



Original Article

Is age of menarche related to urinary symptoms in young Jordanian girls? A prospective cross-sectional study



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المخلص

أهداف البحث: هناك ارتفاع في معدل انتشار سلس البول، خصوصاً عند السيدات، في جميع أنحاء العالم. افترضت هذه الدراسة أن العمر عند بداية الحيض، كنقطة نمو، قد يكون عامل خطورة لحدوث سلس البول.

طرق البحث: أجريت هذه الدراسة المستقبلية المستعرضة على الفتيات اللاتي حضرن إلى العيادة الخارجية للأمراض النسائية في مستشفى الملك عبد الله الجامعي، في الأردن خلال العام ٢٠١٣-٢٠١٤. وقد تم جمع التاريخ الطبي والبيانات الديموغرافية، وتم دراسة الصلة بين بداية الحيض والمشاكل البولية.

النتائج: تضمنت الدراسة ٣٦٠ فتاة (متوسط العمر: 17.6 ± 4.01 عاماً). وأفادت ١٠١ مشاركة (٢٨.٩٪) أنهن يعانين من الحاجة الملحة للتبول؛ و٢٣ (٦.٦٪) من سلس البول؛ و١٧ (٤.٩٪) منهن استخدمن القوط البولية في الليل؛ و٢٣ (٦.٦٪) لديهن عدوى بولية متكررة؛ وتلقى ٦١ (١٢.٣٪) علاجاً لسلس البول، و٤٣ (١٢.٣٪) تم علاجهن لالتهابات المسالك البولية. كما تم تسجيل كثرة التبول أثناء الليل بشكل ملحوظ في الفتيات الأصغر سناً عند دورتهن الأولى. وارتبطت مشاكل البول الأخرى أثناء الحيض مثل الحاجة الملحة للتبول بشكل كبير بزيادة العمر عند الدورة الأولى.

الاستنتاجات: يمثل العمر عند بداية الحيض مؤشراً خطراً مهماً لنشوء سلس البول لاحقاً عند النساء.

الكلمات المفتاحية: سلس البول؛ العمر عند بداية الحيض؛ سلس البول الليلي؛ الحيض

Abstract

Objectives: Urinary incontinence (UI) is highly prevalent worldwide, especially in women. This study hypothesized that the age of menarche, a developmental landmark, may be a risk factor for the development of UI.

Methods: This prospective, cross-sectional study was conducted on girls presenting to the gynaecology outpatient clinic at King Abdullah University Hospital, Jordan, from 2013 to 2014. Medical history and demographic data were collected, and associations between age of menarche and urinary problems were examined.

Results: The study enrolled 360 girls (mean age 17.60 ± 4.01 years). Of the participants, 101 (28.9%) reported experiencing urgency in urination, 23 (6.6%) had UI, 17 (4.9%) reported using urine pads at night, 23 (6.6%) had recurrent urinary infections, 61 (12.3%) had received treatment for UI, and 43 (12.3%) had been treated for urinary infections. Nocturia was significantly more frequently reported in younger girls at their first period ($p = 0.02$). Other urinary problems during menstruation, such as urge incontinence, were significantly associated with older age at first period ($p = 0.05$).

Conclusion: Age of menarche represents an important risk indicator for later development of UI in women.

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Keywords: Age of menarche; Menstruation; Nocturnal enuresis; Urinary incontinence

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Introduction

Urinary incontinence (UI) affects millions of people worldwide, with varying severity and nature. The International Continence Society defines UI as ‘the complaint of any involuntary leakage of urine’.¹ Incontinence may present either as involuntary urine leakage accompanied by a sudden urge to urinate immediately, known as urge UI or overactive bladder, or as the loss of a few drops of urine involuntarily, for example while running or coughing, known as stress UI. Although UI is not a life-threatening condition, severe incontinence can be debilitating. It inhibits social engagement owing to fear of public embarrassment and is a main cause of emotional distress.^{2–4}

A study on pre-menopausal women found that self-reported UI was associated with current hormone use for menstrual disorders (odds ratio [OR] 2.7, 95% confidence interval [CI] 1.2–6.6), a recent decrease in bleeding duration (OR 2.2, 95% CI 1.3–3.7), and being on days 11–15 before the expected end of the menstrual cycle at the time of UI (OR 2.6, 95% CI 1.3–5.0).⁶ However, another study found only limited evidence for variations in the incidence of UI during the menstrual cycle.⁷

Nocturia, on the other hand, is a common symptom that is defined as waking up at night to void, where each micturition is preceded and followed by sleep.⁵ Although, by definition, even a single episode of awakening to urinate is considered nocturia, epidemiological evidence and expert clinical opinions suggest that nocturia is likely to be clinically meaningful if a patient voids 2 or more times in a night.⁶ The prevalence of nocturia is higher with increasing age.^{12,22–25} Occasional nocturia is present in 50% of men and women aged 50–59 years. Among 18–49 year olds, more women than men have nocturia; the sex ratio reverses after 60 years of age, with the prevalence being greater in men than in women.²²

Nocturnal enuresis (NE; synonymous with intermittent nocturnal incontinence) refers to discrete episodes of UI during sleep in children ≥ 5 years of age, which is the population we aimed to analyse in our study.

