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Modeling health status using the logarithmic biophysical modulator

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There are different methods to measure health and nutritional status of samples at different sociodemographic settlements in different communities. Of them, one method can be preferable at a certain topographic condition for specific group of people. Typically, it can then become a common method due to widespread uses by other groups, and hence many researchers often are in doubt to choose the apt method for their studies in dynamic environment of health science. This study aims to design a new modulator of health status for examining the ongoing health and nutritional concerns to the communities including malnutrition, health demography and possible socioeconomic and environmental changes of heath. It uses a wide range of instruments and theories ranging from the Quetelet's index in health science to the Albert Einstein's theory of relativity in physical science. Findings reveal that our proposed logarithmic biophysical modulator of health status [equation (ix)] is a modern and simple tool for health assessment of individuals through statistical modeling. It could be applicable to the study on the worldwide health and nutritional research, geospatial and community health and biostatistics and public health. Also it can be a uniquely functional biophysical model to the discipline of health pedagogy in nutritional epidemiology.

Key words: Health pedagogy, statistical modeling, health status, malnutrition, biophysical modulator

INTRODUCTION

About 2 billion people in the world suffer from various forms of malnutrition (Rahman and Biswas, 2009). Malnutrition is an underlying cause of death of 2.6 million children each year - a third of child deaths globally (Black et al., 2008; Rahman et al., 2008). One in every four of the world's children is stunted, and in developing countries this is as high as one in three (de Onis et al., 2011). This means their bodies fail to develop fully as a result of malnutrition. Undernutrition accounts for 11% of the global burden of disease and is considered the number one risk to health worldwide (Black et al., 2008). Childhood malnutrition leads to stunted growth and influence mortality and morbidity (Rahman and Hakim, 2016a; Rahman, 2006; Megabiaw and Rahman, 2013; Hakim and Kamruzzaman, 2015), which lower the survival opportunities of adults in their later life (Rahman

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Table 1. Classification of MAC measurements.

Under-nutrition level	MAC in mm
Moderate	160 ≤ MAC <185
Severe	MAC <160

and Chowdhury, 2007). About 4 of each 5 malnourished children live in South-East-Asia, and about 83% of childhood deaths are linked to mild to moderate forms of malnutrition (UNICEF, 1997; Rahman et al., 2009). Malnutrition in developing countries happened due to poverty, household food insecurity, gender bias, population pressure, food taboos, health, hygiene and nutritional negligence, famine and man-made disasters (Hakim et al., 2015; Rahman and Harding, 2013; Ghosh and Shah, 2004; Rahman and Kuddus, 2014a; Fakir and Rahman, 2015; Kuddus et al., 2014; Hakim, 2015). Malnutrition is also caused by intra-family feud, poor socioeconomic status, child abuse, deprivation of schooling opportunity and faulty family planning practices (Rahman and Sapkota, 2014; Kuddus and Rahman, 2015; Kamruzzaman and Hakim, 2016; Rahman, 2004; Kamruzzaman and Hakim, 2015; Hakim and Kamruzzaman, 2016; Hakim, 2016). These nutritional issues are affecting the world's population day by day (Hasan et al., 2016). As a result, typical health issues are in need of identification to overcome such poor health conditions with a view to meet healthy samples of population in different communities.

Some common methods for measuring population health and nutritional status are outlined below. The BMI (Body Mass Index) method is the measure of body fat based on body weight (mass) and height applied to individuals, i.e. BMI = Body weight in kg/(Body height in m)^2. Classification of BMI ranges are: i) Underweight: if BMI < 18 kgm^{-2}; ii) Normal weight: if BMI from 18 to 25 kgm^{-2}; iii) Overweight: if BMI from 25 to 30 kgm^{-2}; and iv) Obese: if BMI > 30 kgm^{-2}. This method is widely used for measuring health status of adult people in the community (Rahman et al., 2008). Another method is called MAC or MUAC or MUAC for age (Mid-Upper Arm Circumference). MAC is the circumference of the left upper arm, measured at the mid-point between the tip of the shoulder and the tip of the elbow. MAC is useful to assess the nutritional status of younger children and it is mostly used in emergency situations to identify nutritional treatment requirements of younger patients. Table 1 provides the typical classification of MAC measurements to assess the moderate and severe form of under-nutrition. An additional measurement based on MAC is known as MUAA (Mid-upper Arm Area) which is estimated as: MUAA = MAC^2/ 4π (Kamruzzaman and Hakim, 2016). Besides this, there are three indices called Height for age (HAZ), Weight for age (WAZ), and Weight for height (WHZ) that are based on the standard ratio measures of the height, weight and age following the WHO's growth charts (Rahman and Chowdhury, 2007). These indices are further standardized using statistical concepts of the *Z-score*. Topically, a Z-score measure tells us whether a particular value for observation is equal to the mean, below the mean or above the mean of a bunch of scores. In the *Z*-scores approach: if the measure of a *Z*-score with the population mean μ has a value of 0, then it is equal to the group mean; if μ is positive then, it is above the group mean; if μ is negative, then it is below the group mean; if μ = +1, then it is 1 standard deviation (SD) above the mean; if μ = +2, then it is 2 SD above the mean, if μ = -1, then it is 1 SD below the mean; and if μ = -2, then it is 2 SD below the mean. However, none of these universal methods can precisely obtain the health and nutritional status at small area communities.

