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**EVOLIUCINĖ MEDICINA:
ŽMOGAUS RAIDOS PERSPEKTYVOS IR SVEIKATA
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**EVOLUTIONARY MEDICINE:
PERSPECTIVES ON HUMAN DEVELOPMENT AND HEALTH
CONSEQUENCES IN A CHANGING ENVIRONMENT**

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STRESS-RELATED FACTORS AND EARLIER PUBERTAL DEVELOPMENT IN GIRLS: A SYSTEMATIC REVIEW

Ieva BAGDONAITĖ¹, Patricija SMIGELSKAITĖ¹, Janina TUTKUVIENĖ²

¹Faculty of Medicine, Vilnius University, Lithuania

²Department of Anatomy, Histology and Anthropology, Institute of Biomedical Sciences, Faculty of Medicine, Vilnius University, Lithuania

Contact e-mail: ieva.bagdonaite@mf.stud.vu.lt

Background and Aim: The age of pubertal onset in girls has been declining over recent decades. A range of stressors, including psychological, physical, metabolic and environmental factors, have been proposed as contributing causes. This systematic review aimed to assess associations between these stress domains and early pubertal development in girls.

Materials and Methods: This review was conducted in accordance with PRISMA guidelines. A systematic search of ScienceDirect and PubMed was performed using the terms "early puberty," "girls," "stress," and "early menarche." The initial search yielded 2,827 articles. After applying filters for publication date (2016–2026), English language, and open access, 346 articles remained. Eligible studies examined associations between psychological, physical, metabolic, or environmental stress and early pubertal development in girls. Duplicate records, studies unrelated to the topic, non-human research, and articles without available full text were excluded. Following title and abstract screening, 20 studies met the inclusion criteria and were retained for analysis.

Results: The strongest findings concerned metabolic and nutritional stress. Childhood overweight, obesity, rapid weight gain, poorer diet quality and pro-inflammatory dietary patterns were associated with earlier menarche or pubertal onset. Psychological and emotional stressors, including adverse childhood experiences, sexual abuse, family dysfunction and maternal stress, were also linked with earlier pubertal timing. Physical and somatic stressors showed less consistent associations, particularly for infections and small-for-gestational-age birth followed by catch-up growth. Environmental exposures, particularly endocrine-disrupting chemicals and air pollution, demonstrated biologically plausible but heterogeneous effects across studies.

Conclusions: Earlier pubertal timing in girls likely results from the interaction of metabolic, psychosocial, somatic, and environmental stress signals. The strongest evidence supports metabolic and psychological pathways, potentially mediated through increased adiposity, leptin and insulin signaling, hypothalamic-pituitary-adrenal axis activation, and endocrine disruption.

Keywords: early menarche, early puberty, girls, stress