



Munich Personal RePEc Archive

Broca Index: A Simple Tool to Measure Ideal Body Weight

Mohajan, Devajit and Mohajan, Haradhan

Department of Civil Engineering, Chittagong University of Engineering Technology, Chittagong, Bangladesh, Department of Mathematics, Premier University, Chittagong, Bangladesh

16 January 2023

Online at <https://mpra.ub.uni-muenchen.de/116852/>
MPRA Paper No. 116852, posted 30 Mar 2023 07:20 UTC

Broca Index: A Simple Tool to Measure Ideal Body Weight

Devajit Mohajan

Department of Civil Engineering, Chittagong University of Engineering &
Technology, Chittagong, Bangladesh

Email: devajit1402@gmail.com

Mobile: +8801866207021

Haradhan Kumar Mohajan

Department of Mathematics, Premier University, Chittagong, Bangladesh

Email: haradhan1971@gmail.com

Mobile: +8801716397232

Abstract

Proper measure of ideal body weight (IBW) is necessary in medical science. According to physicians, IBW is related to the lowest morbidity and mortality. Broca Index (BI) is a simple and effective tool to measure IBW; and general physicians, nutritionists, and Life Insurance Companies can use it confidently. In this mini review aspects of Broca Index (BI) are discussed for the calculation of ideal body weight (IBW) of health conscious people.

Keywords: Broca Index, ideal body weight, BMI

1. Introduction

In the 21st century, obesity becomes a global health problem for both developed and developing countries (WHO, 2020). It is considered as one of the most fatal health issues worldwide (Mohajan & Mohajan, 2023c). To measure obesity various anthropometric measurement indices are available. But most of them require more time, a lot of money, tedious methodology, etc. (Bhurosy & Jeewon, 2013). At present also there are many formulas to calculate ideal body weight (IBW), but most of them are very complicated to common people. Only an expert can determine the actual IBW value, and also require charts or calculators to find out it (Alejandro et al., 2018; Mohajan & Mohajan, 2023d). For example, Body Mass Index (BMI) is a popular and reliable anthropometric tool to measure obesity, but it is not a simple method for common people (Henriques et al., 2019).

Broca Index (BI) is an estimation of IBW, where only height in centimeter is used for the measurement. It is the easiest method to calculate the ideal body weight for height. It is developed in 1871 by a French army physician, anatomist, and anthropologist, Pierre Paul Broca (1824-1880). For BI estimation only a single measurement of height in centimeter (cm) is necessary (Laurent et al., 2020). Although Broca Index (BI) is very simple in measurement, it is now considered as outdated, and physicians and clinicians preferred Body Mass Index (BMI) to use in their treatment (Alejandro et al., 2018).

2. Literature Review

The literature review is an introductory division of any research that displays the works of previous researchers in the same field (Polit & Hungler, 2013). It often

behaves with a secondary research source and does not study about future research work (Gibbs, 2008). Weber-Sanchez Alejandro and his coauthors have tried to verify validity of BI compared with Hammond and Robinson formulas, and with IBW that has calculated from ideal body mass index (BMI) (Alejandro et al., 2018). Lipscombe Clare Bernadette and Lipscombe Trevor have established a series of mathematical formulae of IBW to compare the BMI and IBW formulas by means of the ANSURII database (Bernadette & Trevor, 2021).

Jenyz M. Mundodan and his coworkers aim to identify ‘normal range’ for Broca Index, which resembles to the normal range for BMI. They have advised that the weight of a person should ideally be within 81% to 95% of Broca Index (Mundodan et al., 2018). Ramirez López Erik and his coworkers compare the perceived ideal body weight (PIBW) with the calculated IBW by formulas and the BMI of 22. They have obtained that the IBW formulas and BMI of 22 does not necessarily represent a desirable or aesthetic weight (Erik et al., 2018). Devajit Mohajan and Haradhan Kumar Mohajan have discussed obesity related diseases in some details (Mohajan & Mohajan, 2022a-j, 2023a-l).

