, this pilot cross-sectional study aimed to investigate the occurrence and severity of UI in Croatian FA and occurrence-associated factors in this population. From the aim of the research, the following main research questions arose: (i) how prevalent is UI among Croatian female athletes, (ii) what is UI frequency, severity and impact on quality of life in affected female athletes and (iii) which sociodemographic, anthropometric, medical and sport-related factors are associated with UI occurrence. In general, this research will provide insight into a neglected female issue in Croatia. Considering the specific population and possible factors covered with the research questions, the findings are expected to contribute to the broader sports community and female athletes in general.

MATERIALS AND METHODS

Study design

The research was designed as a pilot cross-sectional observational, including an online survey. Following the study design, an effort was made to follow STROBE recommendations.

Participants

Professional female athletes from Croatia actively participating in various competitive sports (i.e. not retired, on longer sick, pregnancy or maternity leave) were invited to participate in the survey. The respondents were expected to understand Croatian in speech and letter, be technologically literate, and be cognitively and physically able to answer the survey requirements, including consent. The study participants were aged 18 to 36 years (22.64 ± 4.55). Criteria for inclusion in the research analysis were confirmation of the female sex, age >18, informed consent and a completely filled-out survey. The participants were asked politely to give honest and accountable answers so that we could comply with the Ethical Principles and, in case of ineligibility, exclude them from the analysis.

Ethics

This cross-sectional survey was conducted in May 2022 in an online environment. In this research, only an online survey was used, which did not include any questions that would require ethics approval. By participating in a survey, all participants agreed for their data to be used in research. The study is in line with the principles established by national and international regulations, including the Declaration of Helsinki and the Code of Ethics. All personal data was handled following Regulation (EU) 2016/679 of the European Parliament and of the Council of April 27 2016, Organic Law 3/2018 of December 5 on the Protection of Personal Data and guarantee of digital rights, and the Croatian National legislation.

Methods

Using the snowball method, an anonymous online Google survey was distributed to female athletes through social networks in May 2022. From sociodemographic and anthropometric data, age, height and weight were collected, according to which the Body Mass Index was calculated. Data related to sports managed were the level of competition, years of entry into competitive sports and professional experience, amount and frequency of daily, weekly and seasonal training, weight lifting and additional vigorous physical activity in free time. In addition to the previous one, data was collected on the number of

competitions on a weekly and monthly level and rest time on a daily and seasonal level. Medical data included the existence or non-existence of urogenital problems (i.e. frequent infections), constipation, parity, oral contraception use, smoking and history of epidural or spinal anaesthesia.

The Croatian Incontinence Questionnaire-Urinary Incontinence Short Form (ICIQ-UI SF) [16] was used simultaneously (with permission). The ICIQ-UI SF evaluates the severity of UI symptoms and their impact on health-related quality of life; a total ICIQ score with a range from 0–21 is achieved from three questions (Q); Q1 quantifies the frequency of urinary leaking, Q2 evaluates the amount of urine leaking, and Q3 defines on how much the urinary incontinence interferes with the everyday life [17]. The occurrence of UI is established according to the response questions mentioned above; when the sum of values from these questions is ≥ 1[18], a higher ICIQ-UI-SF sum score indicates a higher severity of UI. The ICIQ-UI-SF has been frequently used in the assessment of UI in athletes, whereby we will highlight only the most recent research in which it was applied to elite female and male athletes [18]. A group of Croatian authors previously examined the psychometric characteristics of the Croatian ICIQ-UI-SF version on females, concluding that they are very good and, therefore, appropriate [19].