Nocturia and NE are associated with increased rates of depression¹⁵ and work absenteeism,¹⁶ lower self-rated physical and mental health,¹⁷ congestive heart failure,¹⁸ and increased all-cause mortality.¹⁹

Menarche, on the other hand, is a developmental landmark that identifies the first time the process of menstruation occurs within a woman. This marks the ‘official’ onset of puberty. For example, early onset of menarche (i.e. before age 12 years) was found to be associated with short stature and obesity, increased risk of cardiovascular disease, type II diabetes, hypertension, and various types of cancer including

breast and ovarian cancers.^{17–19,31–33} Late onset of menarche (i.e. after age 16 years) is associated with osteoporosis, depression, and social anxiety disorder in the later years of life.²⁰ The landmarks of pubertal events in girls are the onset of puberty, peak height velocity (PHV), and menarche.

Adolescents experience several types of maturation, including cognitive (development of formal operational thought), psychosocial (stages of adolescence), and physical. This complex series of physical transitions is known as puberty, and these changes may influence psychosocial factors. The onset of puberty is marked by the development of breast tissue, whereas PHV is the highest velocity observed during the pubertal growth spurt.

Numerous studies (Table 1) have examined the secular trend of age at menarche in various populations. In general, there is a continuous trend of younger ages at menarche in most parts of the 20th century, although this trend has tended to slow down or stabilize. In the United States, the mean age of menarche was >14 years before 1900²²; it decreased to 12.43 years in a study conducted between 1988 and 1994,²³ although there were significant racial differences between these 2 maturational timings.

Socioeconomic factors or life settings, such as urban/rural residency, family size, family income, and level of parental education, may also influence pubertal development. Girls from families with a high socioeconomic status experience menarche at an earlier age than girls from families with lower socioeconomic status.³⁵ Furthermore, higher parental education has been associated with earlier timing of puberty.³⁵ The improvements in socioeconomic conditions that took place in the 20th century resulted in an earlier onset of puberty in children, indicated by the decrease of age of menarche. However, reports from developed countries have suggested that this trend has been levelling off. Furthermore, girls born in 3rd-world countries who are adopted by parents from developed countries experience early menarche.

We came across a study that tested the hypothesis that different levels of endogenous oestrogen alter fluid regulation and urine production. This study was designed to enrol participants in the mid-follicular phase (oestrogen low) and just before the estimated time of ovulation (oestrogen high). The follicular phase was selected, as the concentration of progesterone remains low in normal healthy subjects during this phase.

The study found that hormones involved in diurnal urine regulation were unaffected by the oestradiol level.³⁶ An influence of high and low levels of oestrogen was observed on diurnal urine.⁸

Table 1: Patient characteristics.

Characteristics	Mean \pm SD
Age (years)	17.6 \pm 4.00
Weight (kg)	56.57 \pm 12.01
Height (cm)	159/48 \pm 6.26
Age at first menarche (years)	12.94 \pm 1.56
Age at urine control, day (years)	2.64 \pm 2.358
Age at urine control, night (years)	2.93 \pm 2.22

SD, standard deviation.

We were interested in examining whether age of menarche may also be related to urinary symptoms including UI and nocturnal enuresis. In our study, we investigated the relationship between age of menarche as a sign of growth and development and UI symptoms, particularly NE.

Materials and Methods

Study population

This was a prospective, cross-sectional pilot study on single girls who are fit and healthy. Girls attending the clinic (with their mothers and not as patients) at the gynaecology outpatient clinic at King Abdullah University Hospital, Jordan University of Science and Technology, between 2013 and 2014, were recruited. A total of 360 girls (age 12–30 years) were enrolled in the study. The study was conducted after obtaining approval from the ethical board, high education deanship of Jordan University of Science and Technology. Moreover, permission from parents was obtained.

