Journal of Associated Medical Sciences 2027; 60(1): 130-138

JAMS
Journal of Associated Medical Sciences

Scopus Indexed & Thai-Journal Citation Index Centre (TCI)

Journal of Associated Medical Sciences

Journal homepage: https://www.tci-thaijo.org/index.php/bulletinAMS/index



Prevalence and patterns of abnormal urinalysis findings among undergraduate students in a screening context

Nunthawadee Niamnuy, Patsarawadee Paojinda, Pannarai Phoengkratok, Piyanan Phanduang, Fatma Keeya, Thanayot Krirkkawin, Mongkol Sonseemachai, Washirapong Santhaveesuk, Kevalin Vongthoung*

Department of Medical Technology, Faculty of Allied Health Sciences, Bansomdejchaopraya Rajabhat University, Bangkok, Thailand.

ARTICLE INFO

ORCID of all authors

Nunthawadee Niamnuy: https://orcid.org/0000-0002-2491-4857
Patsarawadee Paojinda: https://orcid.org/0009-0002-6835-3470
Pannarai Phoengkratok: https://orcid.org/0009-0000-9118-7672
Piyanan Phanduang: https://orcid.org/0009-0007-3017-3585
Fatma Keeya: https://orcid.org/0009-0004-2599-9655
Thanayot Krirkkawin: https://orcid.org/0009-0005-8886-2223
Mongkol Sonseemachai: https://orcid.org/0009-0000-9542-6837
Washirapong Santhaveesuk: https://orcid.org/0009-0007-6326-7262
Kevalin Vongthoung: https://orcid.org/0009-0001-2459-0979

Correspondence

Kevalin Vongthoung
Department of Medical Technology, Faculty of Allied Health Sciences, Bansomdejchaopraya Rajabhat University, Bangkok, Thailand.
Email: kevalin.vo@bsru.ac.th

Article history

Received 7 May 2026
Accepted as revised 28 August 2026
Available online 24 September 2026

Keywords

Urinalysis, urine concentration, physical examination, screening, young adults

doi: 10.66285/JAMS.2027.013
E-ISSN: 2539-6056

ABSTRACT

Background: Urinalysis is widely used as a simple and inexpensive screening tool. However, the overall prevalence of "abnormal" findings in asymptomatic populations may be difficult to interpret when clinically relevant findings are combined with nonspecific changes in urine concentration or appearance.

Objectives: To determine the prevalence and patterns of abnormal urinalysis findings among undergraduate students, distinguish clinical findings from those related to urine concentration and appearance, and examine their associations with water and beverage consumption and urinary health awareness.

Materials and methods: This cross-sectional study included 336 undergraduate students. A single midstream spot urine specimen was collected from each participant and evaluated by physical, chemical, and microscopic examination. The primary outcome was the presence of at least one abnormal urinalysis finding according to prespecified criteria. Clinical findings were summarized separately from findings related to urine concentration and appearance. Associations with plain water intake, beverage consumption, and urinary health awareness were examined using Poisson regression with robust variance estimation, with adjustment for age and gender.

Results: Overall, 58.0% of participants had at least one abnormal urinalysis finding. However, most findings involved urine concentration or appearance (53.3%), whereas clinical findings were observed in only 14.6%. High urinary health awareness was associated with a higher prevalence of the composite urinalysis outcome (adjusted prevalence ratio 1.32; 95% confidence interval 1.04-1.68). Consumption of more than seven glasses of milk-added brewed beverages per week was also associated with the composite outcome, whereas plain water intake and other beverage categories were not significantly associated.

Conclusion: The high overall prevalence of abnormal urinalysis findings was driven mainly by findings related to urine concentration and appearance rather than by clinical findings. Reporting only the composite prevalence may therefore suggest a greater burden of clinically relevant abnormalities than was actually observed. Separating clinical findings from those related to urine concentration or appearance provides a clearer and more appropriate framework for interpreting screening urinalysis.

Introduction

Urinalysis is widely used as a routine screening method because it is simple, inexpensive, and can detect early signs of renal and urinary tract disorders. A complete urinalysis includes physical, chemical, and microscopic examination, and the clinical significance of individual findings depends on their pattern, persistence, and clinical context. In asymptomatic populations, findings classified as abnormal may reflect transient physiological or preanalytical variation rather than underlying disease. Without appropriate interpretation, routine screening urinalysis may therefore lead to over-interpretation and unnecessary follow-up. Accordingly, urinalysis is used not only as a diagnostic test but also as a screening and health education tool in population-based settings.[1-3]

