

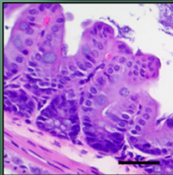


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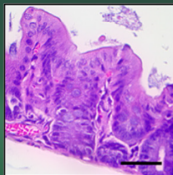
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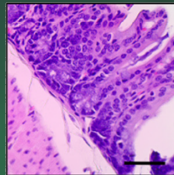
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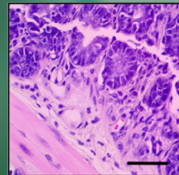
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**Week 8**



**Week 12**



# Biotin Deficiency Induces Intestinal Dysbiosis

Volume 15 • Issue 2 | January (II) 2023



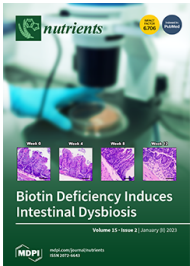
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## Nutrients, Volume 15, Issue 2 (January-2 2023) – 225 articles



**Cover Story** ([view full-size image \(/files/uploaded/covers/nutrients/big\\_cover-nutrients-v15-i2.png\)](#)): Biotin is an essential vitamin and critical cofactor in several metabolic pathways, and its deficiency has been linked to several disorders including inflammatory bowel disease (IBD). We previously reported that biotin deficiency (BD) in mice, whether modeled through intestine-specific deletion of biotin transporter (SMVT-icKO) or through a biotin-deficient diet, resulted in intestinal inflammation consistent with an IBD-like phenotype. To assess whether the gut microbiome is associated with these BD-induced changes, we collected stool and intestinal samples from both of these mouse models and utilized them for 16S rRNA gene sequencing. We find that both diet-mediated and deletion-mediated BD result in the expansion of opportunistic microbes including *Klebsiella*, *Enterobacter*, and *Helicobacter*, at the expense of mucus-resident microbes including *Akkermansia*. [View this paper \(https://www.mdpi.com/2072-6643/15/2/264\)](https://www.mdpi.com/2072-6643/15/2/264)

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**Bioactivity and Digestibility of Microalgae *Tetraselmis* sp. and *Nannochloropsis* sp. as Basis of Their Potential as Novel Functional Foods** (/2072-6643/15/2/477)

by [Samuel Paterson \(https://sciprofiles.com/profile/2017933\)](https://sciprofiles.com/profile/2017933), [Pilar Gómez-Cortés \(https://sciprofiles.com/profile/1143319\)](https://sciprofiles.com/profile/1143319), [Miguel Angel de la Fuente \(https://sciprofiles.com/profile/author/Nmg3L0dHemdkQjVSQTVzbTBpbTRCdz09\)](https://sciprofiles.com/profile/author/Nmg3L0dHemdkQjVSQTVzbTBpbTRCdz09) and [Blanca Hernández-Ledesma \(https://sciprofiles.com/profile/222162\)](https://sciprofiles.com/profile/222162)

*Nutrients* **2023**, *15*(2), 477; <https://doi.org/10.3390/nu15020477> (<https://doi.org/10.3390/nu15020477>) - 16 Jan 2023

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**Abstract** It is estimated that by 2050, the world's population will exceed 10 billion people, which will lead to a deterioration in global food security. To avoid aggravating this problem, FAO and WHO have recommended dietary changes to reduce the intake of animal calories [...]. [Read more.](#)

(This article belongs to the Special Issue **Role of Food Digestion and Digestive System in the Nutritional, Functional and Health Properties of Food Bioactives** (/journal/nutrients/special\_issues/Food\_Digestion\_and\_Digestive\_System))

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### Optimizing the Relationship between Regulation and Innovation in Dietary Supplements: A Case Study of Food with Function Claims in Japan (2072-6643/15/2/476)

by [Keigo Sato](https://sciprofiles.com/profile/1071404), [Kota Kodama](https://sciprofiles.com/profile/933461) and [Shintaro Sengoku](https://sciprofiles.com/profile/907357)

*Nutrients* 2023, 15(2), 476; <https://doi.org/10.3390/nu15020476> - 16 Jan 2023

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**Abstract** Regulation has long been a counterpart of innovation in the health care industry, and recent cases have demonstrated that appropriately designed regulations can both coexist with and promote innovation. This study is the first study to explore how the regulatory environment affected the [...]

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(This article belongs to the Topic [Recent Advances in Consumers' Preferences and Behavior toward Healthy and Functional Foods \(/topics/consumer\\_foods\)](#).)

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### Fructose Diet-Associated Molecular Alterations in Hypothalamus of Adolescent Rats: A Proteomic Approach (2072-6643/15/2/475)

by [Chiara D'Ambrosio](https://sciprofiles.com/profile/879119), [Luisa Cigliano](https://sciprofiles.com/profile/921581), [Arianna Mazzoli](https://sciprofiles.com/profile/842988), [Monica Matuozzo](https://sciprofiles.com/profile/author/YIgvTmZUVnBGcEc4SjIzSEx3RERpRVRYWJR2cW5PMnNiec9nZmMxd3VSOD0=), [Martina Nazzaro](https://sciprofiles.com/profile/1537505), [Andrea Scaloni](https://sciprofiles.com/profile/author/WGozNk5QL2d0WC8xUWs2cJloRUd1NIBmU0djbU1rbUJCL0NiRVVDTXJxcz0=), [Susanna Iossa](https://sciprofiles.com/profile/104957) and [Maria Stefania Spagnuolo](https://sciprofiles.com/profile/875207)

*Nutrients* 2023, 15(2), 475; <https://doi.org/10.3390/nu15020475> - 16 Jan 2023

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**Abstract** Background: The enhanced consumption of fructose as added sugar represents a major health concern. Due to the complexity and multiplicity of hypothalamic functions, we aim to point out early molecular alterations triggered by a sugar-rich diet throughout adolescence, and to verify their persistence [...]

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(This article belongs to the Special Issue [The Impact of Nutrition on Brain Metabolism and Disease \(/journal/nutrients/special\\_issues/brain\\_metabolism\)](#).)

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### Resveratrol Food Supplement Products and the Challenges of Accurate Label Information to Ensure Food Safety for Consumers (2072-6643/15/2/474)

by [Maja Bensa](https://sciprofiles.com/profile/2545662), [Irena Vovk](https://sciprofiles.com/profile/893474) and [Vesna Glavnik](https://sciprofiles.com/profile/912846)

*Nutrients* 2023, 15(2), 474; <https://doi.org/10.3390/nu15020474> - 16 Jan 2023

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**Abstract** The food supplement market is growing as many consumers wish to complement their nutrient intake. Despite all the regulations in place to ensure food supplements safety, there are still many cases of irregularities reported especially connected to internet sales. Twenty resveratrol food supplement [...]

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(This article belongs to the Special Issue [Food Supplements and Functional Foods Assessment for Health and Nutrition \(/journal/nutrients/special\\_issues/Food\\_Supplements\\_Assessment\\_Nutrition\)](#).)

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### Prevalence of Sarcopenic Obesity and Factors Influencing Body Composition in Persons with Spinal Cord Injury in Japan (2072-6643/15/2/473)

by [Ryu Ishimoto](https://sciprofiles.com/profile/2642826) (<https://sciprofiles.com/profile/2642826>), [Hiroataka Mutsuzaki](https://sciprofiles.com/profile/56402) (<https://sciprofiles.com/profile/56402>),  
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*Nutrients* **2023**, *15*(2), 473; <https://doi.org/10.3390/nu15020473> (<https://doi.org/10.3390/nu15020473>) - 16 Jan 2023

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**Abstract** This study aims to investigate the prevalence of sarcopenic obesity and factors influencing body composition in persons with spinal cord injury (SCI) in Japan. Adults with SCI aged  $\geq 20$  years who underwent whole-body dual-energy X-ray absorptiometry between 2016 and 2022 were retrospectively [...] [Read more](#).