Data collection

Informed consent was obtained from all participants/parents. Demographic data and medical history were obtained for each participant, including age, weight, height, age at first menstruation, number of pads used per day, age at the onset of day/night urinary continence, and urinary frequencies during daytime and night-time. All medical history data were recorded as categorical variables (yes/no), and included pre-menstrual and menstrual pain, urinary continence at present, urinary urgency at present, NE at present and stress incontinence, incomplete voiding, increased urinary complaints during menstruation, use of night pads, urinary infections, treatment for urinary or menstruation problems, and parental support.

Statistical analysis

Data were analysed using SPSS v22 (IBM, Chicago, IL, USA). Demographic and medical characteristics are presented as means and standard deviations for continuous variables and as frequencies and percentages for categorical variables. Data were compared between participants by using Student's *t*-test and the chi-square test. Statistical significance was set at $p < 0.05$.

Results

The age (mean \pm standard deviation [SD]) of the studied population was 17.60 ± 4.01 years (Table 1). The girls weighed between 35 and 75 kg (mean \pm SD: 56.57 ± 12.01 kg), and had a mean \pm SD height of 159.48 ± 6.26 cm (range 125–176 cm). Age at first period ranged from 7 to 18 years (mean 12.94 ± 1.56 years). The number of days of the current period ranged from 1 to 15 days, with a median of 6 days, whereas the number of pads used per day ranged from 1 to 15 (median 6 pads/day). The majority of participants reported that they experienced pre-menstrual pain ($n = 272$, 75.6%), and most of them experienced menstrual pain ($n = 282$, 78.3%). Most

Table 2: Medical history in relation to menstrual and urinary problems.

	n (%)
Pre-menstrual pain	
Yes	272 (75.6)
No	61 (16.9)
Menstrual pain	
Yes	282 (78.3)
No	51 (14.2)
Treatment for menstrual pain	
Yes	85 (23.6)
No	229 (63.6)
Urine urgency at present	
Yes	101 (28.1)
No	212 (58.9)
Urgency incontinence at present	
Yes	23 (6.4)
No	306 (85)
Nocturnal enuresis	
Yes	10 (2.8)
No	315 (87.5)
Stress incontinence	
Yes	21 (5.8)
No	312 (86.7)
Urine night pads	
Yes	17 (4.7)
No	315 (87.5)
Recurrent urine infections	
Yes	23 (6.3)
No	305 (84.7)
Treatment for incontinence	
Yes	61 (16.9)
No	268 (74.4)
Treatment for urinary infections	
Yes	43 (11.9)
No	283 (78.6)
Incomplete voiding, day/night	
Yes	11 (3.1)
No	317 (88.1)
Increased urinary problems with periods	
Yes	76 (21.1)
No	168 (46.7)

experienced both menstrual and pre-menstrual pain ($n = 247$, 68.6%), with only 27 (7.5%) experiencing neither. About a quarter of participants ($n = 85$, 23.6%) reported that they had required analgesic treatment during periods.

The medical histories of participants in relation to menstrual and urinary problems are presented in Table 2.

A total of 101 participants (28.1%) reported experiencing urinary urgency at the time of their clinic visit, whereas 23 (6.4%) reported urge incontinence. Moreover, 10 participants (2.8%) had NE and 21 (5.8%) reported stress incontinence.

Participants reporting menstrual pain were significantly likely to be older than those reporting no pain ($p < 0.001$) (18.14 ± 3.95 vs. 15.94 ± 3.77 years) (Table 3). Participants reporting pre-menstrual pain were significantly more likely to be older at the time of clinic visit ($p < 0.001$), older at their first period ($p = 0.034$), and weigh more ($p = 0.015$) (Table 3). Treatment during periods was significantly more likely required by older girls ($p < 0.001$) and those who were older at their first period ($p < 0.001$).

In the analysis of NE, the group of girls with a history of NE showed delayed age of menarche (around 13.02 ± 1.52

Table 3: Association between patient demographics and patient-reported incidences of menstrual or pre-menstrual pain.

	No pre-menstrual pain (mean ± SD)	Pre-menstrual pain (mean ± SD)	p	No menstrual pain (mean ± SD)	Menstrual pain (mean ± SD)	p
Age at 1st period (years)	12.81 ± 1.387	12.95 ± 1.595	0.583	12.55 ± 1.520	13.03 ± 1.568	0.034
Age at present (years)	15.94 ± 3.767	18.14 ± 3.947	<0.001	15.63 ± 3.229	18.26 ± 3.965	<0.001
Weight (kg)	54.26 ± 10.475	57.22 ± 9.705	0.059	53.31 ± 12.439	57.76 ± 11.653	0.015
Height (cm)	160.40 ± 6.045	159.59 ± 6.196	0.428	159.76 ± 6.590	159.63 ± 6.098	0.898

SD, standard deviation.

years) relative to girls in the control group (11.50 ± 2.32 years) ($p = 0.002$). The same group compared with controls showed daytime control at age 2.47 ± 1.75 vs. 2.71 ± 2.77 years ($p < 0.001$) and night-time control at age 2.82 ± 2.09 vs. 2.43 ± 2.73 years ($p < 0.001$).