Urine specific gravity, urine osmolality, and urine color are commonly used as practical indicators of urine concentration and short-term hydration status in epidemiological and field-based studies.[4-6] However, measurements obtained from a single spot urine specimen may be influenced by recent fluid intake, time of collection, physical activity, environmental conditions, and other short-term factors. Spot urine samples, therefore, provide limited information about long-term fluid balance and should be interpreted with caution when 24-hour urine collection is not feasible.[7]

Young adulthood is a transitional life stage characterized by changes in daily routines, dietary habits, and beverage consumption. Previous studies have reported suboptimal fluid intake and frequent consumption of sweetened or milk-based beverages among young adults, both of which may influence urine concentration and appearance.[8-10] Findings related to urine concentration or appearance in this population may therefore reflect modifiable behaviors or short-term physiological variation rather than clinically significant pathology.

Interpreting screening urinalysis requires a clear distinction between clinical findings and nonspecific findings related to urine concentration or appearance. For example, concentrated or deeply colored urine may reflect recent fluid intake, while turbidity may result from cells, crystals, mucus, microorganisms, or contamination and is not disease-specific when considered in isolation. Failure to consider these differences may lead to unnecessary concern or follow-up among asymptomatic individuals.[11-13] Current evidence also emphasizes that urine concentration alone should not be used as a definitive measure of hydration adequacy or overall health at the population level.[14,15]

Therefore, this study aimed to determine the prevalence and patterns of urinalysis findings among undergraduate students and to examine their associations with water intake, beverage consumption, and urinary health awareness. Clinical findings were considered separately from findings related to urine concentration and appearance to support a more cautious interpretation

of screening urinalysis in asymptomatic young adults.

Materials and methods

Study design and participants

This cross-sectional study was conducted among undergraduate students at a university in Bangkok, Thailand. Participants were recruited by convenience sampling during scheduled data collection sessions across several faculties, including Allied Health Sciences, Education, Management Sciences, Science and Technology, and Humanities and Social Sciences. This approach included students from a range of academic disciplines. Eligible participants were undergraduate students aged 18 years or older who completed a self-administered questionnaire and provided a midstream spot urine specimen at the time of data collection. Exclusion criteria were: 1) a self-reported history of chronic kidney disease, 2) current symptoms suggestive of urinary tract infection, including dysuria, urinary frequency, or urgency, and 3) menstruation at the time of urine collection. Participants self-reported eligibility, and no confirmatory clinical or laboratory testing was performed. The required sample size was estimated using the Krejcie and Morgan formula, based on an undergraduate population of 8,753 students, a 95% confidence level, an assumed population proportion of 0.50, and a margin of error of 0.05. The estimated minimum sample size was 368 participants. A total of 336 participants with complete questionnaire and urinalysis data were included in the final analysis.

Urine sample collection and laboratory analysis

Each participant provided a single midstream spot urine specimen in a sterile container. Participants were instructed to collect the midstream portion of the urine stream. Specimens were transported to the laboratory and analyzed within 2 hours after collection. Urinalysis comprised physical, chemical, and microscopic examination. Urine color and clarity were assessed visually under standardized laboratory conditions. Clarity was recorded using the laboratory's predefined semiquantitative grading system as clear, 1+, 2+, 3+, or 4+, with higher grades indicating increasing turbidity.

Chemical analysis was performed using H11 urine reagent strips (DIRUI Industrial Co., Ltd., Changchun, China), which were read using a DIRUI H-500 urine chemistry analyzer in accordance with the manufacturer's instructions. The reagent strips included an ascorbic acid indicator pad to detect potential interference. The analyzer reported blood, leukocyte esterase, protein, glucose, and specific gravity using qualitative or semiquantitative categories. Table 1 presents the operational thresholds used to classify each result as positive or elevated.

For microscopic examination, 10 mL of urine was centrifuged at approximately 400×g for 5 minutes. The supernatant was removed, leaving approximately 1 mL of urine with the sediment, corresponding to an approximately 10-fold concentration. The sediment was gently resuspended, and one drop of the suspension was placed on a glass slide for light microscopic examination. Red blood cells, white blood cells, epithelial cells, casts, crystals, and other formed elements were evaluated according to the laboratory's microscopic reporting criteria. Red blood cell morphology was also assessed and classified as isomorphic or dysmorphic.[1,16]

This study evaluated urinalysis parameters including urine color, turbidity, specific gravity, blood, leukocyte esterase, protein, glucose, and red blood cells on microscopic examination.