3. Research Methodology of the Study

The academicians always take the research as an essential and influential work to lead in academic world (Pandey & Pandey, 2015). Methodology is a guideline to complete a familiar research that helps the researchers to grow the trust of a reader in the research findings (Kothari, 2008). Combining both concepts above, we have realized that the research methodology is a way to the researchers for organizing, planning, designing, and conducting a good research (Legesse, 2014). We have briefly described the Body Mass Index (BMI) and obesity, and then we have

briefly discussed Broca Index (BI) to determine ideal body weight (IBW). Finally, we have highlighted on the drawbacks of BI (Das & Mohajan, 2014; Ferdous & Mohajan, 2022; Isalm et al., 2009a,b, 2010, 2012a,b; Mohajan et al., 2013; Moolio et al., 2009; Rahman & Mohajan, 2019; Roy et al., 2021, Mohajan, 2011, 2012a-c, 2013a-g, 2014a-d, 2015a-d, 2016). We have used Broca Index (BI) related secondary data sources to prepare this mini review research paper (Mohajan, 2017a-d, 2018a-d, 2020a-d, 2021a-d, 2022a-d,).

4. Objective of the Study

Main objective of this study is to discuss Broca Index (BI). It is a very simple in measurement and works only with one standard measurement, height. Other trivial objectives of the study are as follows:

- to highlight on BMI and obesity, and
- to show the limitations of BI.

5. Body Mass Index (BMI)

Belgian Flemish astronomer, mathematician, statistician, and sociologist, Lambert Adolphe Jacque Quetelet (1796-1874), has developed Body Mass Index (BMI) (Mardolkar, 2017). The BMI is a measure of human body fat based on height and weight, where height is measured in meters, and mass in kilograms (Taylor et al., 1998). At present BMI is one of the best available and highly used anthropometric estimates of body fatness for public health purposes (Bhurosy & Jeewon, 2013). The metric formula of BMI is as follows (WHO, 2004):

$$BMI = \frac{mass_{kg}}{height_m^2}, \quad (1)$$

where unit is kg/m^2 . Four categories of BMI were established by World Health Organization (WHO) as: underweight, normal, overweight, and obese (WHO, 1995). An individual is considered underweight if his/her BMI is under 18.5, normal weight if it is within 18.5 to 24.9, overweight if it is within 25 to 29.9, and obese if it is 30 or more (Di Angelantonio & Bhupathiraju, 2016).

6. Obesity

Obesity is defined as an individual having a BMI of 30 and above (WHO, 2020). It is a multifactorial chronic disease that is developed in human body when series of excess food taking happens such a way that energy intake exceeds consumption, i.e., the excess amount of calories is taken in and less is burnt (Chooi et al., 2019). It is growing among industrial, developed and developing and transition economies around the world (Shetty & Schmidhuber, 2011). It has spread worldwide due to the popularity of junk food, changing lifestyles, increasing incomes, urbanization, and aggressive marketing (Lee et al., 2022). Obesity is a consequence of many non-communicable diseases (NCDs), such as hypertension, cardiovascular diseases, Alzheimer disease, asthma, metabolic syndrome, liver steatosis, gallbladder disease, osteoarthritis, obstructive sleep apnea, certain types of cancer, hypercholesterolemia, metabolic syndrome, musculoskeletal disorders, and type 2 diabetes (Mohajan & Mohajan 2023a, b).

7. BI Formula

At present accurate assessment of obesity becomes a public health concern. BI can be expressed as a simple equation as (Rössner, 2007),

$$\text{Standard weight (kg)} = \text{height (cm)} - 100 . \quad (2)$$

When Dr. Broca had developed the Broca Index (BI), it was used to find only normal weight, but later it was expanded to ideal body weight (IBW) (Laurent et al., 2020). For example, a male of 163 cm tall will have a standard weight of 63 kg. For females, the standard weight is 10% less than that of male. For example, a female of 163 cm tall will have a standard weight of $63 \times 0.9 = 56.7$ kg (Erik et al., 2018). Obesity occurs when the weight is 20% in excess of BI value that gives a normal Broca weight within the BMI range of 20 to 25 (James et al., 1998).

The IBW is boon for the human and is related to the lowest mortality. An insurance company considers IBW as a standard measure to identify healthy population (Shah et al., 2006). Broca Index (BI) and BMI cut-offs have a correlation; consequently Broca index can be used for body fat measurement (Alejandro et al., 2018). BI is developed more than 150 years ago in France, but still it is a valid and effective method to determine IBW. For its simplicity it is commonly used in some countries of the world, such as in India, Japan, the Czech Republic, etc. (Shah et al., 2006). BI could be a useful tool for nonprofessionals who face difficulty to calculate their BMI (Laurent et al., 2020).