(This article belongs to the Section [Clinical Nutrition](#) ([/journal/nutrients/sections/Clinical\\_Nutrition/](/journal/nutrients/sections/Clinical_Nutrition/)))

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### Ethnic Differences in Preferences for Lifestyle Intervention among Women after Childbirth: A Multi-Methods Study in Australia (2072-6643/15/2/472)

by [Mingling Chen](https://sciprofiles.com/profile/1815851) (<https://sciprofiles.com/profile/1815851>), [Maureen Makama](https://sciprofiles.com/profile/1382701) (<https://sciprofiles.com/profile/1382701>),  
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*Nutrients* **2023**, *15*(2), 472; <https://doi.org/10.3390/nu15020472> (<https://doi.org/10.3390/nu15020472>) - 16 Jan 2023

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**Abstract** Postpartum weight retention contributes to maternal obesity and varies by ethnicity. Despite the well-established benefits of lifestyle intervention on weight management, little is known about how to engage postpartum women effectively, especially among ethnic minority groups. This multi-methods study aimed to explore ethnic [...] [Read more](#).

(This article belongs to the Special Issue [Dietary Interventions and Women's Health](#) ([/journal/nutrients/special\\_issues/3WDV384J21/](/journal/nutrients/special_issues/3WDV384J21/)))

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### Gut Microbiome Composition and Metabolic Capacity Differ by FUT2 Secretor Status in Exclusively Breastfed Infants (2072-6643/15/2/471)

by [Alexander W. Thorman](https://sciprofiles.com/profile/author/QzFYUIVvVUpXZkldzhKWksrbFQ0WW82bmZJc0xsb1MyWDNIQU00NFZBOD0=) (<https://sciprofiles.com/profile/author/QzFYUIVvVUpXZkldzhKWksrbFQ0WW82bmZJc0xsb1MyWDNIQU00NFZBOD0=>),  
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*Nutrients* **2023**, *15*(2), 471; <https://doi.org/10.3390/nu15020471> (<https://doi.org/10.3390/nu15020471>) - 16 Jan 2023

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**Abstract** A major polymorphism in the fucosyltransferase2 (*FUT2*) gene influences risk of multiple gut diseases, but its impact on the microbiome of breastfed infants was unknown. In individuals with an active *FUT2* enzyme ("secretors"), the intestinal mucosa is abundantly fucosylated, providing mutualist [...] [Read more](#).

(This article belongs to the Special Issue [Effects of Breast Milk and Formula on Infant Intestinal Health and the Infant Gut Microbiome](#) ([/journal/nutrients/special\\_issues/Breast\\_Milk\\_Formula\\_Infant\\_Intestinal\\_Gut\\_Microbiome/](/journal/nutrients/special_issues/Breast_Milk_Formula_Infant_Intestinal_Gut_Microbiome/)))

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**Barriers and Facilitators of the Consumption of Animal-Based Protein-Rich Foods in Older Adults: Re-Analysis with a Focus on Sustainability** (2072-6643/15/2/470)

by [Katherine M. Appleton](https://sciprofiles.com/profile/2491916) (https://sciprofiles.com/profile/2491916)

Nutrients 2023, 15(2), 470; <https://doi.org/10.3390/nu15020470> (https://doi.org/10.3390/nu15020470) - 16 Jan 2023

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**Abstract** Older adults may gain health benefits from the consumption of animal-based protein-rich foods, but environmental pressures suggest advocating some meat and dairy foods over others, and understanding the barriers and facilitators for consuming these different foods would be of value. Existing data on [...] [Read more.](#)

(This article belongs to the Special Issue **Dietary and Lifestyle-Related Behaviours in Community-Dwelling Older Adults** (/journal/nutrients/special\_issues/Lifestyle\_Older/))

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**Effects of Interaction between SLC35F3 and Carbohydrate Intake on the Incidence of Metabolic Syndrome in Korean Middle-Aged Adults** (2072-6643/15/2/469)

by [Haeun Park](https://sciprofiles.com/profile/1982698) (https://sciprofiles.com/profile/1982698) and [Dayeon Shin](https://sciprofiles.com/profile/872833) (https://sciprofiles.com/profile/872833)

Nutrients 2023, 15(2), 469; <https://doi.org/10.3390/nu15020469> (https://doi.org/10.3390/nu15020469) - 16 Jan 2023

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**Abstract** Solute carrier family 35 member F3 (SLC35F3) mediates intracellular thiamine transport, which is crucial for carbohydrate metabolism as thiamine is required for key pathways such as glycolysis and the tricarboxylic acid cycle. This study aimed to investigate the impact of the [...] [Read more.](#)

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[./2072-6643/15/2/468/pdf?version=1673878329](https://doi.org/10.3390/nu15020468/pdf?version=1673878329)

**Siraitia grosvenorii Extract Attenuates Airway Inflammation in a Murine Model of Chronic Obstructive Pulmonary Disease Induced by Cigarette Smoke and Lipopolysaccharide** (2072-6643/15/2/468)

by [Mi-Sun Kim](https://sciprofiles.com/profile/author/cWIPTXJoMFVsbFRVMXVvYWYya3BSR2xpOHhMZ3NvWUhzNGxpNjNRWkLJLZz0=) (https://sciprofiles.com/profile/author/cWIPTXJoMFVsbFRVMXVvYWYya3BSR2xpOHhMZ3NvWUhzNGxpNjNRWkLJLZz0=),

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[Yoon-Young Sung](https://sciprofiles.com/profile/519402) (https://sciprofiles.com/profile/519402)

Nutrients 2023, 15(2), 468; <https://doi.org/10.3390/nu15020468> (https://doi.org/10.3390/nu15020468) - 16 Jan 2023

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**Abstract** We studied the activities of *Siraitia grosvenorii* extracts (SGE) on airway inflammation in a mouse model of chronic obstructive pulmonary disease (COPD) stimulated by cigarette smoke extract (CSE) and lipopolysaccharide (LPS), as well as in LPS-treated human bronchial epithelial cell line (BEAS-2B). SGE [...] [Read more.](#)

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**Does Bariatric Surgery Reduce the Risk of Colorectal Cancer in Individuals with Morbid Obesity? A Systematic Review and Meta-Analysis** (2072-6643/15/2/467)

by [Andrea Chierici](https://sciprofiles.com/profile/author/YkJxK2diWEI3RVpSSGdmaXR2N1pCaGxIQ0JZZW4raUJwZXhIUmxGaVRJWT0=) (https://sciprofiles.com/profile/author/YkJxK2diWEI3RVpSSGdmaXR2N1pCaGxIQ0JZZW4raUJwZXhIUmxGaVRJWT0=),

[Paolo Amoretti](https://sciprofiles.com/profile/author/a2VRVGVYcVlyVmJKdTBSOTd1WXA3cFk0emNKNSsxUERkdERYSm55d01uMD0=) (https://sciprofiles.com/profile/author/a2VRVGVYcVlyVmJKdTBSOTd1WXA3cFk0emNKNSsxUERkdERYSm55d01uMD0=),

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**Abstract** Bariatric surgery has shown to be effective in producing sustained weight loss and the resolution of obesity related medical problems. Recent research focused on the role of obesity and adipose tissue in tumorigenesis, finding a strong crosslink through different mechanisms and highlighting an [...] [Read more.](#)

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**The Impact of the COVID-19 Pandemic on Public Interest in the Energy Labelling on Restaurant Menus (/2072-6643/15/2/466)**

by [Areej A. Alkhalidy \(https://sciprofiles.com/profile/632713\)](#),

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*Nutrients* **2023**, *15*(2), 466; <https://doi.org/10.3390/nu15020466> (<https://doi.org/10.3390/nu15020466>) - 16 Jan 2023

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**Abstract** No study has investigated the effect of the COVID-19 pandemic on the public's interest in using energy labelling on restaurant menus. This study explores the effects of the COVID-19 pandemic on the public interest in using energy labelling on restaurant menus and meal [...] [Read more.](#)

(This article belongs to the Special Issue [Body Weight and Food/Eating-Related Behaviours during COVID-19 Pandemic, Traumatic or Stressful Life Events \(/journal/nutrients/special\\_issues/90BSD41K93\)](#))

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**Policy to Decrease Low Birth Weight in Indonesia: Who Should Be the Target? (/2072-6643/15/2/465)**

by [Ratna Dwi Wulandari \(https://sciprofiles.com/profile/1946537\)](#), [Agung Dwi Laksono \(https://sciprofiles.com/profile/2378570\)](#) and

[Ratu Matahari \(https://sciprofiles.com/profile/author/MjAvb0gxdnJjcUNtbWdWdTBTtR3BCak5VaE1WTUdNSDROUXyZQ21yRmJrcz0=\)](#)