Outcome definition

The primary outcome was the presence of at least one abnormal urinalysis finding according to prespecified criteria. Clinical findings included positive results for blood, leukocyte esterase, protein, or glucose, as well as an increased urinary red blood cell count on microscopic examination. Findings related to urine concentration or appearance included a specific gravity of ≥1.030, deep yellow urine, or turbidity graded from 1+ to 4+. The two groups of findings were summarized separately because abnormalities related to urine concentration or appearance may reflect short-term physiological variation or preanalytical factors and do not necessarily indicate underlying disease. Turbidity was retained as an abnormal physical finding but was not interpreted as a disease-specific abnormality when present in isolation.

Assessment of water and beverage consumption

Plain water intake was assessed as the number of glasses consumed per day, with one glass defined as 200 mL. Inadequate plain water intake was defined a priori as fewer than six glasses per day. Consumption of other beverages was assessed as the number of glasses consumed per week using predefined categories: 0, 1-2, 3-4, 5-7, and >7 glasses per week. Beverages were classified as brewed beverages, milk-added brewed beverages, or sugar-sweetened beverages. Fluid obtained from food sources, such as fruits and meals, was not quantified and was considered when interpreting findings related to urine concentration.

Urinary health awareness questionnaire

Urinary health awareness was assessed using a structured 10-item questionnaire developed for this study. The questionnaire assessed knowledge and awareness related to urinary health and hydration behaviors. Internal consistency was evaluated using Cronbach's alpha, which was 0.751. Total scores ranged from 0 to 10 and were categorized into tertiles representing low, moderate, and high awareness. The questionnaire had not undergone external validation.

Consideration of potential analytical interference

The urine dipstick included an ascorbic acid indicator pad, and urinary ascorbic acid was measured as part of routine chemical urinalysis. Elevated urinary ascorbate may produce false-negative results for glucose and blood.

Statistical analysis

Descriptive statistics were used to summarize participant characteristics and the prevalence of individual urinalysis findings. Associations between the study variables and the composite urinalysis outcome were examined using Poisson regression with robust variance estimation. Results were reported as prevalence ratios (PRs) with 95% confidence intervals (CIs). Multivariable models were adjusted a priori for age and gender. Analyses of milk-added brewed beverage consumption by frequency category were additionally adjusted for urinary health awareness. An additional exploratory analysis compared individual urinalysis parameters between participants consuming ≤7 and >7 glasses of milk-added brewed beverages per week. Fisher's exact test was used because several cells had small counts. A complete-case analysis was performed. The regression analyses included 328 participants because of missing covariate data. Statistical significance was defined as a two-sided $p<0.05$. All analyses were conducted using IBM SPSS Statistics for Windows, version 28.0 (IBM Corp., Armonk, NY, USA).

Results

Participant characteristics

A total of 336 undergraduate students were included in the analysis. The median age was 20 years (interquartile range, 19-21 years), and most participants were female (71.1%). Approximately two-thirds reported inadequate plain water intake (<6 glasses/day). Milk-added brewed beverages and sugar-sweetened beverages were commonly consumed, whereas high-frequency consumption was less common. Participant characteristics and selected study variables are summarized in Figure 1.