Concerning stress UI, the group of girls with a history of stress UI showed delayed age of menarche (around 12.98 ± 1.53 years) relative to girls in the control group (12.65 ± 2.13 years) ($p = 0.363$). The same group compared with controls showed daytime control at age 2.57 ± 1.98 vs. 2.89 ± 2.76 years ($p = 0.523$) and night-time control at age 2.97 ± 2.29 vs. 2.26 ± 0.91 years ($p = 0.224$).

There was no relationship between UI at present and age at night UI (Table 4). NE was significantly more likely to be reported by younger girls at their first period ($p = 0.02$) and by older girls at the time of achieving daytime and night-time urine control ($p < 0.001$).

Increased urinary problems with menstruation were significantly associated with menstrual ($p = 0.002$) and pre-menstrual ($p = 0.001$) pain. Pre-menstrual pain was also significantly associated with urinary infection ($p = 0.04$) and incontinence ($p = 0.09$). Although there were similar trends for a relationship with menstrual pain, they did not reach statistical significance.

Discussion

Menarche is a rather late event in puberty and usually occurs 6 months after PHV is achieved. The age at which menarche occurs generally represents developmental maturity and is variable, as it is dependent on the interaction between genetic and environmental factors.

The most visible changes during puberty are growth in stature and development of secondary sexual characteristics. Equally profound changes occur in terms of body composition, achievement of fertility, and changes in most body systems, such as bones with increased growth and

mineralization, brain development, cardiovascular system with greater aerobic power reserves, electrocardiographic changes, and blood pressure changes. The onset of puberty occurs after reactivation of the hypothalamic gonadotropin-releasing hormone secretory system.³⁴

There are 3 methods for assessing age at menarche: the a) status quo, b) recall or retrospective, and c) prospective methods.²¹ In the status quo method, data of age of menarche can be obtained by asking a girl (or her parent) about her 'current status', i.e. whether she has had her first menses at the time of assessment, and her birth date. In the status quo method, the sample must be large, representative of the population, and, in developed countries, include participants ranging in age from 8 to 16 years.

In the recall method, menarcheal data are obtained by asking post-menarcheal women (or their mothers) to recall their age at first menses. Furthermore, all women included must be at a menstruating age. This is the method we used in our study. Although the prospective method is more accurate, such studies are not easy to perform, as they should be longitudinal in nature, with pre-menarcheal girls followed-up regularly.

Our study data were subjective in nature, associated with recall bias, and resulted in some missing information. Moreover, no objective measurements of UI were performed and there was no correlation between NE and weight or adjustment for the weight variable, as our aim was to determine whether there is a relation between NE and age of menarche. Additionally, many of the participants could not remember their weight at the time of menarche; however, their current weight is easier to measure, and this point will help in designing our next step. Despite these limitations, this study provides further clarification about the possible role of steroid hormones in UI in women, and encourages performing further research to confirm age of menarche as a predictive factor for later urinary problems. The mean age of

Table 4: Association between urinary problems and patient characteristics.

	Presence of urinary problem	Nocturnal enuresis now (mean ± SD)	p	Stress incontinence now (mean ± SD)	p	UI now (mean ± SD)	p
Age at 1st period (years)	Yes	13.02 ± 1.52	0.002	12.98 ± 1.53	0.363	13.00 ± 1.50	0.308
	No	11.50 ± 2.32		12.65 ± 2.13		12.65 ± 1.95	
Age now (years)	Yes	17.93 ± 4.00	0.301	17.84 ± 4.04	0.289	17.88 ± 4.03	0.345
	No	16.60 ± 3.34		16.85 ± 3.63		17.00 ± 3.57	
Age at urine control during the day (years)	Yes	2.47 ± 1.75	<0.001	2.57 ± 1.98	0.523	2.45 ± 1.75	0.005
	No	2.71 ± 2.77		2.89 ± 2.76		2.67 ± 2.55	
Age at urine control during the night (years)	Yes	2.82 ± 2.09	<0.001	2.97 ± 2.29	0.224	2.83 ± 2.10	0.131
	No	2.43 ± 2.73		2.26 ± 0.91		2.60 ± 2.26	

UI, urinary incontinence; SD, standard deviation.