*Nutrients* **2023**, *15*(2), 465; <https://doi.org/10.3390/nu15020465> (<https://doi.org/10.3390/nu15020465>) - 16 Jan 2023

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**Abstract** The study aimed to analyze the target of the policy to decrease low birth weight (LBW) in Indonesia. This cross-sectional study used a sample of live births in last five years preceding the survey of birth weight. Data collection took place from July [...] [Read more.](#)

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**Bioactive Molecules from Marine Diatoms and Their Value for the Nutraceutical Industry (/2072-6643/15/2/464)**

by [Paola Nieri \(https://sciprofiles.com/profile/1917091\)](#), [Sara Carpi \(https://sciprofiles.com/profile/703902\)](#),

[Roberta Esposito \(https://sciprofiles.com/profile/1701832\)](#), [Maria Costantini \(https://sciprofiles.com/profile/35807\)](#) and

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**Abstract** The search for novel sources of nutrients is among the basic goals for achievement of sustainable progress. In this context, microalgae are relevant organisms, being rich in high-value compounds and able to grow in open ponds or photobioreactors, thus enabling profitable exploitation of [...] [Read more.](#)

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Department of Medical Biotechnology, Yeungnam University, Gyeongsan, Korea

**Interests:** extracellular matrix; skeletal muscle and metabolic disorders; neurodegenerative disorders; bioinformatics and computational biology; computer-aided drug design; in silico approaches



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**Interests:** Food safety, Antioxidants, Antimicrobial, food microbiology, food processing

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University of the Balearic Islands and CIBER Fisiopatología de la Obesidad y Nutrición (CIBEROBN), Palma de Mallorca, Spain

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The Pediatric Gastroenterology, Hepatology & Nutrition Clinic; Dana-Dwek Children's Hospital; The Tel-Aviv Medical Center; Tel-Aviv University; 6 Weizmann St. Tel-Aviv, Zip 6423906, Israel

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School of Health Sciences, Liverpool Hope University, Liverpool, UK

**Interests:** Young Adults; nutritional assessments; older adults; zinc requirements; cardiometabolic risk; energy balance

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**Dr. Elitsa Ananieva**

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**Interests:** branched-chain amino acid metabolism; amino acids; cancer; T cell metabolism; Glucose Metabolism; mtor signaling

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Human-Centered Mobility Research Center, Information Technology and Human Factors, National Institute of Advanced Industrial Science and Technology, Tsukuba, Ibaraki 305-8566, Japan.

**Interests:** energy expenditure; energy intake; energy metabolism; appetite; physical activity; cognitive function

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**Dr. Gowtham K Annarapu**

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Department of Medicine, Vascular Medicine Institute, University of Pittsburgh, Pittsburgh, USA

**Interests:** type 2 diabetes; mitochondrial bioenergetics; obesity; platelet biology; vascular biology; hematology

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Department of Pharmacy, University of Naples Federico II, Via Domenico Montesano 49, 80131 Naples, Italy

**Interests:** nutraceutical; nutrition; polyphenols; antioxidant

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**Dr. Sandro Arguelles**

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Department of Physiology, Faculty of Pharmacy at University of Seville, Seville, Spain

**Interests:** oxidative stress; aging; cancer; antioxidants

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**Dr. Shinichi Asano**

**Website** (<https://www.wvsom.edu/research/faculty/shinichi-asano>)

Department of Biomedical Sciences, West Virginia School of Osteopathic Medicine, Lewisburg, WV 24901, USA

**Interests:** obesity; vascular physiology; inflammation; physical activity; lifestyle medicine

---

**Dr. Petjon Ballico**

**Website** (<https://portalcientifico.cita-aragon.es/ipublic/profile/index/iMarinaID/04-315259/name/BALLCO%20,%20PETJON>)

Departamento de Economía Agroalimentaria y de los Recursos Naturales, Centro de Investigación y Tecnología Agroalimentaria de Aragón, Zaragoza, Spain

**Interests:** eye-tracking and sustainable packaging; choice experiments and food choices; hedonic price analysis on food labelling; virtual reality in consumer behaviour and nutrition labeling

---

**Dr. Kalpita Banerjee**

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Weill Cornell Medical College, Department of Ophthalmology, New York, USA

**Interests:** Neurodegeneration; cellular signaling; mitochondria; stress

---

**Dr. Sudip Banerjee**

**Website** ([https://www.msm.edu/about\\_us/FacultyDirectory/Medicine/SudipBanerjee/index.php](https://www.msm.edu/about_us/FacultyDirectory/Medicine/SudipBanerjee/index.php))

Department of Medicine, Morehouse School of Medicine, Atlanta, USA

**Interests:** inflammation; gastrointestinal inflammation/injury; innate immunity; inflammatory bowel disease (IBD); mitochondria, oxidative stress, Reactive Oxygen Species; reactive nitrogen species; ionizing radiation; acute radiation syndrome; metal toxicity, melatonin

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**Dr. Tanushree Banerjee**

**Website** (<https://profiles.ucsf.edu/tanushree.banerjee>)

Department of General Internal Medicine, University of California, San Francisco, USA

**Interests:** chronic kidney disease (ckd); patient outcomes; quality of life; nutritional risk factors; hiv

---

**Dr. Reena Bapputty**

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Pediatric Endocrinology, School of Medicine, Case Western Reserve University, Cleveland, Ohio, USA

**Interests:** complications of diabetes; diabetic retinopathy; inflammatory markers; retinopathy

---

**Dr. Maria Cristina Barbalace**

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Department for Life Quality Studies, University of Bologna, 47921 Rimini, Italy

**Interests:** nutraceuticals; Oxidative stress; Neuroinflammation; Neurodegeneration; bioactive compounds; natural compounds; cell cultures

---

**Dr. Elizabeth Barber**

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Department of Nutrition, Dietetics and Food, Monash University, Notting Hill 3168, Australia

**Interests:** nutrition; foods; diabetes; polyphenol; Metabolism; carbohydrate; Fat; omega-3

---

**Dr. Iliaria Barchetta**

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Department of Experimental Medicine, Sapienza University of Rome, Viale Regina Elena 324, 00161 Rome, Italy

**Interests:** diabetes; obesity; NAFLD; Gut peptides; inflammation; Adipose Tissue; Liver; clinical research

---

**Dr. Ewa Barg**

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Department of Basic Medical Sciences, Wrocław Medical University, ul. Borowska 211, 50-556, Wrocław, Poland

**Interests:** Endocrinology; metabolic disorders; late effects of oncological therapy

---

**Dr. Michael J. Barratt**

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Department of Pathology and Immunology, Washington University School of Medicine, St Louis, MO 63110, USA

**Interests:** microbiome; microbiota; malnutrition; probiotics; Prebiotics; Synbiotics; gut health

---

**Dr. Tessa Barrett**

**Website** (<https://med.nyu.edu/faculty/tessa-j-barrett>)

Department of Medicine, New York University School of Medicine, New York 10016, NY, USA

**Interests:** atherosclerosis; Thrombosis; inflammation; platelets; myeloid cells; diabetes

---

**Dr. Renata Barros**

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New, Adjacent and Disruptive Innovation, Amway Corporation, Ada, MI 49505 USA

**Interests:** carotenoids; Skin Nutrition; anti-oxidants; lutein; astaxanthin; nails; hair



**Dr. Anja Baumann**

**Website** (<https://nutrition.univie.ac.at/en/research/professorship-molecular-nutritional-sciences-univ-prof-dr-ina-bergheim/team/>)

Department of Nutritional Sciences, Molecular Nutritional Science, University of Vienna, Althanstr. 14, UZAll, 1090 Vienna, Austria

**Interests:** nutrition; liver disease; metabolic disease; gut-liver-axis; intestinal permeability; aging

**Dr. Kristine Beaulieu**

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School of Psychology, University of Leeds, Leeds, LS2 9JT, United Kingdom

**Interests:** physical activity; appetite control; energy balance; food reward; energy restriction; human research



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Health and Wellness Studies Department, The State University of New York at Binghamton, Binghamton, NY 13902, USA

**Interests:** dietary and lifestyle factors and brain function ( cognitive, mental health, sleep and others) with a special interest in age groups and gender differences

**Dr. Fabiën Belle**

**Website**

([https://www.ispm.unibe.ch/research/research\\_groups/child\\_and\\_adolescent\\_health/paediatric\\_cancer\\_epidemiology\\_group/index\\_eng.html](https://www.ispm.unibe.ch/research/research_groups/child_and_adolescent_health/paediatric_cancer_epidemiology_group/index_eng.html))

Childhood Cancer Research Group, Institute of Social and Preventive Medicine (ISPM), University of Bern, 3012 Bern, Switzerland; Center for Primary Care and Public Health (Unisanté), University of Lausanne, 1010 Lausanne, Switzerland

**Interests:** nutritional epidemiology; cancer; childhood cancer; obesity; childhood cancer survivors; late effects



**Dr. Francesco Bennardo**

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School of Dentistry, Department of Health Sciences, Magna Graecia University of Catanzaro, Viale Europa, 88100 Catanzaro, CZ, Italy

**Interests:** Dentistry; digital dentistry; implantology; oral medicine; oral pathology; oral surgery; osteonecrosis of the jaw; platelet concentrate; platelet-rich fibrin; Platelet-Rich Plasma

**Dr. Russell Best**

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**Interests:** sport nutrition; ergogenic aids; menthol; supplements; Environmental Physiology

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1. Center for Infectious Medicine, Department of Medicine, Karolinska Institute, Stockholm, Sweden.