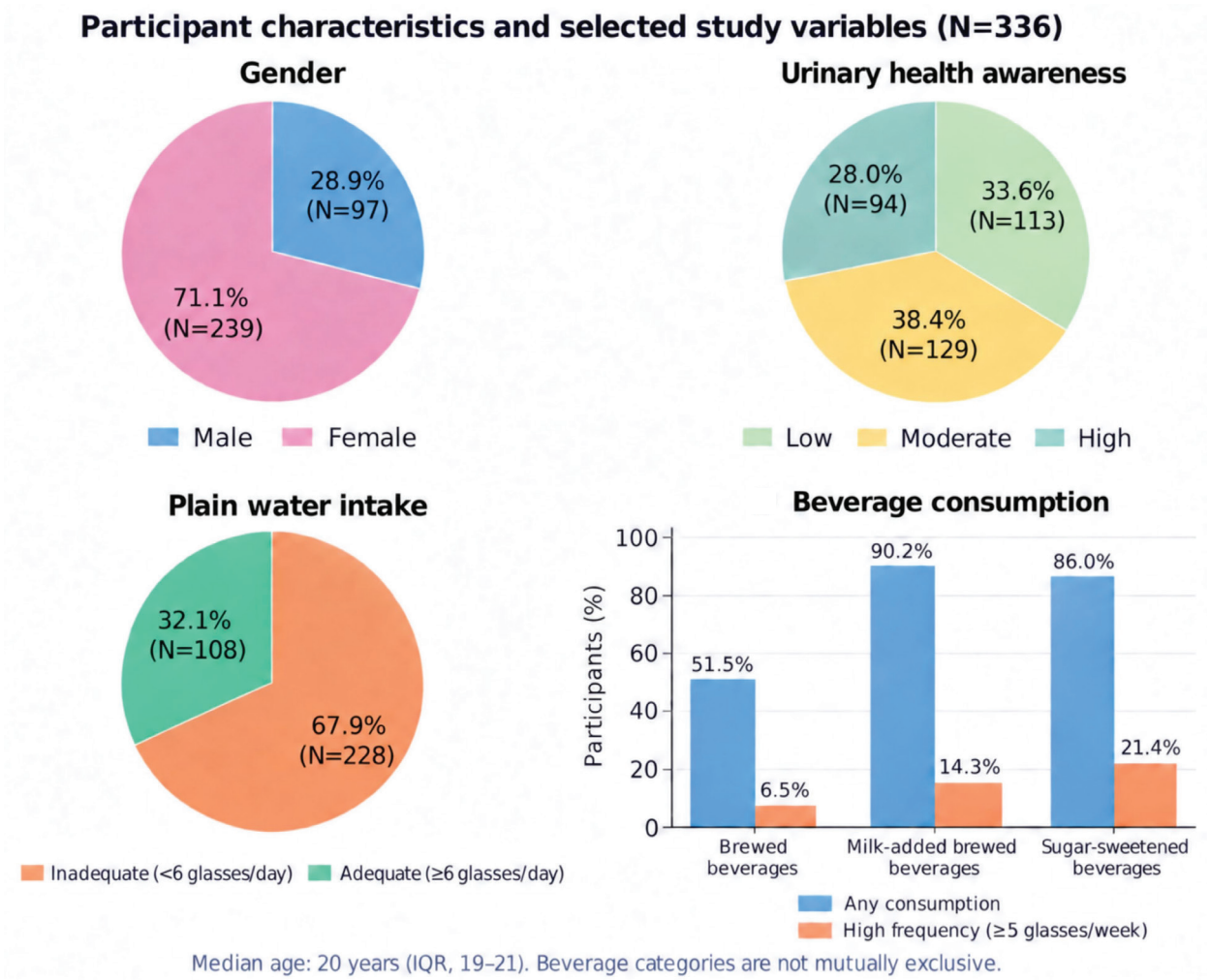


Figure 1. Participant characteristics, urinary health awareness, and beverage consumption among undergraduate students (N=336).

Prevalence of abnormal urinalysis findings

Overall, 58.0% of participants had at least one abnormal urinalysis finding included in the composite outcome. Findings related to urine concentration or appearance were observed in 53.3% of participants, whereas clinical findings were observed in 14.6%. Elevated specific gravity and turbidity were the most common individual findings. Protein-positive results were observed in 29 participants (8.6%), and no urinary casts were identified among these participants. Four participants had increased urinary RBC counts (1.2%); RBCs identified on microscopy were isomorphic, and no dysmorphic RBCs were observed. The distribution of individual urinalysis findings and the composite outcome is presented in Table 1 and Figure 2.

Table 1. Operational definitions and prevalence of urinalysis findings among participants (N=336).

Domain	Urinalysis finding	Operational definition used in the study	N (%)
Overall	Any abnormal urinalysis finding	Presence of at least one clinical finding or at least one finding related to urine concentration or appearance	195 (58.0)
Chemical	Blood positive	Analyzer result of ± or greater	17 (5.1)
Chemical	Leukocyte esterase positive	Analyzer result of ± or greater	11 (3.3)
Chemical	Protein positive	Analyzer result of trace or greater	29 (8.6)
Chemical	Glucose positive	Analyzer result of 1+ or greater	3 (0.9)
Microscopic	Increased RBC count	>3 RBCs per high-power field	4 (1.2)
Urine concentration	Elevated specific gravity	Specific gravity ≥1.030	131 (39.0)
Physical appearance	Deep yellow urine	Urine visually classified as deep yellow according to the laboratory color scale	36 (10.7)
Physical appearance	Turbidity	Urine clarity graded from 1+ to 4+ according to the laboratory's semiquantitative turbidity scale	105 (31.3)

Note: RBC: red blood cell. The RBCs observed in participants with increased urinary RBC counts were isomorphic; no dysmorphic RBCs were identified. No urinary casts were identified among participants with positive urine protein results. Clinical findings included positive blood, leukocyte esterase, protein, glucose, or an increased RBC count on microscopy. Findings related to urine concentration or appearance included specific gravity ≥1.030, deep yellow urine color, or turbidity graded from 1+ to 4+. Turbidity was classified as an abnormal physical finding but was not considered evidence of underlying disease when interpreted in isolation.