This study aims to design a simple modulator of health status for examining the ongoing health and nutritional concerns in communities including the malnutrition.

METHODOLOGY

This is a methodological review study to design an appropriate technique for modelling health status of samples. A range of instruments have been collected from the Quetelet's index in health science, unit bracket method, SI unit of body mass (Bandini and Dietz, 1987), SI and CGS units of body height in health physics, logarithmic gesture in algebra (Poliyanin and Manzhirov, 2007), ratio and percentages in statistics and Albert Einstein's theory of relativity in the branch of physics (Freedman et al., 2005; Einstein, 1916). These instruments have then used for examining all mathematical and/or statistical modeling in search of a quicker health status modulator in order to measure the health status of the population in the community.

RESULTS

The BMI is the measure of body fat relying on the body mass and body height (Ganong, 2001; Garrow and Webster, 1985; Strain and Zumoff, 1992), derived from the body mass divided by the square of the body height and is universally manifested in unit of kgm^{-2}, resulting from body mass in kilogram (kg) and body height in metre (m) of a sample in a population. So the statistical indicator to assess the BMI yielding to the equation as follows:

$$BMI = m_{kg} / h_m^2 \qquad (1)$$

Where,

m_{kg} = Body mass in kg, h_m = Body height in m and BMI = Body mass index in kgm^{-2}

Lambert Alolphe Jacques Quetelet (Eknoyan, 2008), a Belgian astronomer, mathematician, statistician and sociologist invented the BMI philosophy during the period of his pioneering social physics. The BMI concept was named the Quetelet index pointing at the BMI invertor's surname Quetelet. So the BMI is equivalent to the

Quelelet index and the mathematical music in the connection is as follows:

$$BMI = QI \quad (2)$$

Where,
QI = Quetelet index
Inserting the Equation 2 value in the Equation 1.

$$QI = m_{kg} / h_m^2 \quad (3)$$

Body mass measuring in the SI base unit kg is the easiest trick in biophysics while body height measuring in the SI base unit m is harder and so the biophysics laureates are in vast use of the CGS base unit centimeter (cm) in order to measure body height of a sample in a population which is then converted into the SI base unit m with a view to bring to light the QI value in the SI derived unit kgm^{-2}. The following rule is applicable glancing at the unity bracket method (Bela, 2013) to convert the CGS unit cm into the SI unit m,

$$100 \text{ cm} = 1 \text{ m}$$
$$\text{Or, } 10^2 \text{ cm} = 1 \text{ m}$$
$$\text{Or, } 1 \text{ cm} = 1 / 10^2 \text{ m}$$
$$\text{Or, } 1 \text{ cm} = 10^{-2} \text{ m} \quad (4)$$

Inserting the Equation 4 value in the Equation 3,

$$\begin{aligned} QI &= m_{kg} / (10^{-2} h_{cm})^2 \\ &= m_{kg} / 10^{-4} h_{cm}^2 \\ &= 10^4 m_{kg} / h_{cm}^2 \quad (5) \end{aligned}$$

QI is a parameter used to determine health status of a sample in a population (Norgan and Ferro-Luzzi, 1982; Freedman, 2005; Davies and Lucas, 1989) and health status is imposed to the symbol H as rule as the myth of considering the initial alphabet of a word having massive influx in the scientific branch of physics.

$$\text{So, } QI = H; \quad (6)$$

Where,
H = Modulator of health status

The Equation 5 turned into the following icon as the Equation 6 stealing into the Equation 5,

$$H = 10^4 m_{kg} / h_{cm}^2 \quad (7)$$

Taking log (Shirali, 2002) in both side of the Equation 7,

$$\begin{aligned} \log H &= \log (10^4 m_{kg} / h_{cm}^2) \\ &= \log (10^4 m_{kg}) - \log h_{cm}^2 \\ &= \log 10^4 + \log m_{kg} - \log h_{cm}^2 \\ &= 4\log 10 + \log m_{kg} - 2 \log h_{cm} \\ &= 4 + \log m_{kg} - 2 \log h_{cm} \quad [\text{As } \log 10 = 1 \text{ in common logarithm}] \quad (8) \end{aligned}$$

The health status is replied to the equation below calculating the Equation (8),

$$H = \log^{-1} (4 + \log m_{kg} - 2 \log h_{cm}) \quad (9)$$

The picked up H value within the range of 18 to 25 kgm^{-2} found putting the measured body mass in kg and body height in cm in the Equation 9 is the indicator of healthy (H^+) and 18 to 25 kgm^{-2} deviated value the indicator of non-healthy (H^-) sample in the population (WHO, 2006a).