2. Department of Pathology, College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia.

**Interests:** tuberculosis; vitamin d deficiency; Immunological protection; immunomodulation; hiv

**Dr. Guillaume Bidault**

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1. Institute of Metabolic Science, MDU MRC. University of Cambridge Metabolic Research Laboratories, CB2 0QQ Cambridge, UK

2. Addenbrooke's Hospital, Hills Rd, Cambridge, CB2 0SP, UK.

**Interests:** obesity; Adipose Tissue; immunity; Macrophages; cardiovascular diseases; Metabolism

**Dr. Jessica Daus Bihuniak**

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Department of Nutrition and Food Studies, Steinhardt School, New York University, 411 Lafayette Street, 5th Floor, New York, NY 10003, USA

**Interests:** clinical research; behavioral weight loss; Young Adults; college students; older adults; Bone health; Mediterranean diet

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The Nutrition Group, Department of Epidemiologic Research, Statens Serum Institut, Copenhagen, Denmark

**Interests:** nutrition; epidemiology; adolescence; dietary assessment; physical activity

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**Prof. Dr. Sonia Blaney**

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School of food sciences, nutrition and family studies, Université de Moncton, New Brunswick, Canada

**Interests:** infant and young child feeding; adolescent Nutrition



**Dr. Vincent Blasco-baque**

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Université Paul Sabatier III (UPS), F-31432, Toulouse, France

**Interests:** gut microbiota; obese; oral health; high-fat diet

**Dr. Monika Boberska**

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**Interests:** healthy diet; promotion programs; childhood obesity; food availability

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Department of Treatment of Obesity, Metabolic Disorders and Clinical Dietetics, Poznan University of Medical Sciences, Poznan, Poland

**Interests:** obesity; insulin resistance; dyslipidemia; metabolic syndrome; type 2 diabetes; microbiota

**Prof. Dr. Ali Boolani**

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Department of Physical Therapy, Department of Biology, Clarkson University, Potsdam, NY, USA

**Interests:** physical activity; energy; exercise physiology; fatigue; exercise; sleep; diet; exercise psychology; fall risks; anti-racism; predicting moods

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Unit of Molecular Biology, School of Pharmacy, University of Camerino, 62032 Camerino, Italy

**Interests:** nutrigenomics; Epigenetics; molecular nutrition; nutrigenetics; Early-life nutrition; obesity

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Neurologic Clinic, Fondazione IRCCS Istituto neurologico Carlo Besta, 20133 Milan, Italy

**Interests:** neurology; neuro-oncology psychiatry; neuropharmacology

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Department of Sport, Exercise and Rehabilitation, Northumbria University, Newcastle Upon Tyne, NE1 8ST, UK

**Interests:** Sport-Nutrition; energy-intake; energy-expenditure; adolescent; elite

**Dr. Sabri Bromage**

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Department of Nutrition, Harvard T.H. Chan School of Public Health, Boston, MA 02115, USA

**Interests:** dietary assessment; diet quality; nutritional epidemiology; nutrition surveillance; international nutrition

**Dr. Ronald B. Brown**

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School of Public Health and Health Systems, University of Waterloo, Waterloo, Ontario N2L 3G1, Canada

**Interests:** pathophysiology; epidemiology; Grounded Theory; psychology; dietetics

**Dr. Alejandro Gomez Bruton**

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Department of Psychiatry and Nursing, Faculty of health and sport sciences, University of Zaragoza, 50012 Zaragoza, Spain

**Interests:** body composition; caffeine supplementation; bone; exercise; physical activity

**Prof. Dr. Anna Brytek-Matera**

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Institute of Psychology, Nutritional Psychology Unit, University of Wroclaw, 50-527 Wroclaw, Poland

**Interests:** nutritional psychology; eating disorders; orthorexia nervosa; obesity; eating behaviours

**Dr. Michał Brzeziński**

**Website** (<https://gumed.edu.pl/42769.html>)

Department of Paediatrics, Gastroenterology, Allergology and Pediatric Nutrition, Medical University of Gdańsk, Gdańsk, Poland

**Interests:** nutrition; paediatric obesity; vitamin d; underweight; parenteral nutrition; enteral nutrition; public health nutrition

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Australian Centre for Pacific Islands Research; School of Health and Sport Sciences, University of the Sunshine Coast, Maroochydore, 4557, Australia

**Interests:** pacific islands; food choice; food security; school food and nutrition education; sustainability

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University of Alaska Anchorage, Department of Biological Sciences, Anchorage, AK, 99508, United States

**Interests:** copper; zinc; Cirrhosis; NAFLD; wilson disease

---

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1. Instituto de Investigación Sanitaria La Fe de Valencia, Cystic Fibrosis Unit, 46026 Valencia, Spain

2. Universitat Politècnica de València, Research Institute of Food Engineering for Development, 46022 Valencia, Spain

**Interests:** in vitro digestion; pancreatic insufficiency; cystic fibrosis; dietary habits; lipids; lipolysis

---

**Dr. Sara C. Campbell**

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Department of Kinesiology and Health, Rutgers University, New Brunswick, NJ 08901, USA

**Interests:** gut microbiome; high fat diet; inflammation; exercise; Functional Foods; intestinal health; Metabolism

---

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Medical-Surgical Department of Clinical Sciences and Translational Medicine, University Sapienza, via di Grottarossa 1035–1039, 00189, Rome, Italy

**Interests:** diverticular disease; diverticulitis; Dyspepsia; Gastroesophageal Reflux Disease; Atrophic Gastritis; gastrointestinal malabsorption

---

**Prof. Dr. Jeffrey E. Cassisi**

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Department of Psychology, University of Central Florida, Orlando, FL 32816 USA

**Interests:** eating behaviors; mental health; diabetes; metabolic syndrome; Psychological Assessment

---

**Dr. Jesus Castro-Marrero**

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Vall d'Hebron Research Institute (VHIR), Division of Rheumatology, ME/CFS Research Unit, Universitat Autònoma de Barcelona, E-08035 - Barcelona, Spain

**Interests:** chronic fatigue syndrome; myalgic encephalomyelitis; nutraceutical; antioxidants; fibromyalgia; nutritional supplements; population-based interventions

---

**Prof. Dr. Manuel Castro-Sanchez**

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Department of Didactics of Musical, Plastic and Corporal Expression, University of Granada, 18071 Granada, Spain

**Interests:** bullying; education; emotional intelligence; health; Mediterranean diet; motivational climate; Physical Education; psychology; self-concept; Sport; violence

---

**Dr. Simona Censi**

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Endocrinology Unit, Department of Medicine (DIMED), University of Padua, Via Ospedale Civile 105, 35121, Padua, Italy

**Interests:** Iodine; thyroid; Endocrinology; Metabolism; Thyroid Cancer

---

**Dr. Hala Chaaban**

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Department of Pediatrics, Neonatal-Perinatal Medicine The University of Oklahoma Health Sciences Center

**Interests:** necrotizing enterocolitis; intestinal inflammation; Intestinal Development; Neonatal Sepsis; Intestinal invasion; intestinal permeability