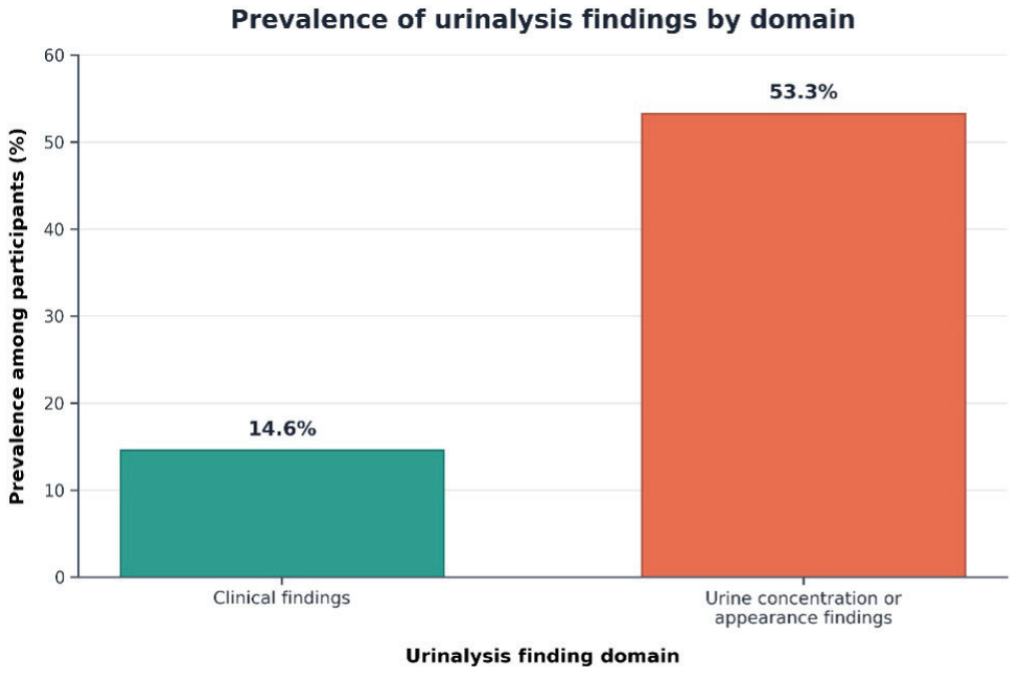


Figure 2. Prevalence of abnormal urinalysis findings among undergraduate students.

Multivariable associations with the composite urinalysis outcome

After adjustment for age and gender, higher urinary health awareness was associated with a greater prevalence of the composite urinalysis outcome. Participants in the highest awareness tertile had a 32% higher prevalence of the composite outcome than those in the lowest tertile (adjusted prevalence ratio [aPR], 1.32; 95% confidence interval [CI], 1.04-1.68). No significant association was observed for the moderate awareness tertile. Age and gender were not significantly associated with the composite outcome. Similarly, inadequate plain water intake and overall consumption of brewed beverages, milk-added brewed beverages, or sugar-sweetened beverages were not significantly associated with the composite outcome (Table 2).

Table 2. Multivariable associations with the composite urinalysis outcome (N=328).

Variable	aPR	95% CI	*p* value
Urinary health awareness			
Moderate vs low	1.10	0.86-1.40	0.451
High vs low	1.32	1.04-1.68	0.024*
Age, per year	0.97	0.91-1.03	0.309
Gender (female vs male)	1.11	0.89-1.39	0.350
Inadequate plain water intake, <6 glasses/day	0.93	0.62-1.41	0.746
Beverage consumption, any			
Brewed beverages	1.21	0.93-1.57	0.148
Milk-added brewed beverages	1.00	0.80-1.25	0.984
Sugar-sweetened beverages	1.06	0.75-1.50	0.741

Note: All variables shown in the table were included in the same multivariable model. The composite outcome was defined as the presence of ≥1 clinical finding or ≥1 finding related to urine concentration or appearance. aPR: adjusted prevalence ratio, CI: confidence interval, *p<0.05.

When milk-added brewed beverage consumption was examined by frequency category, only consumption of more than seven glasses per week was associated with a higher prevalence of the composite outcome (aPR, 1.52; 95% CI, 1.00-2.30). Lower consumption categories were not significantly associated with the outcome, and we observed no monotonic dose-response pattern (Table 3). In the additional exploratory analysis, protein-positive results were more frequent among participants who consumed more than seven glasses of milk-added brewed beverages per week than among those who consumed seven glasses or fewer per week (30.0% vs 8.0%; Fisher's exact p=0.046). No statistically significant differences were observed for the other individual urinalysis parameters. Because the >7 glasses/week group included only 10 participants, this finding should be interpreted cautiously (Table 4).

Table 3. Association between frequency of milk-added brewed beverage consumption and the composite urinalysis outcome: adjusted for age, gender, and urinary health awareness (N=328).