Statistical Analysis

Statistical data processing was performed in the PSPP program (GNU Project, version 1.4.1/5 September 2020). Of the initial 76 received responses, 70 eligible ones were analysed. Kolmogorov Smirnov test was used for data distribution normality check. Consequently, the chi-square test was used to verify the association between UI occurrence with medical data and competition level, while the t-test and analysis of variance were used to examine the relationship between UI with sociodemographic and anthropometric and other sports-related data, including additionally examined UI severity concerning competition level. The defined level of significance was $p < 0.05$. Categorical variables are described by frequencies and percentages, while continuous variables are represented by arithmetic mean and standard deviation. The results are presented systematically, tabularly and narratively, emphasising the findings of the ICIQ-UI-SF assessment. Considering the range of observed factors possibly related to UI, only those values of statistically significant associations are presented in the results. In contrast, the insignificant ones are annotated and further elaborated on in the discussion.

RESULTS

Participants

The average age of 70 females from 12 different sports was 22.64 ± 4.55, and they had a regular Body Mass Index (of 22.22 ± 2.50). Of females who entered competitive sports at the age of puberty (9.52 ± 2.85 years of age), 32 of them now compete at national (45.71 %), 29 on the world (41.43 %), and 9 at international/European (12.86 %) level, with professional experience being a third of their age (7.41 ± 4.29 years). On average, they train 2.84 ± 1.42 hours a day, 5.56 ± 2.64 days a week, of which 2.25 ± 2.24 hours with weights, and practice additional moderate to vigorous physical activity 1.80 ± 1.71 days a week. On average, they compete for 0.94 ± 0.53 times per week and 3.17 ± 1.43 per month, rest 14.44 ± 9.45 hours per day and 4.74 ± 2.77 weeks per year. Participants' sociodemographic, anthropometric and sports-related data can be seen in Table 1. Most female athletes were nulliparous (97.1 %), with a prevalence of constipation at 11.4 % and urinary tract problems at 8.6 %, primarily oral contraceptives non-users (78.6 %), non-smokers (80.0 %) and no history of epidural/spinal anaesthesia (81.4 %), as seen in Table 2.

Table 1. Participants' sociodemographic and anthropometric data and sports characteristics

Data type	Indicator	M	SD
Sociodemographic and anthropometric data	Age	22.64	4.55
	Weight (kg)	64.14	9.474
	Height (cm)	169.40	7.254
	BMI	22.22	2.503
Characteristics of sports	Age of entry into the competitive sport	9.52	2.857
	Years of professional experience	7.41	4.292
	Training		
	hours a day	2.87	1.429
	days a week	5.56	2.646
	months per season	10.10	1.819
	hours a day (weightlifting)	2.25	2.247
	days a week (free time vigorous activity)	1.80	1.716
	Rest		
	hours a day	14.44	9.456
	months per season	4.74	2.770
	Competitions		
	per week	0.94	0.535
	per month	3.17	1.434

M-arithmetic mean, SD- standard deviation

Table 2. Medical data of participants

Medical data	Yes		No	
	n	%	n	%
Urogenital problems	6	8.6	64	91.4
Constipation	8	11.4	62	88.6
Parity	2	2.9	68	97.1
Oral contraception use	15	21.4	55	78.6
Smoking	14	20.0	56	80.0
History of epidural or spinal anaesthesia	13	18.6	57	81.4

n - number of respondents, % - percentage

Table 3. Summarised data on UI occurrence and frequency of urinary leakage

Sport	ICIQ score for frequency of urinary leakage n (%)			
	0	1	2	3
Handball	19 (70.4 %)	3 (11.1 %)	4 (14.8 %)	1 (3.7 %)
Athletics	4 (100.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Weightlifting	1 (50.0 %)	1 (50.0 %)	0 (0.0 %)	0 (0,0 %)
Gymnastics	3 (100.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Alpine skiing	2 (100.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Soccer	6 (85.7 %)	1 (14.3 %)	0 (0.0 %)	0 (0.0 %)
Volleyball	2 (100.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Swimming	0 (0.0 %)	1 (100.0 %)	0 (0.0 %)	0 (0.0 %)
Table tennis	3 (100.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Court tennis	4 (57.1 %)	3 (42.9 %)	0 (0.0 %)	0 (0.0 %)
Water polo	3 (60.0 %)	2 (40.0 %)	0 (0.0 %)	0 (0.0 %)
Synchronised swimming	6 (85.7 %)	1 (14.3 %)	0 (0.0 %)	0 (0.0 %)
Total sample	53 (75.7 %)	12 (17.1 %)	4 (5.7 %)	1 (1.4 %)

n - number of respondents, % - percentage, 0 - never, 1- about once a week or less, 2 - two or three times a week, 3 - about once a day