8. Limitations of Broca Index

Broca Index works only with one standard measurement, i.e., height. One major fault of it is that it is not specific for height outliers, and also it does not provide correct value for infants. Broca index do not make the difference among muscle mass, large frames, and body fat mass (Godescu, 2020). Some people who are well developed physically, such as athletes, strong workers, muscular persons, gymnasts, acrobats, etc.; they are considered as obese by Broca Index due to their larger muscles and body frames than the average (Rahman & Adjeroh, 2015).

Hence, Broca Index does not offer a correct diagnostic in these situations, and does not make the difference among muscles mass, large frames and body fat mass (Krakauer & Krakauer, 2012).

9. Conclusions

In the study we have observed that BI offers the same accuracy formula as other more complex formulas that provide to measure overweight and obesity. But at present it is rarely used in healthcare and nutrition science. Since BI has validity and utility in clinical practice, and also for its simplicity we, the common people can use it for the measurement of our IBW as an alternative tool. In the crowded areas where outpatients are numerous and patients are not critically ill; general physicians can take Broca Index (BI) as their measurement for treatment. Also nutritionists can assess the general nutritional status through the use of BI. To maintain an aesthetic figure, health conscious people can use Broca Index (BI) confidently. Life Insurance Companies can also use Broca Index (BI) to open account for the healthy beneficiaries.

References

Alejandro, W.-S. et al. (2018). Validation of the Broca Index as the Most Practical Method to Calculate the Ideal Body Weight. *Journal of Clinical Investigation and Studies*, 1(1), 1-4.

Bernadette, L. C., & Trevor, L. (2021). Ideal Body Weight Formulas in Relation to Body Mass Index and Reference Heights. *Medicina Internacia Revuo*, 29(2), 93-98.

Bhurosy, T., & Jeewon, R. (2013). Pitfalls of Using Body Mass Index (BMI) in Assessment of Obesity Risk. *Current Research in Nutrition and Food Science*, 1(1), 71-76.

- Chooi, Y. C., Ding, C., & Magkos, F. (2019). The Epidemiology of Obesity. *Metabolism: Clinical and Experimental*, 92, 6-10.
- Das, S., & Mohajan, H. K. (2014). Generating Functions for $P(n, p, *)$ and $P(n, *, p)$. *American Review of Mathematics and Statistics*, 2(1), 33–35.
- Di Angelantonio, E., & Bhupathiraju, S. et al. (2016). Body-Mass Index and All-Cause Mortality: Individual-Participant-Data Meta-Analysis of 239 Prospective Studies in Four Continents. *Lancet*, 388(10046), 776-786.
- Erik, R. L. et al. (2018). Comparison of Perceived Weight as Ideal against Ideal Body Weight Formulas and Body Mass Index of 22 Kg/m² in Young Adult Women. *Revista Salud Pública y Nutrición*, 17(1), 7-15.
- Ferdous, J., & Mohajan, H. K. (2022). Maximum Profit Ensured for Industry Sustainability. *Annals of Spiru Haret University. Economic Series*, 22(3), 171–181.
- Gibbs, R. W., Jr. (2008). Metaphor and Thought: The State of the Art. In R. W. Gibbs, Jr. (Ed.), *The Cambridge Handbook of Metaphor and Thought*. Cambridge University Press, Cambridge.
- Godescu, A. (2020). The Anthropometric Generalization of the Body Mass Index. *Preprints*, <https://doi.org/10.20944/preprints202007.0662.v1>
- Henriques, A. et al. (2019). Obesity-Related Knowledge and Body Mass Index: A National Survey in Portugal. *Eating and Weight Disorders*, 25(5), 1437-1446.
- Islam, J. N., Mohajan, H. K., & Moolio, P. (2009a). Preference of Social Choice in Mathematical Economics. *Indus Journal of Management & Social Sciences*, 3(1), 17–38.
- Islam, J. N., Mohajan, H. K., & Moolio, P. (2009b). Political Economy and Social Welfare with Voting Procedure. *KASBIT Business Journal*, 2(1), 42–66.
- Islam, J. N., Mohajan, H. K., & Moolio, P. (2010). Utility Maximization Subject to Multiple Constraints. *Indus Journal of Management & Social Sciences*, 4(1), 15–29.
- Islam, J.N.; Mohajan, H. K., & Moolio, P. (2011), Output Maximization Subject to a Nonlinear Constraint, *KASBIT Business Journal*, 4(2), 104–120.
- Islam, J. N., Mohajan, H. K., & Datta, R. (2012a). Aspects of Microfinance System of Grameen Bank of Bangladesh. *International Journal of Economics and Research*, 3(4), 76-96.