Milk-added brewed beverage consumption (glasses/week)	aPR	95% CI	*p* value
0* (non-consumer)	1.00	Reference	-
1-2	1.01	0.80-1.29	0.913
3-4	1.05	0.80-1.37	0.729
5-7	1.11	0.74-1.65	0.621
>7	1.52	1.00-2.30	0.049**

Note: aPR: adjusted prevalence ratio, CI: confidence interval. *Reference group was participants reporting no consumption of milk-added brewed beverages (0 glasses/week); **p<0.05.

Table 4. Component-specific urinalysis findings according to milk-added brewed beverage consumption.

Urinalysis parameter	≤7 glasses/week (N=326)	>7 glasses/week (N=10)	*p* value
Blood positive	16 (4.9)	1 (10.0)	0.409
Leukocyte esterase positive	10 (3.1)	1 (10.0)	0.286
Protein positive	26 (8.0)	3 (30.0)	0.046*
Glucose positive	3 (0.9)	0 (0.0)	1.000
Increased red blood cell count	4 (1.2)	0 (0.0)	1.000
Specific gravity ≥1.030	129 (39.6)	2 (20.0)	0.327
Deep yellow urine	35 (10.7)	1 (10.0)	1.000
Turbidity	101 (31.0)	4 (40.0)	0.510

Note: Data are presented as N (%). Fisher's exact test was used for all comparisons, *$p<0.05$. Interpret the statistically significant difference in protein-positive results with caution, given the small >7-glasses/week subgroup and the exploratory testing of multiple urinalysis parameters.

Discussion

This study found that 58.0% of undergraduate students had at least one urinalysis finding that met the prespecified abnormality criteria. However, the principal finding was not simply the high overall prevalence. More importantly, findings related to urine concentration and physical appearance drove the composite prevalence, whereas clinical findings were considerably less common. Separating urinalysis findings into clinical and urine concentration/appearance domains provided a more clinically meaningful interpretation of the overall prevalence. When all findings were combined into a single composite outcome, more than half of the participants were classified as having an abnormal urinalysis result. In contrast, only 14.6% had a clinical finding, whereas 53.3% had a finding related to urine concentration or appearance. Reporting only the composite prevalence may therefore overstate the burden of findings that warrant clinical concern. These results suggest that screening urinalysis should be interpreted not only by whether an abnormal result is present, but also by the type of finding detected.[1-3,11]

Elevated specific gravity and turbidity were the most common individual findings. Urine specific gravity may vary with recent fluid intake and other short-term physiological or environmental factors, whereas turbidity may result from cells, crystals, mucus, microorganisms, contamination, or other suspended material.[1,2,4-7,14-16] These findings are therefore less disease-specific than protein-positive results, glucosuria, hematuria, or increased urinary RBC counts. Nevertheless, they remain relevant because they reflect the physiological and preanalytical context of screening urinalysis. Their high prevalence indicates that urine concentration and specimen-related factors may substantially influence the apparent frequency of abnormal findings in young adult screening populations.

Clinical and microscopic findings were much less common. Protein-positive results were observed in 29 participants, and no urinary casts were identified among these participants. Only four participants had increased urinary RBC counts, and the RBCs were isomorphic rather than dysmorphic, a pattern less suggestive of glomerular bleeding.[1,16] However, the small number of cases and the absence of confirmatory testing precluded definitive source-specific interpretation. Taken together, the relative scarcity of clinical and microscopic findings supports the interpretation that the high composite prevalence was largely attributable to nonspecific physical or concentration-related findings rather than to a high burden of overt urinary tract or renal abnormalities.

These findings have practical implications for laboratory reporting and screening programs. In asymptomatic populations, classifying all physical, chemical, and microscopic findings under a single category of "abnormal urinalysis" may create an exaggerated impression of clinical abnormality. A domain-based interpretation more clearly distinguishes findings that primarily reflect urine concentration or appearance from those that may require clinical evaluation. Such an approach may improve communication among laboratories, clinicians, and screened individuals and may reduce unnecessary anxiety or follow-up testing without dismissing potentially important clinical findings.[1-3,16]

Higher urinary health awareness was associated with a greater prevalence of the composite urinalysis outcome. Although this finding may appear counterintuitive, awareness does not necessarily correspond to healthier behavior or normal laboratory results. Participants with previous urinary concerns or prior abnormal findings may have developed greater awareness, whereas others may have had knowledge that did not translate into changes in fluid intake or beverage practices.[12,13] Because awareness and urinalysis findings were assessed at the same time, the temporal direction of this association could not be established. The finding should therefore be interpreted as an association rather than as evidence that greater awareness causes

abnormal urinalysis results.