Table 4. The amount of leaked urine

Sport	ICIQ score for the amount of leaked urine n (%)	
	0	2
Handball	19 (70.4 %)	8 (29.6 %)
Athletics	4 (100.0 %)	0 (0.0 %)
Weightlifting	1 (50.0 %)	1 (50.0 %)
Gymnastics	3 (100.0 %)	0 (0.0 %)
Alpine skiing	2 (100.0 %)	0 (0.0 %)
Soccer	6 (85.7 %)	1 (14.3 %)
Volleyball	2 (100.0 %)	0 (0.0 %)
Swimming	0 (0.0 %)	1 (100.0 %)
Table tennis	3 (100.0 %)	0 (0.0 %)
Court tennis	4 (57.1 %)	3 (42.9 %)
Water polo	3 (60.0 %)	2 (40.0 %)
Synchronised swimming	6 (85.7 %)	1 (14.3 %)
Total sample	53 (75.7 %)	17 (24.3 %)

n - number of respondents, % - percentage, 0 - none, 2 - a small amount

UI occurrence and frequency of urinary leakage

As seen in Table 3, the presence of UI in the total sample was 24.3 %. At the same time, among sports, it was recorded in 8 (29.6 %) handball players, 3 (42.9 %) tennis players, 2 (40 %) water polo players, one (14.3 %) synchronised swimmers (14.3 %) and soccer players (14.3 %), one weightlifter (50 %) and the only swimmer (100 %). According to ICIQ-UI SF, in all athletes with UI, it is a small amount of urine that mostly leaks approximately once a week or less often (70.59 %), but there is also a leakage 2 to 3 times a week (23.52 %) and once a day (5.89 %). The average ICIQ score for this question was 1.35 ± 0.606.

Amount of urine leakage

According to ICIQ-UI SF, as seen in Table 4, in all athletes with UI, it is a small amount of urine that mostly leaks, evaluated with an average score of 2, according to ICIQ.

UI interference with quality of life

In affected female athletes, measured on the ICIQ scale from 0 (no interference) to 10 (great interference), reported interference of UI with quality of life varied from 1 to 7, with an average ICIQ score of 3.05 ± 2.105. It can be interpreted as 70.59 % mild and 29.41 % moderate to severe. Detailed data can be seen in Table 5.

UI severity - ICIQ sum score

The severity of UI observed in female athletes is 47 % slight and 53 % moderate (Table 6). At the same time, the highest average ICIQ sum score is present in handball players and the lowest in water polo and synchronised swimming athletes (Table 7). Although it is t included in the ICIQ sum score, it is to be reported that urine leaks mainly after urination and dressing (35.29 %), when coughing and sneezing (29.41 %), before getting to the toilet (17.65 %), during physical activity (12.76 %) and without apparent reasons (5.89 %).

Association of UI occurrence with sociodemographic, anthropometric, medical and sport-related factors

When investigating the connection between the occurrence of UI and medical data, we obtained one significant difference, $\chi 2(1,n = 70) = 4.666$, $p < 0.05$, according to which

female athletes who smoke to a greater extent than expected report the existence of UI. No significant association with other medical data was found.

To verify the association with sports, sociodemographic and anthropometric-related factors, certain UI features were observed as dichotomous and continuous and analysed with different statistical methods; however, no significant findings were observed.