- Islam, J. N., Mohajan, H. K., & Datta, R. (2012b). Stress Management Policy Analysis: A Preventative Approach. *International Journal of Economics and Research*, 3(6), 1–17.
- James, W. P. T. et al. (1998). *Healthy Nutrition: Preventing Nutrition Related Diseases in Europe*. WHO Regional Publications, European Series, No. 24. World Health Organization Regional Office for Europe, Copenhagen.
- Kothari, C. R. (2008). *Research Methodology: Methods and Techniques* (2nd Ed.). New Delhi: New Age International (P) Ltd.
- Krakauer, N. Y., & Krakauer, J. C. (2012). A New Body Shape Index Predicts Mortality Hazard Independently of Body Mass Index. *PLoS One*, 7(7), e39504.
- Laurent, I., & Astère, M. et al. (2020). The Use of Broca Index to Assess Cut-Off Points for Overweight in Adults: A Short Review. *Reviews in Endocrine and Metabolic Disorders*, 21(4), 521-526.
- Lee, X. Y. B., Yusof, N. W., Pillai, N. K., Yap, C. G., & Jahan, N. K. (2022). Review Paper: Association between Social Network and Obesity among Adult Population. *Open Journal of Endocrine and Metabolic Diseases*, 12, 20-46.
- Legesse, B. (2014). *Research Methods in Agribusiness and Value Chains*. School of Agricultural Economics and Agribusiness, Haramaya University.
- Mardolkar, M. (2017). Body Mass Index (BMI) Data Analysis and Classification. *International Journal of Computer Science and Mobile Computing*, 6(2), 8-16.
- Mohajan, H. K. (2011). Greenhouse Gas Emissions Increase Global Warming. *International Journal of Economic and Political Integration*, 1(2), 21-34.
- Mohajan, H. K. (2012a). Green Marketing is a Sustainable Marketing System in the Twenty First Century. *International Journal of Management and Transformation*, 6(2), 23-39.
- Mohajan, H. K. (2012b). Aspects of Green Marketing: A Prospect for Bangladesh. *International Journal of Economics and Research*, 3(3), 1-11.
- Mohajan, H. K. (2012c). *Importance of Green Marketing at Present and Future*. Lambert Academic Publishing, Germany.

- Mohajan, H. K. (2012d). Greenhouse Gas Emissions of the USA. *Indus Journal of Management & Social Sciences*, 6(2), 132-148.
- Mohajan, H. K. (2012e). Relation between Lease Finance and Purchase. *International Journal of Economics and Research*, 3(3), 146–158.
- Mohajan, H. K. (2013a). Economic Development of Bangladesh. *Journal of Business Management and Administration*, 1(4), 41-48.
- Mohajan, H. K. (2013b). Ethiopia: A Socio-economic Study. *Journal of Business Management and Administration*, 1(5), 59-74.
- Mohajan, H. K. (2013c). Friedmann, Robertson-Walker (FRW) Models in Cosmology. *Journal of Environmental Treatment Techniques*, 1(3), 158-164.
- Mohajan, H. K. (2013d). *Global Greenhouse Gas Emissions and Climate Change*. Lambert Academic Publishing, Germany.
- Mohajan, H. K. (2013e). Poverty and Economic Development of Kenya. *International Journal of Information Technology and Business Management*, 18(1), 72-82.
- Mohajan, H. K. (2013f). Global Food Price Hike is a Burden to the Poor. *International Journal of Information Technology and Business Management*, 19(1), 1–15.
- Mohajan, H. K. (2013g). Food, Agriculture and Economic Situation of Bangladesh. MPRA Paper No. 54240. <https://mpra.ub.uni-muenchen.de/54240/>
- Mohajan, H. K. (2014a). Greenhouse Gas Emissions of China. *Journal of Environmental Treatment Techniques*, 1(4), 190–202.
- Mohajan, H. K. (2014b). Chinese Sulphur Dioxide Emissions and Local Environment Pollution. *International Journal of Scientific Research in Knowledge*, 2(6), 265-276.
- Mohajan, H. K. (2014c). The Most Fatal 2014 Outbreak of Ebolavirus Disease in Western Africa. *American Journal of Epidemiology and Infectious Disease*, 2(4), 101-108.
- Mohajan, H. K. (2014d). Improvement of Health Sector in Kenya. *American Journal of Public Health Research*, 2(4), 159–169.