Consumption of more than seven glasses of milk-added brewed beverages per week was associated with a higher prevalence of the composite urinalysis outcome. However, no consistent dose-response pattern was observed, and the confidence interval approached the null value. In the additional exploratory analysis, protein-positive results were more frequent among very frequent consumers than among those who consumed seven glasses or fewer per week. Although the difference reached the conventional threshold for statistical significance (p=0.046), interpret the finding cautiously because the >7-glasses/week group included only 10 participants, of whom three had protein-positive results. The result does not establish a causal relationship between milk-added brewed beverage consumption and urinary protein positivity. The observed association may reflect beverage substitution, broader dietary or lifestyle patterns, or residual confounding.[8-10] Larger studies using repeated urine specimens and confirmatory assessment of urinary protein are needed to determine whether this association is reproducible and clinically meaningful.

This study's principal contribution is interpretive rather than diagnostic. The findings show that a high prevalence of abnormal screening urinalysis does not necessarily correspond to an equally high prevalence of clinically significant urinary abnormalities. By distinguishing clinical findings from those related to urine concentration and appearance, this study offers a practical approach to interpreting urinalysis results in asymptomatic young adults. This approach may be useful in university health screening, occupational screening, and other population-based settings in which urinalysis is performed without a specific clinical indication.

Limitations

This study has several limitations. First, its cross-sectional design does not allow causal relationships to be established between urinary health awareness, beverage consumption, and urinalysis findings. Second, participants were recruited by convenience sampling from a single university, which may limit the generalizability of the findings to other young adult populations. Urinalysis was based on a single midstream spot urine specimen. Short-term variation related to recent fluid intake, specimen collection time, physical activity, and other preanalytical factors may therefore have influenced urine concentration and appearance. Participants self-reported beverage consumption, urinary health awareness, urinary symptoms, and medical history, which may have been affected by recall or reporting bias. Fluid intake from food sources was not quantified.

Despite these limitations, the study used a structured physical, chemical, and microscopic urinalysis protocol and distinguished clinical findings from those related to urine concentration or appearance. This approach allowed a more meaningful interpretation of overall prevalence than the composite outcome alone would have.

Future study

Future studies should include larger and more diverse populations and collect repeated urine specimens to determine whether abnormal findings persist over time. Fluid and beverage intake should also be assessed more comprehensively, alongside confirmatory clinical and laboratory evaluations, to clarify the clinical significance of findings related to urine concentration and appearance. Prospective and intervention studies, particularly those involving structured hydration guidance or changes in beverage consumption, may help determine whether modifying fluid intake affects urinalysis findings and improves the interpretation of screening results.

Practical implications

In screening urinalysis among asymptomatic young adults, report and interpret clinical findings separately from findings related to urine concentration or physical appearance. This distinction may help laboratory professionals and healthcare providers avoid overestimating the prevalence of clinically relevant abnormalities, minimize unnecessary concern and follow-up testing, and offer more appropriate guidance on fluid intake and the need for repeat testing.

Conclusion

Abnormal urinalysis findings were common among undergraduate students, but the overall prevalence was driven primarily by urine concentration and physical appearance rather than by clinical or microscopic findings. The overall prevalence of abnormal urinalysis in asymptomatic populations may therefore be difficult to interpret clinically when findings of differing significance are combined into a single outcome. Separating clinical findings from those related to urine concentration or appearance provides a more informative framework for interpreting screening urinalysis. This approach may help laboratories and clinicians identify findings that warrant further evaluation while avoiding overinterpretation of isolated, nonspecific physical findings. The associations with urinary health awareness and very frequent consumption of milk-added brewed beverages should be regarded as exploratory. Further studies using repeated urine specimens, more comprehensive assessment of fluid intake, and confirmatory clinical evaluation are needed to determine whether these findings persist and are clinically relevant.

Ethical approval

The Human Research Ethics Committee of the Research and Development Institute, Bansomdej-

chaopraya Rajabhat University approved the study protocol (IRB No. BSRU-REC 670505). Written informed consent was obtained from all participants before enrollment. All data were anonymized prior to analysis.

Declaration of generative AI and AI-assisted technologies

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) to improve the language, readability, and clarity of the text. After using this tool, the authors reviewed and revised the content as necessary and take full responsibility for the content of the published article.

Funding

This research received no external funding.

Conflict of interest

The authors declare no conflicts of interest.