Table 5. UI interference in everyday life

Sport	ICIQ score for UI interference in everyday life n (%)						
	0	1	2	3	5	6	7
Handball	19 (70.4 %)	1 (3.7 %)	3 (11.1 %)	0 (0.0 %)	1 (3.7 %)	2 (7.4 %)	1 (3,7 %)
Athletics	4 (100.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Weightlifting	1 (50.0 %)	0 (0.0 %)	0 (0.0 %)	1 (50.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Gymnastics	3 (100.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Alpine skiing	2 (100.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Soccer	6 (85.7 %)	0 (0.0 %)	1 (14.3 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Volleyball	2 (100.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Swimming	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	1(100.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Table tennis	3 (100.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Court tennis	4 (57.1 %)	1 (14.3 %)	0 (0.0 %)	1 (14.3 %)	0 (0.0 %)	1 (14.3 %)	0 (0.0 %)
Water polo	3 (60.0 %)	2 (40.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Synchronised swimming	6 (85.7 %)	1 (14.3 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Total sample	53 (75.7 %)	5 (7.1 %)	4 (5.7 %)	3 (4.3 %)	1 (1.4 %)	3 (4.3 %)	1 (1.4 %)

n - number of respondents, % - percentage, 0 to 7 - reported interference score on the ICIQ scale from 0 (no interference) to 10 (great interference)

Table 6. ICIQ sum score frequencies

ICIQ sum score	n	%
4	5	29.4
5	3	17.6
6	4	23.5
9	1	5.9
10	3	17.6
11	1	5.9
Total	17	100.0

n - number of respondents, %- percentage

Table 7. The average score of ICIQ sum score concerning the sport

Sport	n	M	SD
Handball	8	7.63	2.875
Weightlifting	1	6.00	0.000
Soccer	1	5.00	0.000
Swimming	1	6.00	0.000
Tennis	3	6.33	2.517
Water polo	2	4.00	0.000
Synchronised swimming	1	4.00	0.000

n - number of respondents, M -arithmetic mean, SD - standard deviation

DISCUSSION

At the beginning of this discussion, it is necessary to point out that this research, which covers the issue of UI in female athletes, is the first of its kind in Croatia, which gives it a special significance. Withal, given the research topic's relative rarity in European areas, its relevance can be considered much broader. Our previously presented results, discussed below in more detail, provide insights into a present but neglected female athlete issue in Croatia and will undoubtedly have application value considering the research outcomes.

Research implies that engagement in sports practice increases the prevalence of UI [2], with athletes having a significantly higher risk of presenting UI than sedentary females [4]. Moreover, UI occurrence is reported globally and in many sports. It may interfere with everyday life or training, leading female athletes to change or compromise their performance or risk compromising it [2]. Despite the existence and associated risks for UI development in female athletes, which are indisputable and confirmed by empirical evidence**,** UI in females is a relatively neglected topic in Croatia, particularly in sports. The possible existence of UI or the risk of the onset of UI must be addressed promptly considering those, as mentioned earlier, personal and social sequels, impaired quality of life and compromised sports performance. UI issue has yet to be observed in Croatian female athletes, so this pilot cross-sectional study aimed to investigate the phenomena of UI and related factors in this population by addressing specific research questions.

To address this study's aim and research questions, we distributed an anonymous online Google survey to female athletes through social networks in May 2022. We collected their sociodemographic, anthropometric and medical data, general characteristics of competitive sport, the severity of UI symptoms and their impact on health-related quality of life using the Croatian version of ICIQ-UI SF.

The research included the answers of 70 respondents from 12 different sports, on average, female athletes in their early twenties. Respondents had a regular Body Mass Index; most were nulliparous with a low prevalence of constipation and urinary tract problems, primarily oral contraceptive non-users, non-smokers and with no history of epidural/spinal anaesthesia. Females who entered competitive sports at the age of puberty w compete at national (45.71 %), world (41.43 %), and international/European (12.86 %) levels, with professional experience being a third of their life age. On average, they train 3 hours a day, six days a week, 3 hours with weights, and practice additional moderate to vigorous physical activity two times a week. On average, they compete once weekly and three times monthly, resting for 15 hours per day and five weeks per year.