---

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**Website** (<https://www.healthcare4ppl.com/physician/arkansas/fort-smith/surbhi-chamaria-1649583923.html>)

Interventional Cardiology, Mercy Hospital, Fort Smith, Arkansas, USA

**Interests:** heart healthy diet; DASH diet; nutrition involving cardiovascular diseases; diabetic diet

---

**Dr. Mei-Wei Chang**

**Website** (<https://nursing.osu.edu/faculty-and-staff/mei-wei-chang>)

The Ohio State University

**Interests:** low-income, obesity, stress, intervention, diet, physical activity, psychosocial factors

---

**Dr. Blesson Chellakkan**

**Website** (<https://www.bcm.edu/people-search/blesson-chellakkan-selvanesan-19320>)

Reproductive Endocrinology and Infertility Division, Department of Obstetrics and Gynecology, Baylor College of Medicine, Houston, Texas, USA

Family Fertility Center, Texas Childrens Hospital, Houston, Texas, USA

**Interests:** Low protein programming; Glucose Metabolism; mitochondria; nutrition and reproduction

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Department of food Science, Nutrition, and Nutraceutical Biotechnology, Shih Chien University, Taipei 10462, Taiwan

**Interests:** children; infant; vitamin d; diabetes; immunity

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Department of Medical-Surgical Sciences and Bio-Technologies, Sapienza University of Rome, Latina, Italy

**Interests:** pathology; cancer; gene regulation; molecular biology; Adipose Tissue



**Dr. Havovi Chichger**

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Biomedical Research Group, School of Life Sciences, Faculty of Science and Engineering, Anglia Ruskin University, Cambridge CB1 1PT, UK

**Interests:** vascular biology; endothelium; epithelium; diabetes; sweeteners; respiratory distress syndrome

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Cardiovascular and Metabolic Sciences, Lerner Research Institute, Cleveland Clinic, Cleveland, OH, USA

**Interests:** molecular biology; cell biology; Microbiology; cancer; Signal Transduction; tumor; breast cancer

**Dr. Ping-Fing Chiu**

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1. Division of Nephrology, Department of Internal Medicine, Changhua Christian Hospital, Changhua, Taiwan

2. Department of Hospitality management, Mindao University, Changhua, Taiwan

**Interests:** chronic kidney disease; dialysis; renal transplant; acute kidney disease; End Stage Renal Disease

**Prof. Dr. Yu-Ching Chou**

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School of Public Health, National Defense Medical Center, Taipei City 114, Taiwan (R.O.C.)

**Interests:** epidemiology; Applied Biostatistics; data analysis; molecular epidemiology; cancer epidemiology; public health

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Leicester Medical School, University of Leicester, Leicester, Leicestershire, George Davies Centre, Lancaster Road, LE17HA, UK

**Interests:** vitamin d; Medical Education; iron nutrition; geriatric nutrition; nutrition in respiratory illness

**Dr. Jakub Chycki**

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The Sport Science Institute, The Academy of Physical Education in Katowice, Poland

**Interests:** anaerobic performance; buffer capacity; bicarbonate; Ketogenic Diet; Creatine

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University of Salerno, Department of Medicine, Surgery and Dentistry, Scuola Medica Salernitana

**Interests:** small intestine, celiac, irritable bowel disease, functional, inflammatory bowel disease

**Dr. Valentina Ciappolino**

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Fondazione IRCCS Ca' Granda-Ospedale Maggiore Policlinico, Department of Neurosciences and Mental Health, 20122 Milan, Italy

**Interests:** n-3 pufas; nutritional psychiatry; Affective Disorder; zinc; vitamin d; psychosis

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Department of Biology and Biotechnology, University of Warmia and Mazury, 10-719 Olsztyn, Poland

**Interests:** genetic polymorphism; SNP; milk; cancer; vitamin d; serotonin

**Prof. Dr. Raffaele Ivan Cincione**

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Department of Clinical and Experimental Medicine, University of Foggia, Polyclinic "United Hospitals of Foggia", 71122 Foggia, Puglia, Italy

**Interests:** low carb and ketogenic diet; nutritional diabetes reversing; obesity and metabolic inflexibility; body composition; exogenous ketosis; energy metabolism and sport nutrition; adjuvant metabolic therapy in neoplasms and neurodegenerative diseases; impaired intestinal permeability and microbiota

**Dr. Neil Clarke**

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School of Life Sciences, Faculty Research Centre for Sport, Exercise and Life Sciences, Coventry University, Coventry, CV1 2DS, UK.

**Interests:** nutritional ergogenic aids; carbohydrate supplementation; caffeine and coffee; hydration and rehydration

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**Interests:** Pregnant and lactating Mother; Perinatal & Neonatal Nutrition; Lipids; human milk

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**Interests:** gut microbiota; proteomics; metabolomics; Cardiovascular Diseases and nutritions



**Dr. Maria Correa-Rodríguez**

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Health Sciences Faculty, University of Granada (UGR), Avenida de la Ilustración s/n, 18100-Armilla (Granada), Spain.; Instituto de Investigación

Biosanitaria, IBS. Avda. de Madrid, 15. Pabellón de consultas externas 2, 2ª planta, 18012 Granada, Spain

**Interests:** obesity; metabolic syndrome; dietary assessment; Anthropometry

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Department of Basic Medical Sciences, College of Osteopathic Medicine, Western University of Health Sciences, Pomona, CA 91766, USA

**Interests:** gut microbiota; obesity; food intake; diabetes; gut hormones

**Prof. Dr. Paula Crespo-Escobar**

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Health Science Department, Universidad Europea Miguel de Cervantes, Valladolid, Spain

**Interests:** gluten free diet; nutritional status; nutritional assessment; nutritional epidemiology; food allergies; infant nutrition

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Warsaw University of Life Sciences 02-776 Warsaw Nowoursynowska 159C str.

**Interests:** Food Technology; Human nutrition; catering technology; food quality; food safety; sensory analysis; food street; nutrition value; physicochemical evaluation; sous-vide

**Dr. Ewelina Czenczek- Lewandowska**

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Institute of Health Sciences, Medical College, University of Rzeszów, Al. Kopisto 2a, 35-959 Rzeszów, Poland

**Interests:** diabetes type 1; childhood obesity; physical activity; diet; disability; Health Behaviours; physical therapy; rehabilitation; Oral Rehabilitation

**Dr. Enza D'auria**

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Department of Pediatrics-Vittore Buzzi Children's Hospital, University of Milan, 20154 Milan, Italy

**Interests:** food allergy; atopic dermatitis; allergy; microbiota; endotypes; Complementary feeding

**Dr. Lanfranco D'Elia**

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Department of Clinical Medicine and Surgery, "Federico II" University of Naples Medical School Via S. Pansini, 580131-Naples, Italy

**Interests:** salt intake; potassium intake; Cardiovascular Disease; hypertension; meta-analysis

**Dr. David Daguet**

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**Interests:** plant extracts; fibers; gut health; nutrition; food supplements

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Joslin Diabetes Center, Section on Integrative Physiology and Metabolism, Boston, MA 02215, USA

**Interests:** aging; Metabolism; Brown Adipose Tissue; Thermogenesis; senescence

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## Article

# Policy to Decrease Low Birth Weight in Indonesia: Who Should Be the Target?

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**Abstract:** The study aimed to analyze the target of the policy to decrease low birth weight (LBW) in Indonesia. This cross-sectional study used a sample of live births in last five years preceding the survey of birth weight. Data collection took place from July to September 2017. The weighted sample size was 17,848 participants. The variables analyzed included residence, age, marital status, education, employment, parity, and wealth. The study employed binary logistic regression in the final stage to determine the target of policy regarding LBW. The results showed that women in urban areas were 1.200 times more likely to deliver babies with LBW than women in rural areas. All age groups were less likely to deliver babies with LBW than those aged 45–49. The study also found all marital statuses had a lower likelihood of providing babies with LBW than those who had never been in a marriage. Women of all education levels had a greater risk of giving birth to babies with LBW than women with higher education levels. Unemployed women had 1.033 times more chances of delivering babies with LBW than employed women. Primiparous women were 1.132 times more likely to give birth to babies with LBW than multiparous women. Overall, the women in all wealth status categories had a higher probability of delivering babies with LBW than the wealthiest groups. The study concluded that policymakers should target women who live in urban areas, are old, have never been married, have low education, and are unemployed, primiparous, and poor to decrease LBW cases in Indonesia.



