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**NEUROLOGICAL CORRELATES OF SUBCLINICAL BLEEDING BURDEN
IN HEALTHY MENSTRUATING FEMALES**

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Relevance. Bleeding disorders remain substantially underdiagnosed in females, with heavy menstrual bleeding frequently normalized. Beyond hematological consequences, accumulating evidence suggests that chronic, subclinical bleeding burden may be associated with neurological symptoms, including fatigue, cognitive dysfunction, dizziness, and restless legs phenomena. However, this relationship remains underexplored in otherwise healthy, undiagnosed populations.

Aim: To characterize the association between bleeding burden and neurological symptom load in healthy menstruating females and to explore potential underlying pathophysiological mechanisms.

Materials and methods. A cross-sectional online survey was conducted in 173 menstruating participants. Primary analysis was performed on 143 individuals after exclusion of hormonal contraceptive users to preserve physiological hormonal profiles. Two composite indices were constructed: a Bleeding Symptom Index (BSI), incorporating menstrual and systemic bleeding features, and a Neurological Symptom Index (NSI), capturing fatigue, cognitive dysfunction, dizziness, and restless legs symptoms. Statistical analysis was performed in R (v4.5.3) using Spearman correlation and mediation modeling. Findings were contextualized with current literature.

Results and their discussion. A statistically significant moderate positive correlation was observed between BSI and NSI (Spearman $r = 0.358$, 95% CI [0.206, 0.493], $p < 0.0001$). Sensitivity analysis in the full cohort confirmed robustness ($r = 0.401$, $p < 0.0001$). A distinct dose-response relationship was identified, with higher bleeding severity associated with progressively elevated neurological symptom scores. Symptom clustering revealed a predominant fatigue-dizziness-cognitive dysfunction triad, supporting a systemic mechanism. Mediation analysis demonstrated that self-reported anemia accounted for only 3.1% of the association, indicating that conventional anemia diagnosis inadequately captures the underlying pathway.

These findings suggest a mechanism operating below the clinical threshold of anemia, likely involving subclinical iron deficiency and tissue-level depletion. Iron functions as a rate-limiting cofactor for tyrosine hydroxylase in dopamine synthesis, providing a plausible link to executive dysfunction and restless legs phenomena. Additionally, menstrual cycle-related fluctuations in estrogen and progesterone may modulate dopaminergic and serotonergic pathways, further amplifying neurological symptom expression. Collectively, this supports the presence of a silent, systemic burden in which normalized heavy bleeding masks measurable neurological morbidity.

Conclusions. Undiagnosed bleeding burden in otherwise healthy females is associated with a measurable, significant, and dose-dependent increase in neurological symptoms. The minimal mediating role of anemia suggests that clinically “silent” iron deficiency and related systemic effects may underlie this relationship. Recognition of this hidden burden has important implications for early screening, particularly through ferritin-based assessment rather than reliance on overt anemia.