The presence of UI in our sample was 24.3 % in total. At the same time, among sports, the occurrence was recorded as the highest among handball players. A meta-analysis from 2020 showed that in a sample of 1254 female athletes in their twenties, the incidence of UI was 25.9 % among different sports, with high-impact sports increasing the risk [5]. Comparing the incidences, our results are generally very similar, considering the higher incidence among our handball players who participate in the sport classified as a high-intensity, body-contact sport [20]. Considering that we are comparing our occurrence findings with the findings of a meta-analysis as a work of substantial evidence, it gives it additional reliability. Additionally, in most of the studies included in the meta-analysis above, the ICIQ-UI-SF used in our study was also used. Simeone et al. focused on factors related to UI occurrence in a group of female athletes and observed a relationship with the sports level; the higher the level, the higher the UI occurrence [21]. Our research did not find a statistically significant difference in UI occurrence concerning the level at which female athletes compete, as Opara et al. did not find either [22].

Stress UI is the involuntary loss of urine on effort or physical exertion or on sneezing or coughing and is a dominating symptom [23] among high-impact and competition-level sports. Addressing UI among both sexes (20-30 years of age) with ICIQ-UI-SF, Rodríguez-López et al. found a prevalence of 45.1 % in females compared to 14.7 %

male athletes with 59.9 % stress UI and 22.7 % urine leakage while training, 40.5 % when jumping, 19.6 % while running and 20.2 % in other different situations [24]. In the research of Almeida et al., an occurrence stress UI of 56.6 % was found in nulliparous female athletes [25], very similar to the research results of Rodríguez-López et al. from the year 2022 [18]. Opara et al. found 62.5 % of stress UI among elite female athletes participating in high-impact sports and almost 60% of nulliparous females [22]. According to ICIQ-UI SF, in our primarily nulliparous female athletes with UI, it is a small amount of urine that mostly leaks approximately once a week or less often. Still, there is also a leakage 2 to 3 times a week and once a day, although much less frequent. Urine leaks mainly after urination and dressing, when coughing and sneezing, less often before getting to the toilet, during physical activity, and without apparent reasons as rarest. However, although it is a small amount of leaked urine in the vast majority of cases, the fact that it happens to our athletes mostly after they have already finished urinating and dressing is worth noting. This kind of symptomatology moves in the direction of post-micturition dribble (PMD), involuntary loss of urine immediately after urination [26], and usually after leaving the toilet. Almeida et al. found the occurrence of PMD in 13.3 % of female athletes examined, but much less than stress UI [25]. To date, urological research has focused on symptoms of voiding or storage (i.e. urinary incontinence, frequency, urgency). In contrast, post-micturition symptoms (i.e. PMD) have received relatively little attention, despite their potential burden on health-related quality of life (HRQOL) [27], which is also visible in the lack of research on this topic in the field of women's health in sports. Given that the goal of this research does not cover the resulting causal link to a specific type of UI, we will leave the research question as inherent for another study.

In our sample, freely interpreting, the interference of UI with quality of life is mainly mild, and the severity of UI is slight to moderate. At the same time, the highest UI severity is present in handball players and the lowest in water polo and synchronised swimming athletes. A study on a mixed-sex sample showed that among athletes with UI, the condition was to a greater extent slight, to a lesser extent moderate, and in the most minor severe [24]. These results are consistent with those sex-specific, where female athletes described their condition mainly as slight, to a lesser extent moderate and severe at least [18], ultimately consistent with ours. In addition to HRQOL, UI interferes with the daily life of both female and male athletes affected; on a mixed-sex sample, the mean score for some impact of UI on QoL was 4.35 ± 2.98 points out of 10 [24], and therefore slightly higher than in our female-only sample (3.05 ± 2.105). Female athletes examined by Lopes et al. reported 40 % mild and 20 % moderate UI impact on HRQOL [28]. The connection between the occurrence and severity of UI with high-impact sports such as handball has already been mentioned. Still, it should be noted that sports such as swimming and cycling are far less risky than running [23], while jumping is the activity that most likely provokes UI [5]. Additionally, we examined the difference in UI severity concerning the level at which the athletes compete, which was insignificant. We encountered a lack of evidence to compare with this result of ours, given that most of the research available focuses on UI occurrence and related factors and UI severity only *per se*, without possibly associated factors. The symptoms of UI certainly interfere with the everyday life of females. Their relationship does not have to be vice versa because of our individuality; even a minimal urine leakage can significantly impact the quality of life.