CRediT authorship contribution statement

Nunthawadee Niamnuy: conceptualization, data curation, methodology, supervision, validation, writing-original draft; **Patsarawadee Paojinda:** conceptualization, methodology, supervision, formal analysis; **Pannarai Phoengkratok:** formal analysis, investigation; **Piyanan Phanduang:** formal analysis, investigation; **Fatma Keeya:** formal analysis, investigation; **Thanayot Krirkkawin:** formal analysis, investigation; **Mongkol Sonseemachai:** formal analysis, investigation; **Washirapong Santhaveesuk:** formal analysis, investigation; **Kevalin Vongthoung:** conceptualization, methodology, supervision, validation. All authors contributed to writing, review, and editing and approved the final version of the manuscript.

Acknowledgements

The authors thank all undergraduate students who participated in this study. We also gratefully acknowledge the Department of Medical Technology, Faculty of Allied Health Sciences, Bansomdejchaopraya Rajabhat University, for providing the facilities and support needed to complete this research.

References

[1] Simerville JA, Maxted WC, Pahira JJ. Urinalysis: a comprehensive review. Am Fam Physician. 2005; 71(6): 1153-62.

[2] Delanghe J, Speeckaert M. Preanalytical requirements of urinalysis. Biochem Med (Zagreb). 2014; 24(1): 89-104. doi: 10.11613/BM.2014.011.

[3] World Health Organization. Screening programmes: a short guide. Increase effectiveness, maximize benefits and minimize harm. Copenhagen: WHO Regional Office for Europe; 2020.

[4] Armstrong LE, Johnson EC, McKenzie AL, Muñoz CX. Interpreting common hydration biomarkers on the basis of solute and water excretion. Eur J Clin Nutr. 2013; 67(3): 249-53. doi: 10.1038/ejcn.2012.214.

[5] Perrier E, Rondeau P, Poupin M, Le Bellego L, Armstrong LE, Lang F, et al. Relation between urinary hydration biomarkers and total fluid intake in healthy adults. Eur J Clin Nutr. 2013; 67(9): 939-43. doi: 10.1038/ejcn.2013.93.

[6] Feng Y, Fang G, Qu C, Cui S, Geng X, Zou L, et al. Validation of urine colour Lab* parameters for assessing hydration status among athletes. Front Nutr. 2022; 9: 997189. doi: 10.3389/fnut.2022.997189.

[7] Cheuvront SN, Kenefick RW, Zambraski EJ. Spot urine concentrations should not be used for hydration assessment: a methodology review. Int J Sport Nutr Exerc Metab. 2015; 25(3): 293-7. doi: 10.1123/ijsnem.2014-0138.

[8] Islam MA, Al-Karasneh AF, Bin Hussain A, Muhanna A, Albu-Hulayqah T, Naqvi AA, et al. Assessment of beverage consumption by young adults in Saudi Arabia. Saudi Pharm J. 2020; 28(12): 1635-47. doi: 10.1016/j.jsps.2020.10.010.

[9] Popkin BM, D'Anci KE, Rosenberg IH. Water, hydration, and health. Nutr Rev. 2010; 68(8): 439-58. doi: 10.1111/j.1753-4887.2010.00304.x.

[10] Zhang N, Du S, Tang Z, Zheng M, Yan R, Zhu Y, et al. Hydration, fluid intake, and related urine biomarkers among male college students in Cangzhou, China: a cross-sectional study: applications for assessing fluid intake and adequate water intake. Int J Environ Res Public Health. 2017; 14(5): 513. doi: 10.3390/ijerph14050513.

[11] Topham PS, Jethwa A, Watkins M, Rees Y, Feehally J. The value of urine screening in a young adult population. Fam Pract. 2004; 21(1): 18-21. doi: 10.1093/fampra/cmh105.

[12] Nutbeam D. Health literacy as a public health goal: 25 years on. Health Promot Int. 2025; 40(4): daaf119. doi: 10.1093/heapro/daaf119.

[13] Sørensen K, Van den Broucke S, Fullam J, Doyle G, Pelikan J, Slonska Z, et al. Health literacy and public health: a systematic review and integration of definitions and models. BMC Public Health. 2012; 12: 80. doi: 10.1186/1471-2458-12-80.

[14] Armstrong LE. Assessing hydration status: the elusive gold standard. J Am Coll Nutr. 2007; 26(5 Suppl): 575S-84S.doi:10.1080/07315724.2007.10719661.

[15] Cheuvront SN, Muñoz CX, Kenefick RW. The void in using urine concentration to assess population fluid intake adequacy or hydration status. Am J Clin Nutr. 2016; 104(3): 553-6. doi: 10.3945/ajcn.115.129858.

[16] Kouri TT, Hofmann W, Falbo R, Oyaert M, Schubert S, Gertsen JB, et al. The EFLM European Urinalysis Guideline 2023. Clin Chem Lab Med. 2024; 62(9): 1653-786. doi: 10.1515/cclm-2024-0070.