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# APPLICATION OF NUMERICAL METHOD TO ANALYSE THE TREND OF BABIES WITH ABNORMALITIES

(*Penggunaan Kaedah Berangka untuk Menganalisis Trend Bayi dengan Keabnormalan*)

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*ABSTRACT*

Compartmental models are commonly used in epidemiology to study the dynamics of infectious diseases, but they can also be used to model other health outcomes, such as the incidence of babies born with abnormalities. In this study, we present a two-compartment model that divides the population of new-borns into babies born with abnormalities (unhealthy) and babies born without abnormalities (healthy). The model assumes that the incidence of abnormalities is a function of certain factors, such as maternal age or environmental factors, and that babies can transition between the compartments depending on their health status. We present the mathematical equations for this model and demonstrate how it can be simulated using MATLAB code. Our results show how the model can be used to simulate the dynamics of babies born with abnormalities over time, providing insights into the factors that influence their incidence and the effectiveness of interventions to reduce their occurrence. This model can be adapted and extended to explore more complex scenarios and study the impact of different interventions on the health outcomes of new-borns.

*Keywords*: baby abnormalities; healthy babies; predictor-corrector method; Runge-Kutta method

*ABSTRAK*

Model kompartmen biasanya digunakan dalam epidemiologi untuk mengkaji dinamik penyakit berjangkit, tetapi ia juga boleh digunakan untuk memodelkan hasil kesihatan lain, seperti kejadian bayi yang dilahirkan dengan keabnormalan. Dalam kajian ini, kami membentangkan model dua petak yang membahagikan populasi bayi baru lahir kepada bayi yang dilahirkan dengan keabnormalan (tidak sihat) dan bayi yang dilahirkan tanpa keabnormalan (sihat). Model ini menganggap bahawa kejadian keabnormalan adalah fungsi faktor-faktor tertentu, seperti usia ibu atau faktor persekitaran, dan bayi boleh beralih antara petak bergantung kepada status kesihatan mereka. Kami membentangkan persamaan matematik untuk model ini dan menunjukkan bagaimana ia boleh disimulasikan menggunakan kod MATLAB. Keputusan kami menunjukkan bagaimana model ini boleh digunakan untuk mensimulasikan dinamik bayi yang dilahirkan dengan keabnormalan dari masa ke masa, memberikan pandangan tentang faktor-faktor yang mempengaruhi kejadian mereka dan keberkesanan intervensi untuk mengurangkan kejadian mereka. Model ini boleh disesuaikan dan diperluaskan untuk meneroka senario yang lebih kompleks dan mengkaji kesan intervensi yang berbeza terhadap hasil kesihatan bayi baru lahir.

*Kata kunci*: keabnormalan bayi; bayi sihat; kaedah peramal-pembetul; kaedah *Runge-Kutta*

## References

Bae J.-M. 2016. A suggestion for quality assessment in systematic reviews of observational studies in nutritional epidemiology. *Epidemiol Health* **38**: e2016014.

Blue G.M., Kirk E.P., Sholler G.F., Harvey R.P. & Winlaw D.S. 2012. Congenital heart disease: current knowledge about causes and inheritance. *Med J Aust* **197**(3): 155–159.

Cleveland Clinic. 2021. Birth defects. https://my.clevelandclinic.org/health/diseases/12230-birth-defects (12 January 2023).
Dai L., Zhu J., Liang J., Wang Y.-P., Wang H. & Mao M. 2011. Birth defects surveillance in China. *World Journal of Pediatrics* **7**: 302–310.
Department of Statistics Malaysia. 2022. Vital statistics. https://open.dosm.gov.my/publications/vitalstatistics_2022 (12 January 2023).
Du Y., Xu X., Chu M., Guo Y. & Wang J. 2016. Air particulate matter and cardiovascular disease: the epidemiological, biomedical and clinical evidence. *Journal of Thoracic Disease* **8**(1): E8–E19.
Emmanuel S., Okoye I., Ezenweke C., Shobanke D. & Adeniyi I. 2023. Estimating nonlinear regression parameters using particle swarm optimization and genetic algorithm. *FUDMA Journal Of Sciences* **6**(6): 202-213.
Hwang B.-F., Lee Y.L. & Jaakkola J.J.K. 2015. Air pollution and the risk of cardiac defects: A population-based case-control study. *Medicine* **94**: e1883.
Liu Y., Chen S., Zühlke L., Black G.C., Choy M.K., Li N. & Keavney B.D. 2019. Global birth prevalence of congenital heart defects 1970–2017: updated systematic review and meta-analysis of 260 studies. *International Journal of Epidemiology* **48**(2): 455-463.
Moller A.-B., Petzold M., Chou D. & Say L. 2017. Early antenatal care visit: a systematic analysis of regional and global levels and trends of coverage from 1990 to 2013. *The Lancet Global Health* **5**(10): e977–e983.
Moss A.J., Gussoni C.C. & Isabel-Jones J. 1976. Echocardiography in congenital heart disease. *The Western Journal of Medicine* **124**(2): 102–121.
Thong M.K., Ho J.J. & Khatijah N.N. 2005. A population-based study of birth defects in Malaysia. *Annals of Human Biology* **32**(2): 180-187.
UNICEF. 2020. UNICEF Data: Monitoring the situation of children and women. https://data.unicef.org/country/mys/ (12 January 2023).
van der Linde D., Konings E.E., Slager M.A., Witsenburg M. Helbing W.A., Takkenberg J.J. & Roos-Hesselink J.W. 2011. Birth prevalence of congenital heart disease worldwide: a systematic review and meta-analysis. *Journal of the American College of Cardiology* **58**(21): 2241-2247.
Vrijheid M., Martinez D., Manzanares S., Dadvand P., Schembari A., Rankin, J. & Nieuwenhuijsen M. 2011. Ambient air pollution and risk of congenital anomalies: a systematic review and meta-analysis. *Environmental Health Perspective* **119**(5): 598–606.
World Health Organization. 2022. Congenital disorders. https://www.who.int/news-room/fact-sheets/detail/birth-defects (12 January 2023).
Zaidi S. & Brueckner M. 2017. Genetics and genomics of congenital heart disease. *Circulation Research* **120**: 923–940.

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