When investigating medical-related factors in this study, one significant difference was obtained, $\chi 2(1,n = 70) = 4.666$, $p < 0.05$, according to which female athletes who smoke to a greater extent than expected report the existence of UI. In the general female population, previous and current heavy smoking [29], use of oral contraceptives [9], and spinal anaesthesia [15] have been proven to be associated with UI. We did not find reliable empirical evidence for the female athlete population to compare with ours, which is also noted by meta-analysis; factors such as hormone use and smoking could not be assessed since they were not detailed in most studies [2]. In contrast, menopause, surgery in the

region, childbirth [30], constipation and urinary infections [31] are significantly related to UI occurrence. Although we observed UI occurrence in relation to parity, constipation and urogenital infections, our research did not yield the same findings as in previous research.

To verify the association with sports, sociodemographic and anthropological-related factors, certain UI variables were observed as dichotomous and continuous and analysed with different statistical methods; however, no significant findings were yielded. Previous observational studies found a positive correlation between UI concerning Body Mass Index [25], training per week, and hours of exercise per day. In contrast, a negative correlation emerged with weeks of rest in year [24]. Opara et al. did not find a significant association of UI occurrence with the age of female athletes [22], just as we did not. As observed in our study, Rodríguez-López et al. observed no association between UI and years of sports practice [24]. The reason for our results can be linked to the fact that this research covered a small number of respondents compared to previous research. As another possible reason, we will mention the ICIQ-UI-SF instrument itself. Despite the extended use of the ICIQ-UI-SF, this questionnaire was t developed for professional was not athletes, and UI prevalence could have been underestimated [18] among our female athletes.

Concluding the discussion, we emphasise the need for promptly adequate assessment of the possible existence of UI or the risk of the onset of UI with the aim of optimal multidisciplinary treatment, emphasising the awareness and assessment competencies of sports experts who are closest to female athletes, including coaches and physiotherapists, in the first line. At the same time, it is necessary to encourage honest, open and shameless reporting of symptoms that may be related to UI by female athletes, thereby reducing their subjective marginalisation.

As a limitation of this research, we point out the (in)convenient sample, which included fewer subjects and the marked sample heterogeneity. Previous studies' heterogeneity on this topic was also reported through the meta-analyses mentioned in this paper. However, given that this is an observational pilot study and that we have shown UI presence in a quarter of the examined Croatian female athletes and one associated risk factor, these limitations should be accepted only as an opportunity to improve future research. In addition to improvements in future research, a larger sample of female athletes would also enable an objective look into the association between specific sports disciplines and UI. As an improbable but still possible risk of bias related to bladder function, it is necessary to mention unrecognised early pregnancy by the respondents at the time of filling out the survey, even though they were, as stated in the participation invitation, active athletes (i.e. not retired, on longer sick, pregnancy or maternity leave). Adding to limitations, athletes, as a specific population, have specific physical demands due to their training sessions; therefore, specific tools are needed [18] to address particular health problems. It is necessary to test the psychometric characteristics of ICIQ-UI-SF on this population and then think about developing a new instrument intended explicitly for professional athletes.

CONCLUSION

UI is present in a quarter of examined Croatian FA, with mild to moderate severity. It mildly interferes with the quality of life and seems to be associated with smoking. Our findings contribute to preserving women's health in sports and apply to UI assessment in FA and counselling on smoking cessation as a proven UI risk. In addition, findings contribute to raising awareness and preserving women's health in sports and are applicable in the context of UI assessment and, ultimately, optimal prevention strategies and timely treatment referrals.

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