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**Keywords:** low birth weight; maternal and child health; maternal health; public health; nutrition; health policy

## 1. Introduction

A newborn should have an average body weight of  $\geq 2500$  kg. The baby is categorized as having a low birth weight if its weight is  $< 2500$  g (1500–2499 g). Birth weight is crucial for infant development because it is associated with infant mortality [1,2]. A study states that birth weight is an essential indirect indicator of maternal nutrition and a predictive predictor of potential infant mortality and malnutrition. Due to these issues, researchers nowadays measure birth weight as an indicator of health. Babies born with low birth weight are at high risk of neonatal mortality. They are also at risk of experiencing stunting, delays in brain nerve development, and other diseases at this stage of development [3,4]. Another impact of LBW is increasing neonatal deaths globally by around 60–80% [5].

The incidence of LBW babies is more than 20 million births each year globally. Overall, the global prevalence shows that the LBW rate in developed regions was 27.2%, compared to 17.3% in Asia, 5.6% in Central Asia, and 27.2% in Southern Asia [3]. Low birth weight became the focus of the World Health Organization and United Nations Children’s Fund (UNICEF) in 1992, and then the WHO targeted ending malnutrition by 2025 globally. Based on the WHO’s data, 15% of babies worldwide experienced LBW, and more than half were

babies born in Asia [6]. Risk factors related to the incidence of LBW include socioeconomic and maternal characteristics. Socioeconomics deals with the type of residence, occupation type, parents' educational status, and wealth index [7]. At the same time, maternal factors include preterm delivery, a history of low birth weight, maternal age, height, hemoglobin level, lack of iron supplementation, and frequency of Antenatal Care (ANC) visits [8]. LBW is also related to exclusive breastfeeding behavior, which significantly supports a baby's growth and development in the first two years [4].

A previous study showed that other factors that influence the incidence of LBW, including cultural practices, are crucial to be addressed by health workers in providing maternal and child health care services. Indonesia is rich in artistic methods for treating diseases and caring for mothers and newborns, which can cause maternal and infant mortality [9]. The trend of LBW babies in Indonesia in 2018 was 6.2%. This figure had decreased by 4% from 2013, when the rate was 10.2% [10]. Although Indonesia has experienced a decrease in the number of LBW babies, this percentage has not met the target reduction of cases of 3% per year [10]. The situation is also related to the number of stunting incidents resulting from LBW. Indonesia is a developing country ranked fifth for the highest LBW babies out of 88 countries worldwide [11]. The incidence of stunting in Indonesia reached 37.8% in 2015 and 31% in 2018. This decrease in percentage has not yet attained the annual reduction target of 7.3% [12].

Based on the factors related to LBW, the Indonesian government strives and is committed to accelerating nutrition levels through the 'Scaling Up Nutrition (SUN)' program. The government includes long-term, medium-term, and short-term development plans regulated by the law. In the long-term development plan (2005–2025), the Indonesian government focuses on the first 1000 days of life through the fulfilment of nutrition for the womb until the baby is two. The government carries out cross-sectoral synergies in concrete steps to improve food production, processing, and consumption that meet nutritional needs. Such actions increase nutrition awareness, promotion, education regarding physical and health activities, and access to quality science- and technology-based nutrition services [13,14]. Furthermore, the Indonesian government has initiated the 'Desa Siaga' or Alert Village program since 1994. It is a community engagement program that seeks to help pregnant women by maximizing the resources available, such as access to transportation, costs, and social support in their living areas [15].

The most critical part of implementing the policy for LBW prevention is educating pregnant women and young women (adolescents) who will prepare for pregnancy. Health workers can attempt to minimize beliefs in cultural behavior that can endanger pregnant women's and babies' health and safety and improve the quality of baby feeding, especially exclusive breastfeeding [16,17]. Advocacy and dissemination of information to the community by healthcare workers will help empower knowledge of LBW prevention [9]. Based on the background, the study aimed to analyze the target of the policy to decrease LBW cases in Indonesia.

## 2. Materials and Methods

### 2.1. Data Source and Study Design

This cross-sectional study analyzed secondary data from the 2017 Indonesia Demographic and Health Survey (IDHS). It used a sample of live births in the last five years preceding the survey, comprising birth weight, written records, and maternal memories. The author used the 'IDIR71FL\_Individual Recode' files.

The stratified two-stage sampling design used in the 2017 IDHS was as follows: Stage 1: selecting several census blocks systematically proportional to size probability with the number of households resulting from the 2010 population census listing. In this example, an implicit stratification procedure based on urban and rural regions was used for sorting census blocks based on the wealth index category of the 2010 population census data. Stage 2 picks 25 ordinary households in each census block based on updating the households in each census block [18]. The 2017 IDHS collected data from July to September

2017. The 2017 IDHS investigated the babies' mothers as respondents among live births within the last five years. Around 94% of mothers reported their babies' birth weight; the study selected as many as 17,848 participants as the sample in the final process.

## 2.2. Variables

The study used LBW as a dependent variable. It defined LBW as a birth weight of fewer than 2500 g regardless of gestational age [18]. Apart from LBW as the dependent variable, the study analyzed seven independent variables: the type of residence, age group, marital status, education level, employment status, parity, and wealth status.

Following the Indonesian Central Bureau of Statistics, the study divided residences into urban and rural categories. The study split ages into seven groups: 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, and 45–49 years. Education level, the last certificate owned, was categorized into four categories: no education, primary, secondary, and higher. Marital status had three categories: never in marriage, married/living with a partner, and divorced/widowed.

Meanwhile, this study divided employment status into two categories: unemployed and employed. Parity, the acknowledgment of the number of live babies ever born, was studied in three categories, namely primiparous (<2), multiparous (2–4), and grand multiparous (>4).

The 2017 IDHS described wealth status as the socioeconomic quintile in a household. It was related to household income as seen from the styles and prices of furniture, such as televisions, bicycles, motorcycles, and household products, including drinking water supplies, bathroom amenities, and flooring materials. The 2017 IDHS determined the value of this variable by using the principal component analysis in the report. Every household's score for the national wealth quintiles was then grouped into the same five classes, accounting for 20% of the population [10]. They were the poorest (quintile 1), poorer (quintile 2), middle (quintile 3), richer (quintile 4), and richest (quintile 5) [19,20].

## 2.3. Data Analysis

The study employed the bivariate test to analyze all data investigated at the first stage. In the bivariate analysis, the researchers used the chi-square test. Before conducting a binary logistic regression test, the study performed a co-linearity test to ensure no multicollinearity symptoms existed between the independent variables. The study used binary logistic regression to determine the policy's target at the final stage. The author processed all statistical analyses in SPSS 26 software.

The study used ArcGIS 10.3 to map the percentage distribution of LBW cases by provinces in Indonesia (ESRI Inc., Redlands, CA, USA). The study collected the shapefile of administrative boundary polygons from the Indonesian Bureau of Statistics.