menarche in our study population (12.94 ± 1.56 years) is in line with the reported mean age of menarche of 12.81 years in a recent meta-analysis in Iranian populations.²¹ This is lower than that reported in some developed countries (e.g. 13 years in Denmark,²² 13.2 years in Finland,²³ and 13.09 years in Sweden²⁴), but higher than that reported in other European and Asian countries (e.g. 12.3 years in Thailand,²⁵ 12.5 years in Japan,²⁶ 12.2 years in Italy,²⁷ and 12.31 years in Spain²⁴). Differences in menarcheal age have been reported to be influenced by a number of factors including nutritional status, geographic location, biological factors, social factors, and lifestyle.^{20,28,29} During the last few decades, reports have suggested that improvements in the socioeconomic and public health conditions of developed countries have led to the earlier onset of puberty in children.^{20,30}

In addition, oestrogen and progesterone receptors have been shown to be expressed in the urinary tract; however, these data were in conflict with some studies that found inconsistent or absent expression of steroid hormone receptors.^{8–11} Oestrogen deficiency is also associated with urinary tract dysfunction in postmenopausal women, whereas high levels of circulating progesterone are associated with bladder irritability and increased urine urgency.^{12,13}

Clinical trials have suggested that both progesterone and oestrogen therapy may influence the incidence of UI; however, a meta-analysis of trial data found that although subjects treated with oestrogen therapy reported improvements in UI, this was not associated with improvements in objective urodynamic measurements of involuntary urinary loss.¹⁴ Hence, we tried to classify the associated menstrual problems in our participants as pre-menstrual and menstrual pain requiring analgesia, which could indicate hormonal imbalance and, hence, could possibly be related to urinary symptoms.

UI is a common problem in children, occurring in approximately 15% of 5-year-old children. Most of these children have isolated NE. NE has a high rate of spontaneous resolution, with its prevalence decreasing from 16% at age 5 years, to 5% at age 10 years, and to 1–2% at age ≥ 15 years.^{2,3}

Considering that most children achieve bowel and bladder control between 24 and 48 months of age, 25% are toilet trained at 24 months, 85% at 30 months, and 98% at 36 months; however, girls achieve control sooner than boys. In our study, girls achieved daytime urine control at age 2.64 ± 2.358 years and night-time control at age 2.93 ± 2.22 years, taking the study and control groups together.

Urinary control is a neurological, physical, and psychological developmental process. During early foetal life, urological development and genital development go hand in hand and are both affected by different socioeconomic factors or life settings, such as urban/rural residency, family size, family income, level of parental education, and pubertal development. Girls from families with a high socioeconomic status experience menarche at an earlier age than girls from families with lower socioeconomic status. Furthermore, higher parental education has been associated with earlier timing of puberty.³⁶

The relationship of hormonal status with the incidence of UI remains controversial.

In our study, age of menarche, as a solid indicator of puberty, was related to urinary symptoms. Urgency and urge UI were both significantly associated with older age at menarche, whereas NE was significantly associated with younger age at menarche. We found that girls with NE had their menarche at a later age than did girls without NE (13.02 ± 1.52 vs. 11.50 ± 2.32 years) ($p = 0.002$). Stress incontinence resolved by the age of 12.98 ± 1.53 years in the study group compared with 12.65 ± 2.13 years in the control group ($p = 0.363$).

Urge incontinence resolved by the age of 13.00 ± 1.50 years in the study group and 12.65 ± 1.9 years in the control group ($p = 0.308$).

However, no relationship was found for stress incontinence. In addition, the presence of pre-menopausal or menopausal pain was significantly associated with increased urinary problems during menstruation.

In the future, a more specific study confirming the significance of these bivariate analysis findings with a multivariate analysis, such as the logistic regression model, is recommended to further strengthen the overall conclusions of our study. Moreover, the findings of this study will prompt more definitive prospective studies with a focused data set collected after including age at menarche as a factor, by using a standardized symptom questionnaire in a local language and focusing on distinguishing between stress and urge symptoms, such as by using urogenital distress inventory or defined symptom measures (e.g. a bladder diary).

Conclusions

NE was significantly more frequently reported by girls who were younger at their first period ($p = 0.02$). Other urinary problems during menstruation (i.e. urgency and urge UI) were significantly associated with older age at first period ($p = 0.05$). Age of menarche represents an important risk indicator for later development of UI in women.

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Conflict of interest

The authors have no conflict of interest to declare.

Authors' contributions

LM contributed to data collection, statistical analysis, literature review, and manuscript writing and approval. OBH contributed to data collection and analysis, literature review, and final manuscript approval. OAK contributed to data collection and analysis, and manuscript writing and approval. All authors are responsible for the manuscript contents and agree to be accountable for all aspects of the work. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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