

International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Diagnostic Performance of Urine Dipstick Grades for Significant and Severe Proteinuria in Hypertensive Pregnancy

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Received: 14-05-2026
Accepted: 05-06-2026
Available online: 30-06-2026

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ABSTRACT

Background: Urine dipstick testing is rapid and inexpensive but is influenced by urinary concentration and observer interpretation. We evaluated whether dipstick grades discriminate significant and severe proteinuria in hypertensive pregnancy.
Methods: This secondary diagnostic-accuracy analysis included 150 women with paired urine dipstick and 24-hour urinary protein measurements. Dipstick results were 2+, 3+ or 4+. Outcomes were significant proteinuria (>300 mg/24 hours) and severe proteinuria (>2000 mg/24 hours). Diagnostic indices with Wilson 95% CIs and ROC areas were calculated.
Results: Dipstick grades were 2+ in 72 (48.0%), 3+ in 50 (33.3%) and 4+ in 28 (18.7%). For significant proteinuria, a threshold ≥3+ had sensitivity 69.0%, specificity 100%, PPV 100% and NPV 51.4% (AUC for ordinal grade 0.845). For severe proteinuria, ≥4+ had sensitivity 100%, specificity 98.4%, PPV 92.9% and NPV 100% (AUC 0.992). Spot P/C ratio outperformed dipstick grade for significant proteinuria (AUC difference 0.143; bootstrap 95% CI 0.101–0.187).
Conclusion: Higher dipstick grades showed strong discrimination in this selected dataset, particularly 4+ for >2000 mg/24 hours. Because no negative, trace or 1+ samples were included, these findings cannot establish dipstick performance for routine screening or exclusion of proteinuria.

Keywords: Urine dipstick; proteinuria; preeclampsia; diagnostic accuracy; 24-hour urine; hypertensive pregnancy.

INTRODUCTION

Urinary protein testing remains common in the evaluation of hypertensive pregnancy. Guidelines permit quantitative protein-to-creatinine (P/C) ratio testing and recognise limitations of visual dipsticks, especially when quantitative methods are unavailable.[1] Dipstick results are affected by urine concentration, pH, contamination, reagent characteristics and visual interpretation.[2–5]

A recent systematic review of 19 studies found that the 1+ threshold had pooled sensitivity of 68% and specificity of 85%, with substantial heterogeneity.[6] More recent comparative evidence similarly suggests that quantitative spot P/C ratios outperform dipstick testing for significant proteinuria.[7] Nevertheless, dipsticks remain attractive in resource-limited and urgent settings because results are immediate and require little laboratory infrastructure.

This study evaluated the diagnostic performance of ordinal dipstick grades against 24-hour protein excretion, separately for significant proteinuria (>300 mg/24 hours) and severe proteinuria (>2000 mg/24 hours), and compared ordinal dipstick discrimination with the spot P/C ratio.

METHODS

Study population and measurements: This was a secondary analysis of a prospective study of 150 hypertensive pregnant women beyond 28 weeks at Rajkiya Mahila Chikitsalaya/Zanana Hospital, Jawaharlal Nehru Medical College, Ajmer, during 2008–2009. Eligibility criteria and urine collection procedures were as described in the parent study. A visually read reagent-strip dipstick was followed by spot P/C ratio and 24-hour quantitative protein measurement.

Definitions: Significant proteinuria was defined as >300 mg/24 hours and severe proteinuria as >2000 mg/24 hours. Dipstick grade was analysed ordinally (2+, 3+, 4+). Thresholds ≥3+ and ≥4+ were evaluated. Because the dataset contained no negative, trace or 1+ result, conventional screening performance at ≥1+ or ≥2+ could not be estimated.

Statistical analysis: Cross-tabulations were assessed with the chi-square test. ROC analysis treated dipstick grade as an ordinal test. Sensitivity, specificity, predictive values and accuracy were reported with Wilson 95% CIs. A paired bootstrap with 5000 resamples estimated the AUC difference between dipstick grade and spot P/C ratio. Two-sided $p<0.05$ was significant.

RESULTS

Among 150 women, dipstick results were 2+ in 72 (48.0%), 3+ in 50 (33.3%) and 4+ in 28 (18.7%). Significant proteinuria was present in 113 (75.3%) and severe proteinuria in 26 (17.3%). All 37 women without significant proteinuria had a 2+ result; however, 35 additional women with a 2+ result had significant proteinuria. Of the 28 women with 4+, 26 had severe proteinuria.

Table 1: Dipstick grade by 24-hour protein category

Dipstick	≤300 mg	301–2000 mg	>2000 mg	Total
2+	37	35	0	72
3+	0	50	0	50
4+	0	2	26	28
Total	37	87	26	150

Association between dipstick grade and three-level proteinuria category: chi-square=182.16, df=4, p<0.001.