- Mohajan, H. K. (2015a). Sustainable Development Policy of Global Economy. *American Journal of Environmental Protection*, 3(1), 12-29.
- Mohajan, H. K. (2015b). Present and Future of Nestlé Bangladesh Limited. *American Journal of Food and Nutrition*, 3(2), 34-43.
- Mohajan, H. K. (2015c). Basic Concepts of Differential Geometry and Fibre Bundles. *ABC Journal of Advanced Research*, 4(1), 57-73.
- Mohajan, H. K. (2015d). Tuberculosis is a Fatal Disease among Some Developing Countries of the World. *American Journal of Infectious Diseases and Microbiology*, 3(1), 18-31.
- Mohajan, H. K. (2016). An Analysis of Knowledge Management for the Development of Global Health. *American Journal of Social Sciences*, 4(4), 38-57.
- Mohajan, H. K. (2017a). Roles of Communities of Practice for the Development of the Society. *Journal of Economic Development, Environment and People*, 6(3), 27–46.
- Mohajan, H. K. (2017b). Two Criteria for Good Measurements in Research: Validity and Reliability. *Annals of Spiru Haret University Economic Series*, 17(3), 58-82.
- Mohajan, H. K. (2017c). Optimization Models in Mathematical Economics. *Journal of Scientific Achievements*, 2(5), 30-42.
- Mohajan, H. K. (2017d). A Brief Analysis of de Sitter Universe in Relativistic Cosmology. *Journal of Scientific Achievements*, 2(11), 1–17.
- Mohajan, H. K. (2018a). Qualitative Research Methodology in Social Sciences and Related Subjects. *Journal of Economic Development, Environment and People*, 2(1), 19-46.
- Mohajan, H. K. (2018b). *Aspects of Mathematical Economics, Social Choice and Game Theory*. PhD Dissertation, Jamal Nazrul Islam Research Centre for Mathematical and Physical Sciences (JNIRCMPS), University of Chittagong, Chittagong, Bangladesh.
- Mohajan, H. K. (2018c). The Rohingya Muslims in Myanmar are Victim of Genocide! *ABC Journal of Advanced Research*, 7(1), 59-72.
- Mohajan, H. K. (2018d). Medical Errors Must be Reduced for the Welfare of the Global Health Sector. *International Journal of Public Health and Health Systems*, 3(5), 91-101.

- Mohajan, H. K. (2020a). Quantitative Research: A Successful Investigation in Natural and Social Sciences. *Journal of Economic Development, Environment and People*, 9(4), 50–79.
- Mohajan, H. K. (2020b). COVID-19–The Most Fatal Pandemic Outbreak: An Analysis of Economic Consequences. *Annals of Spiru Haret University Economic Series*, 20(2), 127-146.
- Mohajan, H. K. (2020c). The COVID-19 in Italy: Remedies to Reduce the Infections and Deaths. *Malaysian Journal of Medical and Biological Research*, 7(2), 59-66.
- Mohajan, H. K. (2020d). Most Fatal Pandemic COVID-19 Outbreak: An Analysis of Economic Consequences. *Annals of Spiru Haret University Economic Series*, 20(2), 127-146.
- Mohajan, H. K. (2021a). *Aspects of Global COVID-19 Pandemic*. Lambert Academic Publishing, Germany.
- Mohajan, H. K. (2021b). Global COVID-19 Pandemic: Prevention and Protection Techniques. *Journal of Economic Development, Environment and People*, 10(1), 51-72.
- Mohajan, H. K. (2021c). Estimation of Cost Minimization of Garments Sector by Cobb-Douglass Production Function: Bangladesh Perspective. *Annals of Spiru Haret University. Economic Series*, 21(2), 267-299.
- Mohajan, H. K. (2021d). Product Maximization Techniques of a Factory of Bangladesh: A Sustainable Procedure. *American Journal of Economics, Finance and Management*, 5(2), 23–44.
- Mohajan, H. K. (2022a). Four Waves of Feminism: A Blessing for Global Humanity. *Studies in Social Science & Humanities*, 1(2), 1-8.
- Mohajan, H. K. (2022b). An Overview on the Feminism and Its Categories. *Research and Advances in Education*, 1(3), 11-26.
- Mohajan, H. K. (2022c). Cost Minimization Analysis of a Running Firm with Economic Policy. *Annals of Spiru Haret University. Economic Series*, 22(3), 317-337.
- Mohajan, H. K. (2022d). Mathematical Analysis of SIR Model for COVID-19 Transmission. *Journal of Innovations in Medical Research*, 1(2), 1-18.
- Mohajan, D., & Mohajan, H. K. (2022a). Mathematical Analysis of SEIR Model to Prevent COVID-19 Pandemic. *Journal of Economic Development, Environment and People*, 11(4), 5-30.