## 2.4. Ethical Approval

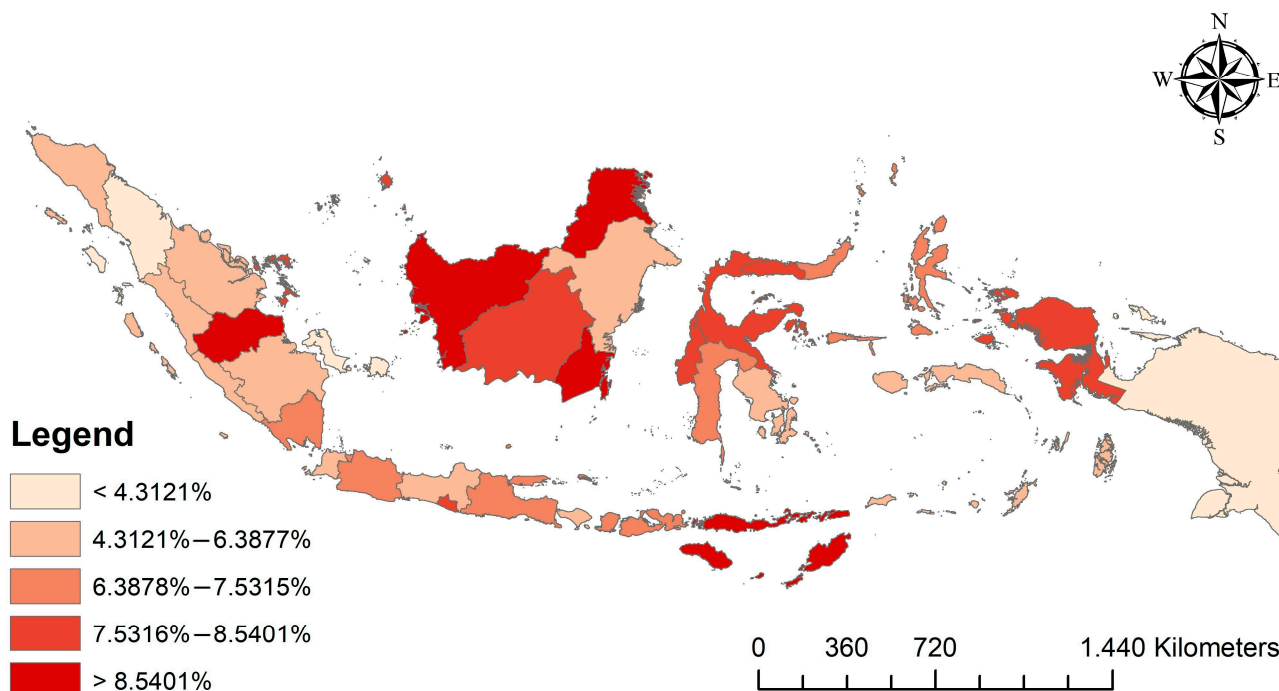
The study used secondary data from the 2017 IDHS for a materials analysis. The survey removed the identities of all respondents from the 2017 IDHS dataset. Participants in this study signed written consent forms, and the children's parents or guardians gave their consent (under 16 years). The author has obtained permission to use data for this study through the website <https://dhsprogram.com> (accessed on 1 November 2020).

The 2017 IDHS adheres to the Standard D.H.S. survey protocol under the Demographic and Health Surveys Program (DHS-7), which has been approved by ICF International's Institutional Review Board and was previously reviewed and approved by the ORC Macro IRB in 2002. DHS surveys that adhere to the Standard are classified as DHS-7 program-approved, and the approval document is attached. ICF International's Institutional Review Board followed the US Department of Health and Human Services requirements for the "Protection of Human Subjects" (45 CFR 46).



### 3. Results

The national average percentage of LBW was 6.981% (95% CI 6.607–7.355%). At least 18 out of the 34 provinces in Indonesia have LBW rates above the national average. Figure 1 shows the percentage distribution of LBW cases by the provinces in Indonesia. The areas with a high percentage of LBW cases tended to be in the Northern Central parts of Indonesia.



**Figure 1.** Distribution of LBW percentage by the province in Indonesia, 2017.

Table 1 presents the descriptive analysis of the LBW cases in Indonesia. The percentage is in the column percentage. Based on residence, women in urban areas tended to give birth to LBW babies more, and women in the 25–29 age group broadly delivered LBW babies more. In addition to these variables, married women or women who lived with partners tended to give birth to LBW babies more.

In terms of education, women with secondary education were more likely to deliver LBW babies. Unemployed women and multiparous women tended to give birth to LBW babies. Moreover, wealthier women were more likely to have LBW babies.

The collinearity test result indicated no symptoms of multicollinearity between the independent variables tested. The tolerance value of all variables was greater than 0.10. Simultaneously, the variance inflation factor (VIF) value for all independent variables was less than 10.00. Then, referring to the basis of decision-making in the multicollinearity test, the study concluded that there was no indication of a strong relationship between the independent variables in the regression model.

According to maternal education level, mothers with only primary school education and less ruled in both nutritional status categories. Based on maternal age, stunted children under the age of five have mothers with an average age slightly older than normal children under five years.

**Table 1.** The descriptive analysis of LBW in Indonesia, 2017.

| Variables                     | Low Birth Weight |                | p-Value |
|-------------------------------|------------------|----------------|---------|
|                               | No (n = 16,602)  | Yes (n = 1246) |         |
| Type of residence             |                  |                | <0.001  |
| Urban                         | 48.3%            | 50.9%          |         |
| Rural                         | 51.7%            | 49.1%          |         |
| Age group                     |                  |                | <0.001  |
| 15–19                         | 2.3%             | 2.9%           |         |
| 20–24                         | 16.3%            | 17.7%          |         |
| 25–29                         | 25.7%            | 25.2%          |         |
| 30–34                         | 26.4%            | 23.1%          |         |
| 35–39                         | 19.6%            | 21.5%          |         |
| 40–44                         | 8.0%             | 7.6%           |         |
| 45–49                         | 1.7%             | 2.0%           |         |
| Marital status                |                  |                | <0.001  |
| Never in union                | 0.1%             | 0.2%           |         |
| Married/Living with a partner | 97.2%            | 96.0%          |         |
| Divorced/Widowed              | 2.7%             | 3.9%           |         |
| Education Level               |                  |                | <0.001  |
| No education                  | 1.2%             | 1.0%           |         |
| Primary                       | 25.6%            | 29.4%          |         |
| Secondary                     | 57.6%            | 56.8%          |         |
| Higher                        | 15.6%            | 12.8%          |         |
| Employment status             |                  |                | <0.001  |
| Unemployed                    | 55.0%            | 56.6%          |         |
| Employed                      | 45.0%            | 43.4%          |         |
| Parity                        |                  |                | <0.001  |
| Primiparous                   | 29.3%            | 31.5%          |         |
| Multiparous                   | 70.7%            | 68.5%          |         |
| Wealth status                 |                  |                | <0.001  |
| Poorest                       | 20.6%            | 21.1%          |         |
| Poorer                        | 20.0%            | 21.8%          |         |
| Middle                        | 20.1%            | 20.0%          |         |
| Richer                        | 20.2%            | 20.1%          |         |
| Richest                       | 19.1%            | 17.0%          |         |

Table 2 displays the binary logistic regression results for LBW cases. The study referenced the category “LBW = No” at this final stage. This analysis indicated that women in rural areas are less likely to give birth to LBW babies in Indonesia. Women living in urban areas are 1.200 times more likely to provide LBW babies than those in rural areas (AOR: 1.200; 95% CI: 1.200–1.200).

While women in all age group categories, except the 45–49 age group, are less likely to give birth to LBW babies. Moreover, pregnant women in all marital status categories, except those who have never been married, are less likely to give birth to LBW babies.

Women in all education level categories showed a higher probability of giving birth to LBW babies than women with higher education levels. Concerning education level, unemployed women are 1.033 times more likely to deliver LBW babies than those employed (AOR: 1.033; 95% CI: 1.032–1.033). This analysis showed that unemployment is a risk factor for women giving birth to LBW babies in Indonesia.

Regarding parity, primiparous women are 1.132 times more likely to labor LBW babies than women with many children (AOR: 1.132; 95% CI: 1.132–1.132). The information indicated that being primiparous is a risk factor for pregnant women giving birth to LBW babies in Indonesia.

**Table 2.** The result of binary logistic regression on LBW in Indonesia, 2017.

| Predictor                              | Low Birth Weight |       |             |             |
|--|------------------|-------|-------------|-------------|
|  | p-Value          | AOR   | 95% CI      |             |
|  |                  |       | Lower Bound | Upper Bound |
| Residence: Urban                       | <0.001           | 1.200 | 1.200       | 1.200       |
| Residence: Rural (ref.)                | -                | -     | -           | -           |
| Age: 15–19                             | <0.001           | 0.932 | 0.932       | 0.933       |
| Age: 20–24                             | <0.001           | 0.870 | 0.870       | 0.871       |
| Age: 25–29                             | <0.001           | 0.837 | 0.836       | 0.837       |
| Age: 30–34                             | <0.001           | 0.774 | 0.774       | 0.774       |
| Age: 35–39                             | <0.001           | 0.958 | 0.957       | 0.958       |
| Age: 40–44                             | <0.001           | 0.813 | 0.813       | 0.813       |
| Age: 45–49 (ref.)                      | -                | -     | -           | -           |
| Marital: Never in union (ref.)         | -                | -     | -           | -           |
| Marital: Married/Living with a partner | <0.001           | 0.399 | 0.399       | 0.400       |
| Marital: Divorced/Widowed              | <0.001           | 0.550 | 0.550       | 0.551       |
| Education: No education                | <0.001           | 1.018 | 1.018       | 1.019       |
| Education: Primary                     | <0.001           | 1.361 | 1.360       | 1.361       |
| Education: Secondary                   | <0.001           | 1.146 | 1.145       | 1.146       |
| Education: Higher (ref.)               | -                | -     | -           | -           |
| Employment: Unemployed                 | <0.001           | 1.033 | 1.032       | 1.033       |
| Employment: Employed (ref.)            | -                | -     | -           | -           |
| Parity: Primiparous                    | <0.001           | 1.132 | 1.132       | 1.132       |
| Parity: Multiparous (ref.)             | -                | -     | -           | -           |
| Wealth: Poorest                        | <0.001           | 1.111 | 1.111       | 1.111       |
| Wealth: Poorer                         | <0.001           | 1.181 | 1.181       | 1.181       |
| Wealth: Middle                         | <0.001           | 1.067 | 1.067       | 1.067       |
| Wealth: Richer                         | <0.001           | 1.079 | 1.079       | 1.079       |
| Wealth: Richest (ref.)                 | -                | -     | -           | -           |

AOR: adjusted odds ratio; LBW: low birth weight.

Finally, Table 2 informs us that the poorest women are 1.111 times more likely to give birth to LBW babies than the most prosperous women (AOR: 1.111; 95% CI: 1.111–1.111). Women of poorer wealth status are 1.181 times more likely to deliver LBW babies than the most affluent women (AOR: 1.181; 95% CI: 1.181–1.181). Women in the middle wealth status group have 1.067 times more chances of giving birth to LBW babies than the most affluent women (AOR: 1.067; 95% CI: 1.067–1.067). Besides, wealthier women are 1.079 times more likely to give birth to LBW babies than the most prosperous women (AOR: 1.079; 95% CI: 1.079–1.079). This analysis implied that women in all wealth status categories except the most decadent have a higher probability of giving birth to LBW babies.

#### 4. Discussion

Nationally, the average percentage of LBW cases, at 6.981% in 2017, was below the target of the National Medium-Term Development Plan in 2015–2019. However, at least 10 out of 34 provinces in Indonesia did not experience a lower percentage of LBW cases below this target. Besides, the Indonesian government recorded 18 regions with a prevalence of LBW cases above the national average [10]. This study informs us that women living in urban areas were more likely to give birth to LBW babies in Indonesia. This finding aligns with the previous research in Afghanistan, reporting that mothers who lived in rural residences were 0.3 times less likely to give birth to LBW babies than those in urban areas [21]. This condition is likely related to higher pollution in urban than rural areas of Indonesia. A previous study found that higher paternal prenatal concentrations of mono-benzyl phthalate and mono-carboxyisononyl phthalate were linked to a 40% and 53% increase in the incidence of LBW in infants who were born spontaneously [22]. Moreover,

previous studies have indicated that a higher pollution level was associated with a higher incidence of LBW [23,24].

This finding contradicts several previous studies. Studies in Ethiopia and Iran provided different conclusions. Mothers in rural Ethiopia and Iran were 1.39 and 1.4 times more likely to give birth to LBW babies than those in urban areas [25]. Another study in Sidama Zone, South Ethiopia, used public hospitals as the research setting for newborns. It found that mothers in rural areas were 3.51 times more likely to give birth to LBW patients than those in urban areas [26].

Based on the age group, the result showed women in all age group categories except the 45–49 age group had a lower likelihood of giving birth to LBW babies. Previous studies in Jordan and Ethiopia also indicated that age influenced LBW incidence [25,27]. A study in Germany reported different results, finding that teenage mothers had higher rates of depression during pregnancy than mothers of older generations. The research indicated that this factor puts adolescent mothers at risk of giving birth to LBW babies [28].

Women in all marital status categories, except those who had never married, had a lower chance of giving birth to LBW babies. An earlier study in Sub-Saharan Africa also reported marital status was associated with LBW babies. Divorced or widowed mothers were more likely to deliver LBW babies than married mothers [29]. Having a partner is a protective factor for women, and wives become a place to share psychological and financial burdens [30]. Besides, mothers in all education level categories had a higher probability of giving birth to LBW babies than women with higher education levels. A study in Jordan and Ethiopia also found similar results: a higher education level was a protective factor for mothers not giving birth to LBW babies [25]. Meanwhile, previous studies in Indonesia showed that pregnant women with primary school education were 2.154 times more likely to give birth to LBW babies (AOR 2.154, 95% CI 1.399–3.315;  $p = 0.004$ ) [1]. Because teaching is a motivating opportunity to live healthily, education is good for your health. Women who receive an education will have more opportunities to develop their abilities and lead healthy lives [31]. Higher-educated women were more likely to experience a better pregnancy and to experience a lower probability of delivering LBW kids [16,32]. A better education level allows mothers to better understand actions needed to provide the best output for themselves and their children [16,33,34]. Many studies have reported that better education is a strong determinant of better production in the health sector [35–38]. Instead, poor education is a barrier to producing quality performance in the health sector [8,32,39]. Unemployment was deemed a risk factor for women giving birth to LBW babies. A previous study in hospital settings in the Ambata-Tembaro zone, Southern Ethiopia, found that unemployed mothers could be 5.4 times more likely to deliver LBW babies than employed mothers [40]. Another study at a large European maternity hospital found similar effects of a multivariable analysis: unemployed women or homemakers increased adjusted odds ratios for LBW [41]. This condition was possibly related to employment and wealth status. Unemployed women are among low-income families [42].

Primiparous women had a higher probability of giving birth to LBW babies than women with many children. A study in Brazil also reported that primiparous mothers had up to 1.62 times the chance of delivering LBW babies than mothers with many children [43]. Moreover, studies in Sub-Saharan Africa and China also provided similar results, indicating that multiparity was associated with reduced cases of LBW [29]. Research in Southern Africa informed different findings that mothers with more than three births were 1.5 times more likely to give birth to LBW babies [40].

Moreover, this study revealed that women in all wealth status categories, compared to the wealthiest, had a higher probability of giving birth to LBW babies. An earlier study analyzing secondary data from the 2016 Ethiopia Demographic and Health Survey in Ethiopia also reported similar results with the incidence of LBW being dominant among the poor [44]. Poor households have limitations in providing food for all family members, including pregnant women. For pregnant women, the mother's nutritional status is an indicator of the adequacy of food and nutrition. Better wealth status is related to the

availability of food in the family and thus is closely related to food intake during pregnancy. Lack of food availability in terms of quantity and quality. This is related to the increasing need for macronutrients and micronutrients in pregnant women and their importance for the mother and fetus. Therefore, a better wealth status can reduce the incidence of LBW [45]. In terms of food insecurity and consumption, a previous study described acute and chronic malnutrition. Reducing malnutrition in children could be done through prenatal measures and supplementary food for children during food insecurity [45].

#### *Study Limitation*

The 2017 IDHS derived the data from a stratified multi-stage sampling procedure. The sampling method allows for an unequal probability of selection.

This current study analyzed secondary data limited to variables reported in the IDHS. It excluded several variables known as determinants of LBW incidence in previous studies. Some were antenatal care during pregnancy [15,45], smoke pollution [46], wanting a later child [25], pregnancy interval and gestational age of <37 weeks at birth [47], hypertension, mid-upper arm circumference [26], maternal height [48], hemoglobin levels [49], and intimate partner violence during pregnancy [50].

Additionally, this study employed a quantitative approach and thus did not uncover the social and cultural phenomena related to LBW regarding family and children value [51–53], pregnancy value, and dietary restrictions in pregnant women [54], and a patriarchal social structure in Indonesia that places women subordinate to men [55].

## 5. Conclusions

Based on the results, policymakers should target pregnant women who live in urban areas, are old, have never been in a marriage, have low education, and are unemployed, primiparous, and poor to decrease LBW cases in Indonesia. The policymaker should target prospective mothers with a higher risk of having LBW babies.

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**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The author cannot publicly share the data because a third party and the authors who own the data do not have permission to share the data. The 2017 IDHS data set requested from the ICF ('data set of childbearing age women') is available from the ICF contact via <https://dhsprogram.com> (accessed on 1 November 2020) for researchers who meet the criteria for access to confidential data.

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