Table 2: Diagnostic performance of dipstick thresholds

Outcome	Threshold	Sensitivity	Specificity	PPV	NPV
>300 mg/24 h	≥3+	69.0% (60.0–76.8)	100.0% (90.6–100.0)	100.0% (95.3–100.0)	51.4% (40.1–62.6)
>300 mg/24 h	≥4+	24.8% (17.7–33.5)	100.0% (90.6–100.0)	100.0% (87.9–100.0)	30.3% (22.9–39.0)
>2000 mg/24 h	≥3+	100.0% (87.1–100.0)	58.1% (49.3–66.4)	33.3% (23.9–44.4)	100.0% (94.9–100.0)
>2000 mg/24 h	≥4+	100.0% (87.1–100.0)	98.4% (94.3–99.6)	92.9% (77.4–98.0)	100.0% (96.9–100.0)

Values are estimate (95% CI). CI=confidence interval; NPV=negative predictive value; PPV=positive predictive value.

Table 3: ROC discrimination of dipstick grade and spot P/C ratio

Outcome	Dipstick AUC (95% CI)	P/C AUC	AUC difference
>300 mg/24 h	0.845 (0.803–0.887)	0.989	0.143 (0.101–0.187)
>2000 mg/24 h	0.992 (0.980–1.000)	0.972	−0.020 (−0.087–0.017)

Dipstick AUC confidence intervals and paired AUC differences were obtained by bootstrap resampling.

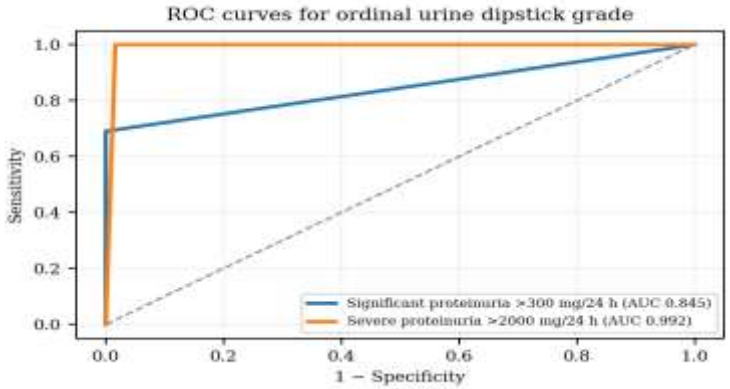

Figure 1: ROC curves for ordinal urine dipstick grade.

DISCUSSION

Dipstick grade was strongly associated with quantitative proteinuria in this selected cohort. A threshold ≥3+ was perfectly specific but only 69% sensitive for significant proteinuria. Conversely, 4+ separated severe proteinuria with 100% sensitivity and 98.4% specificity. The spot P/C ratio discriminated significant proteinuria better than ordinal dipstick grade. These findings accord directionally with evidence that increasing dipstick thresholds improve specificity at the cost of sensitivity. Waugh et al., Meyer et al. and Brown and Buddle documented clinically important dipstick misclassification.[2–4] Teeuw et al. reported pooled sensitivity of only 68% at 1+, concluding that dipsticks perform poorly as exclusion tests.[6] Olisa et al. recently found superior sensitivity and specificity for P/C ratio compared with dipstick testing.[7] Marnoch et al. likewise reported poorer correlation for dipsticks than for the quantitative P/C ratio.[8]

The apparently excellent performance of 4+ for >2000 mg/24 hours must be interpreted cautiously. Dipstick results in this dataset are unusually ordered relative to 24-hour protein: all non-proteinuric observations were 2+, all 3+ observations had 301–2000 mg, and nearly every 4+ observation exceeded 2000 mg.

Limitations

The absence of negative, trace and 1+ results creates spectrum restriction and prevents assessment of dipsticks as routine screening tests. The severe-proteinuria subgroup contained only 26 women, widening confidence intervals. The study was single-centre and performed in an earlier clinical era. Maternal and neonatal outcomes can also be studied and analysed.

CONCLUSION

Dipstick grades ≥3+ and 4+ were highly specific for significant and severe proteinuria, respectively, in this selected cohort, but lower grades could not reliably exclude >300 mg/24 hours. Quantitative testing, preferably a spot P/C ratio should be used for confirmation, when timely 24-hour collection is impractical.

ACKNOWLEDGEMENT

The authors acknowledge the patients and the clinical and laboratory staff involved in the original study. The authors also gratefully acknowledge Dr. Shailendra Vashistha and the VAssist Research team (www.thevassist.com) for their contribution to manuscript preparation and technical support during the manuscript submission process.

Conflict of interest: None.

Source of funding: Nil.

Ethical considerations: Ethics approval was obtained from the Institutional Ethics Committee of Jawaharlal Nehru Medical College, Ajmer; and informed-consent was taken from all the patients.

Data availability: De-identified data may be made available by the corresponding author on reasonable request, subject to institutional ethics approval and protection of participant confidentiality.

Use of artificial intelligence: ChatGPT assisted with language revision, and reference formatting. Authors confirmed responsibility for the final manuscript.

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