- Mohajan, D., & Mohajan, H. K. (2022b). Utility Maximization Analysis of an Emerging Firm: A Bordered Hessian Approach. *Annals of Spiru Haret University. Economic Series*, 22(4), 292-308.
- Mohajan, D., & Mohajan, H. K. (2022c). Sensitivity Analysis among Commodities and Coupons during Utility Maximization. *Frontiers in Management Science*, 1(3), 13-28.
- Mohajan, D., & Mohajan, H. K. (2022d). Importance of Total Coupon in Utility Maximization: A Sensitivity Analysis. *Law and Economy*, 1(5), 65-67.
- Mohajan, D., & Mohajan, H. K. (2022e). Development of Grounded Theory in Social Sciences: A Qualitative Approach. *Studies in Social Science & Humanities*, 1(5), 13-24.
- Mohajan, D., & Mohajan, H. K. (2022f). Exploration of Coding in Qualitative Data Analysis: Grounded Theory Perspective. *Research and Advances in Education*, 1(6), 50-60.
- Mohajan, D., & Mohajan, H. K. (2022g). Memo Writing Procedures in Grounded Theory Research Methodology. *Studies in Social Science & Humanities*, 1(4), 10-18.
- Mohajan, D., & Mohajan, H. K. (2022h). Constructivist Grounded Theory: A New Research Approach in Social Science. *Research and Advances in Education*, 1(4), 8-16.
- Mohajan, D., & Mohajan, H. K. (2022i). Feminism and Feminist Grounded Theory: A Comprehensive Research Analysis. *Journal of Economic Development, Environment and People*, 11(3), 49-61.
- Mohajan, D., & Mohajan, H. K. (2022j). Profit Maximization Strategy in an Industry: A Sustainable Procedure. *Law and Economy*, 1(3), 17-43.
- Mohajan, D., & Mohajan, H. K. (2023a). Sensitivity Analysis among Commodities and Prices: Utility Maximization Perceptions. *Law and Economy*, 2(2), 1-16.
- Mohajan, D., & Mohajan, H. K. (2023b). Straussian Grounded Theory: An Evolved Variant in Qualitative Research. *Studies in Social Science & Humanities*, 2(2), 33-40.
- Mohajan, D., & Mohajan, H. K. (2023c). Sensitivity Analysis between Lagrange Multipliers and Consumer Coupon: Utility Maximization Perspective. *Frontiers in Management Science*, 2(1), 14-25.
- Mohajan, D., & Mohajan, H. K. (2023d). Utility Maximization Analysis of an Organization: A Mathematical Economic Procedure. *Law and Economy*, 2(1), 1-15.