The number of healthy samples $(H^+)_n$ and non-healthy samples $(H^-)_n$ are found using the Equation 9 within the population of N in a community and then the following five postulates are with distinctive features in statistical modeling (Freeman, 2005; Schervish, 1995; Robertson, 1949):

(i) The ratio of healthy and non-healthy samples = $(H^+)_n : (H^-)_n$,
(ii) % of $(H^+)_n = 100 (H^+)_n / N$,
(iii) % of $(H^-)_n = 100 (H^-)_n / N$,
(iv) The population is relatively healthy[38] if $(H^+)_n > (H^-)_n$ and
(v) The population is relatively non-healthy[39] if $(H^+)_n < (H^-)_n$.

DISCUSSION

Health is the level of function or metabolic capacity of living organisms. In humans it is the ability of individuals or communities to adapt and self-manage when facing physical, mental and social challenges (Hube, 2011). The WHO defined health in its broader sense in its 1948 constitution as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (WHO, 2006b). To determine health and nutritional difficulties of people is generally challenging because different risk factors are associated with health and nutritional state (Rahman, 2016). The people are widely deprived of their country’s constitutional basic health, hygiene nutritional care and shelter. The BMI can measure health and nutritional condition in these circumstances defining as a value derived from mass (weight) and height of an individual in the unit of kgm^{-2} giving a big confliction on using mass and/or weight. The mass is a scalar quantity of unit metre (m) while the weight is a vector quantity containing the unit newton (N). The unit of BMI is kgm^{-2} and/or kgN^{-2} which is totally a false concept as well as unit of mass is a base unit but unit of weight is a derived unit.

According to the BMI definition, mass (weight) is used and hence the researchers are at bay over choosing the surer or surest quantity and its corresponding unit. So a simple apt modulator is essential to determine the prevailing health status in the communities aiming to resist malnutrition influencing factors and so the Equation 9 can be the easier option to choose in assessing the overall health status. The German chemist Friedrich Wohler, the pioneer of organic chemistry disapproves the vitalism inventing Wohler synthesis in 1828 (Brinkman et al., 2012; Wohler, 1828). The current study findings similarly can overlap the place of the BMI (Wohler, 1828) in health science. The BMI or other methods (Hakim and Rahman, 2016; Alam et al., 2011; Hakim and Talukder, 2016; Rahman and Kuddus, 2014b; Ahmed and Islam, 2009; Chumlea et al., 2007; Petitt and Sidney, 1988) are using to measure the health and nutritional condition of people fighting shy of taking initiatives to invent a new method (Garrow et al., 1979) to explore the health status of population in communities and the present study derived biophysical modulator that is, logarithmic Equation 9 can take place in the path of the prior existing methods. This biophysical modulator can be a microsimulation modeling (Rahman et al., 2010; Rahman et al., 2013; Islam et al., 2015; Rahman and Harding, 2014) constructive to design effective policies and see the governments and NGOs, environmental and spatial effects across different countries (Rahman, 2016b; Rahman and Upadhyay, 2015; Rahman and Harding, 2016; Phill, 2011; Rahman, 2009) to bear up against the health and nutritional perils to make sure for ending malnutrition by 2020: an agenda for change in the millennium (Rahman, 2016a).

This health microsimulation modeling (Equation 9) is for exploring health status in bio-statistical rhythm as rule as five postulates derived from statistical analyzing of the respective logarithmic modulator. The current study can be a super active tool in health pedagogy (Poole et al., 2016; Karsten, 2012; Glickman and Mitchell, 1948) to resist nutritional victimization through using nutrition counseling with the help of modified mass energy equivalence in nutritional epidemiology in the branch of health science and biostatistics (Rahman and Hakim, 2016b; Chowdhury et al., 2016; Rahman and Hakim, 2016c).

Conclusion

Malnutrition is one of the splendid public health panics in both the developing and developed countries in the world. The current study findings are the five galore popular bio-statistical postulates on existing health status based on the logarithmic biophysical Equation 9. This equation can help to take immediate bid to shirk the malnutrition intensity identifying the health confounding trails and therefore the equation $H = \log^{-1}(4+ \log m_{kg} - 2 \log h_{cm})$ is the logarithmic biophysical modulator of health status in statistical modeling. So the national and international think tank should pave the way to make pinch of salt on this modulator to reduce malnutrition bulk as degree as possible at national as well as international level. Future research should adopt this modulator in designing microsimulation modeling on health pedagogy and nutritional epidemiology. This modulator should also be explored in further study for policy designing, analysis and checking spatial effects for childhood, adulthood and geriatric health status for health and nutritional upgradation.

Conflict of Interests

The authors have not declared any conflict of interests.

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