- Mohajan, D., & Mohajan, H. K. (2023e). Classic Grounded Theory: A Qualitative Research on Human Behavior. *Studies in Social Science & Humanities*, 2(1), 1-7.
- Mohajan, D., & Mohajan, H. K. (2023f). Sensitivity Analysis between Commodity and Budget: Utility Maximization Case. *Law and Economy*, 2(3), 10-21.
- Mohajan, D., & Mohajan, H. K. (2023g). Sensitivity Analysis for Profit Maximization with Respect to Per Unit Cost of Subsidiary Raw Materials. *Frontiers in Management Science*, 2(2), 13–27.
- Mohajan, D., & Mohajan, H. K. (2023h). Families of Grounded Theory: A Theoretical Structure for Novel Researchers. *Studies in Social Science & Humanities*, 2(1), 56-65.
- Mohajan, D., & Mohajan, H. K. (2023i). Obesity and Its Related Diseases: A New Escalating Alarming in Global Health. Unpublished Manuscript.
- Mohajan, D., & Mohajan, H. K. (2023j). Body Mass Index (BMI) is a Popular Anthropometric Tool to Measure Obesity among Adults. Unpublished Manuscript.
- Mohajan, D., & Mohajan, H. K. (2023k). A Study on Body Fat Percentage for Physical Fitness and Prevention of Obesity: A Two Compartment Model. Unpublished Manuscript.
- Mohajan, D., & Mohajan, H. K. (2023l). Ponderal Index: An Important Anthropometric Indicator for Physical Growth. Unpublished Manuscript.
- Mohajan, D., & Mohajan, H. K. (2023m). Long-Term Regular Exercise Increases $\dot{V}O_2\text{max}$ for Cardiorespiratory Fitness. Unpublished Manuscript.
- Mohajan, H. K., Islam, J. N., & Moolio, P. (2013). *Optimization and Social Welfare in Economics*. Lambert Academic Publishing, Germany.
- Moolio, P., Islam, J. N., & Mohajan, H. K. (2009). Output Maximization of an Agency. *Indus Journal of Management and Social Sciences*, 3(1), 39-51.
- Mundodan, J. M., Saju, C. R., & Joshy, V. M. (2019). Utility of Broca's Index in Assessing Body Mass: Analysis of Anthropometric Measures from a Cross Sectional Study. *National Journal of Community Medicine*, 10(11), 600-604.

Pandey, P., & Pandey, M. M. (2015). *Research Methodology: Tools and Techniques*. Bridge Center, Romania, European Union.

Polit, D. F., & Hungler, B. P. (2013). *Essentials of Nursing Research: Methods, Appraisal, and Utilization* (8th Ed.). Philadelphia: Wolters Kluwer/Lippincott Williams and Wilkins.

Rahman, S. A., & Adjeroh, D. (2015). Surface-Based Body Shape Index and Its Relationship with All-Cause Mortality. *PLoS One*, 10(12), e0144639.

Rahman, M. M., & Mohajan, H. K. (2019). Rohingya-The Stateless Community Becoming the Lost Generation. *Journal of Economic Development, Environment and People*, 8(2), 24-36.

Rössner, S. (2007). Paul Pierre Broca (1824-1880). *Obesity Reviews*, 8, 277.

Roy, L., Molla, R., & Mohajan, H. K. (2021). Cost Minimization is Essential for the Sustainable Development of an Industry: A Mathematical Economic Model Approach. *Annals of Spiru Haret University Economic Series*, 21(1), 37–69.

Shah, B., Sucher, K., & Hollenbeck, C. B. (2006). Comparison of Ideal Body Weight Equations and Published Height-Weight Tables with Body Mass Index Tables for Healthy Adults in the United States. *Nutrition in Clinical Practice*, 21(3), 312-319.

Shetty, P., & Schmidhuber, J. (2011). *Nutrition, Lifestyle, Obesity and Chronic Disease*. Population Division, Expert Paper No. 2011/3, Department of Economic and Social Affairs, United Nations, New York, USA.

Taylor, R. W., Keil, D., Gold, E. J., Williams, S. M., & Goulding, A. (1998). Body Mass Index, Waist Girth, and Waist-to-Hip Ratio as Indexes of Total and Regional Adiposity in Women: Evaluation Using Receiver Operating Characteristic Curves. *American Journal of Clinical Nutrition*, 67(1), 44-49.

WHO (1995). *Physical Status: The Use and Interpretation of Anthropometry: Report of a World Health Organization (WHO) Expert Committee*. Geneva, Switzerland: World Health Organization.

WHO (2004). WHO Expert Consultation. Appropriate Body-Mass Index for Asian Populations and Its Implications for Policy and Intervention Strategies. *Lancet*, 363, 157-163.

WHO (2020). *Obesity and Overweight*. World Health Organization, Geneva, Switzerland. <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweigh>