Epidemiology of Adult Obesity, Measurements, Global Prevalence and Risk Factors

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Abstract

This report critically evaluated the epidemiology of obesity in adults. Epidemiology has been identified as an essential science in public health that enhances the strategies used to identify and map emerging diseases. The epidemiology of adult obesity is measured according to the rate of incidence, prevalence and mortality in a certain population through a number of variables including person, place and time. However, the incidence and prevalence of adult obesity have been discussed globally, nationally and regionally identifying places of increased incidence and prevalence in graphs, bar charts and tables. Significantly, public health practice has been indicated to underpin epidemiology studies which are useful to inform practice by providing different levels of intervention to curb adult obesity.

1. Introduction

Obesity or overweight is referred to as the excessive or abnormal accumulation of fat that might present health risks in adults as classified in Table 1 (Wang *et al*., 2012). As a result, obesity or overweight in adults has been a major epidemic around the world (Brundi *et al*., 2012) and associated with several comorbidities (Compos *et al*., 2006).

Table 1: Classification of obesity according to BMI level (BMI of Adults Age 20 and Older)

BMI	Classification
18.5 to 24.9	Normal weight
25 to 29.9	Overweight
30+	Obesity
40+	Extreme obesity

Source: NHANES, 2009-2010

Globally, obesity has been accorded one of the leading causes of death (Meacham and Vieira, 2012). According to Stewart (2010), obesity has caused several deaths worldwide which could have been prevented. As a result, studies have proven high blood pressure to cause 13% of death globally, 6% allocated to high blood glucose, 6% allocated to physical inactivity, and 5% allocated to obesity (WHO, 2012). According to World Health Organisation, 84% of the mortality risk occurs in countries of low and middle income (WHO, 2012). Conversely, Meacham and Vieira (2012), declared that the risk factor is majorly associated with countries of high income. It is alarming that statistic and trends have proven that over 2.8 million overweight and obese people die every year globally (Meacham and Vieira, 2012). This report critically evaluates the epidemiology of obesity in adults, with emphasis on epidemiological key concepts which includes incidence, prevalence, rates, ratios and risk. Essentially, the report will contribute to epidemiological information as relates its use in public health policy and practice.

2. Epidemiology

Epidemiology is an essential science in public health that is concerned with the determinants and distribution of diseases in a given population (Ben-Shlomo *et al*., 2013). According to Compose *et al*. (2006), Epidemiology as a concept is an indispensable science in public health that enhances the strategies used to identify and map emerging diseases. However, an effective epidemiology approach depends on goal-directed and valid data collections (Spellman and Whiting, 2013). Tables 2 and 3 shows the various parameters used in epidemiology measurement.

3. Mortality

Recent study confirmed that obesity is a risk factor for increased rate of mortality in adults (Meacham and Vieira, 2012). According to Metha and Chang (2009), the increased rate of mortality has been attributed to complications arising from obesity (Fig. 1).

Table 2: Measurements in epidemiology

Incident, Prevalence and Mortality Rates	Epidemiology is measured according to the rate of incidence, prevalence and mortality in a certain population through a number of variables (Stewart, 2010; Bailey and Handu, 2013). McKenzie and Pinger (2013) proclaimed that incidence and prevalence is measured by counting cases in a specific population noted to be at risk of a disease condition. Incidence and prevalence can be measured against characteristics such as age, sex and race (Osborn, 2006). Generally, Incidence and prevalence rates are represented as below according to Osborn (2006);
Incident Rate	In incident rate, the numerator is the total number of new cases of adult obesity in a specific period whereas the denominator is total population at risk during this period as represented below (Osborn, 2006). In calculating the incidence rate, cases per 10^n and per day, per week, per month, and per year must be included in the units of incidence rate (Bonita *et al*., 2006)
Prevalence Rate	In prevalence, the numerator is referred to all new and pre-existing cases of adult obesity in a specific period while the denominator is the total population during the same time period (Friis and Sellers, 2014). Essentially, the prevalence rate is multiplied by 10^n which is the appropriate factor. As a result, prevalence is usually expressed and presented as cases per 100 or per 1000 population (Bonita *et al*., 2006).

Mortality Rate	Mortality rate measures the number of deaths in a population over a given period of time (Bailey and Handu, 2013). Proportional mortality ration (PMR) is applied when comparing age groups and the general population (Fletcher and Fletcher, 2014). PMR refers to proportion of all death occurring in a time interval due to a particular cause such as adult obesity. It is expressed in percentage, with the sum of the causes which is 1.00 (100%) as below:

Incidence rate

$$= \frac{\text{Total number of new cases of adult obesity in a specific period}}{\text{Total population at risk during this period}} \; x \; 10^n$$

(Bonita *et al*., 2006:18).

Prevalence rate

$$= \frac{\text{All new and pre} - \text{existing cases of adult obesity in a specific period}}{\text{Total population during the same time period}} \; x \; 10^n$$

(Bonita *et al*., 2006:18).

Mortality rate

$$= \frac{\text{Number of deaths due to obesity during a given time interval}}{\text{Number of deaths from all causes in the same time interval}} \; x \; 100$$

(Osborn, 2006).

Table 3: Characteristics of prevalence and incidence

Characteristic	Incidence	Prevalence
Numerator	New cases occurring during a period of time among a group initially free of disease	Existing cases at a point or period of time
Denominator	All susceptible people without disease at the beginning of the period	All people examined, including cases and non-case
Time	Duration of the period	Single point or period
How measured	Cohort study	Cross-sectional study

Source: (Fletcher and Fletcher, 2014:19).

4. Global, National and Local Perspectives

Globally, obesity has been rising inevitably since 1980, it is still rising and causing adverse impacts on the health of the public (Friis and Sellers, 2014). According to World Health Organisation, it is a major health problem in developed nations and over 1.4 billion adults aged 20 and above were overweight in 2008, at the same time, 200 million men and over 300 million women were reported as obese. Therefore, 11% of adults aged 20 and above were obese while 35% were overweight respectively (WHO, 2012). Again, 35% of women and 34% of men were obese (WHO, 2008, WHO, 2012). By comparing the increase in prevalence since the year 1980 to 2008, 14% of women and 10% of men were obese in 2008 compared to 8% of women and 5% of men in 1980. This has shown a great increase in the prevalence of obesity since 1980 worldwide according to statistical trends (WHO, 2012).
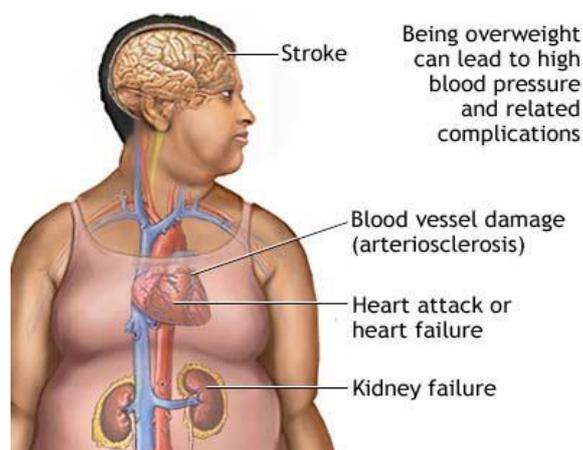

Figure 1: Secondary Complications of Obesity Leading to Death**. Source:** Newcastle Obesity Surgery Centre (2012).

Nevertheless, the accuracy of results on statistical trends depends on valid and reliable data collected in the local and regional settings. Although, a hundred per cent may not be achieved from records completeness and uniform methods in collecting epidemiological data. Therefore, the reliability of data is queried in some parts of the world due to the difficulties associated with data collection

(Oleske, 2009). Furthermore, difficulties associated with data collection have been attributed to poor quality of information; lack of good source of valid information; gaps and missing data; grossly inaccurate data; insecurity; systemic errors and bias: and lack of understanding of a whole community health status (Bendavid, 2011). Additionally, the economic status of a country has been established to affect data collection, low income countries have therefore been well-known to have difficulties in epidemiology data collection (WHO, 2012).

Nationally, adult obesity has also been attributed to a major problem in several countries both developed and developing (WHO, 2012). However, in Europe, UK has been noticed to be the highest in the prevalence of adult obesity. The National Obesity Observatory (NOO, 2013) data factsheet has shown in the above table that 36.9% of adults were overweight giving 41.4% of men and 32.5% of men whereas 24.8% were obese with 23.6% of men and 25.9% of females. However female had a higher prevalence in 2011. Consequently, between 2000/2001 to 2010/2011, a rise in hospital admission due to obesity as primary and secondary by gender was reported in England.

Locally, North East was reported to have the highest rate of incidence and prevalence of obesity in the UK with 13.1%, seconded by North West and Yorkshire and Humbria having 11.5% and 11.3% respectively. Significantly, accurate data collection informs an effective epidemiology process. However, data collection in some part of the world may not be as accurate and reliable as it is in the UK or other western countries. Bendavid (2011:105) stated that "Collection of reliable statistical information depends upon the implementation of appropriate methodology" which will further enhance community diagnosis or situation analysis. Therefore, the lack of appropriate methods will make it difficult to collect data in some parts of the world.

5. Person

The epidemiology variable of a person is a major determinant of how obesity is distributed (Bailey and Handu, 2013). Epidemiology identifies persons that are affected as well as those not affected in the same place and at the same time (Friis and Sellers, 2014). This enables the provision of strong clues that enhances the need for health services to ascertain the cause and provide strategies to control factors that leads to developing obesity (Fletcher and Fletcher (2014). The epidemiological variable of person also leads to early hypothesis regarding the cause and how cases of adult obesity affects the persons identified (Bailey and Handu, 2013). However, the epidemiology variable of person is established by certain key determinants such as age, sex, physical activities, diet and socio economic status (Fletcher and Fletcher, 2014).

5.1. Age and Gender

Over the years, obesity has been a huge public health burden occurring in all ages (Friis and Sellers, 2014). In adults, weight and height are used to compute a person's BMI to measure or determine if he or she is overweight or obese (Meacham and Vieira, 2012). A global picture of obesity in both men and women aged 20 and above were depicted in figs 2 and 3.
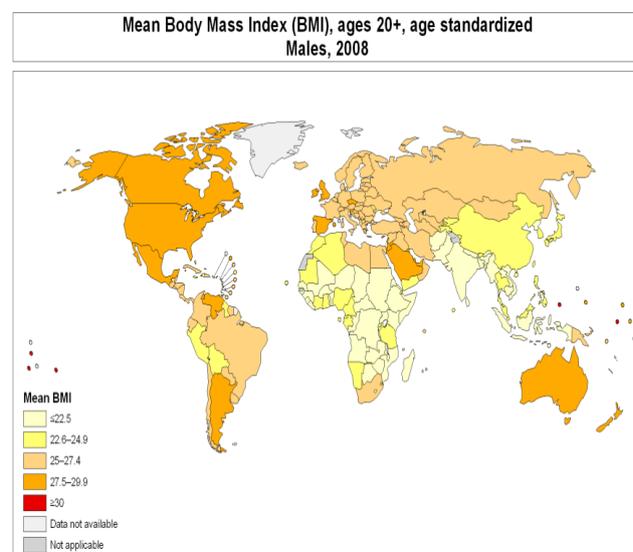

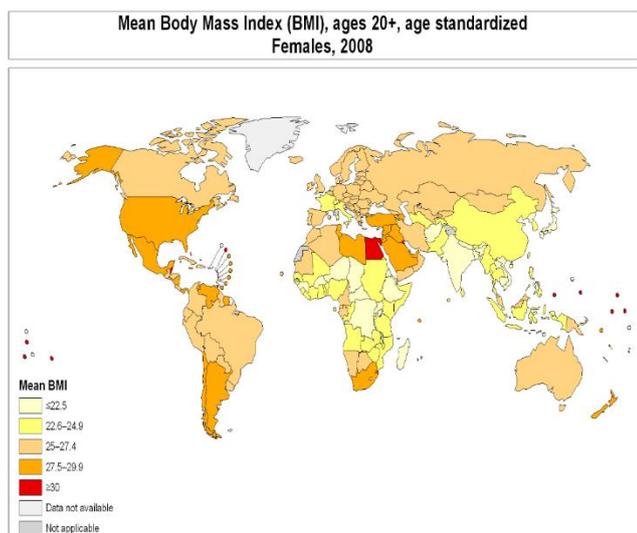**Figure 2:** Men aged 20 and above. **Source:** WHO (2009).

Figure 3: Women aged 20 and above. **Source:** WHO (2009).

Figure 4 shows standardized BMI of age in men and women aged 20 years and over, indicating increase in obesity future estimates. It shows that 1 billion people were estimated to be obese globally by 2008, which will also increase up to 1.5 billion by 2015 (WHO, 2008).
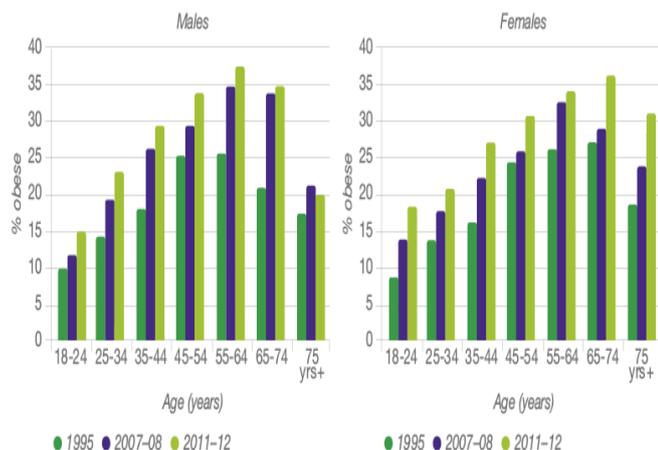

Figure 4: Prevalence of obesity by sex and age between 1995, 2007-2008 and 2011-2012. **Source:** State of Preventive Health (2013).

An increase in prevalence among women than men was reported (Ogben *et al.*, 2012). This has also been proven in several studies, indicating the increase in female adults getting more overweight and obese (Eastwood, 2013). According to Kopelman *et al*. (2009), the determinants that are responsible for the difference in trends in adult obesity for adults have been identified as changes in factors of lifestyle (Eastwood, 2013). These factors were identified as physical inactivity, increase in consuming unhealthy diet, increase alcohol intake (Ogben *et al*., 2012).

The determinants of obesity have also shown obesity in adults to result out of childhood obesity (Eastwood, 2013). Children that are overweight or obese have been reported to remain obese until adulthood or are prone to becoming obese in their adult life (Wahab *et al*., 2011). According to Ailshire (2011), this has been attributed to continual high-calorie intake as well as being inactive physically (Ogben *et al*., 2012). Most adult have also been reported to have the habit of a sedentary lifestyle leading to the accumulation of fat thereby becoming overweight or obese. However, Marcus (2013) emphatically argued that genetic factors could be a predisposing factor to that effect. On the other hand, low socioeconomic status has also been identified as a contributory factor to sustaining obesity (Wahab *et al*., 2011).

There is more prevalence of adult obesity in women has been identified in fig. 5 especially in the first four countries which are the United States in 2008, Mexico in 2006, Chile in 2004, New Zealand in 2007, Ireland in 2007 and United Kingdom in 2008. It has been noticed in fig 5 where some countries

have a higher prevalence of obesity in men than women such as Luxembourg in 2007. Basically, fig 5 showed how obesity was distributed between men and women in the Organisation for Economic Co-operation and Development (OECD) countries.
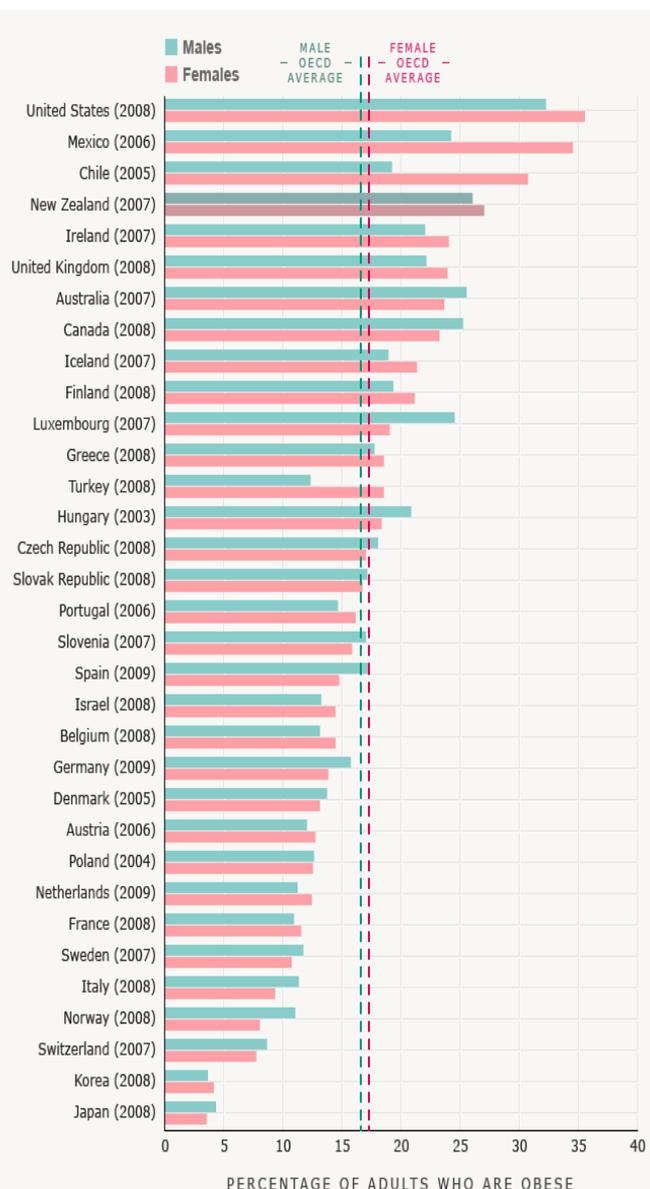

Figure 5: Percentage of obese adults (both men and women) in in OECD countries. **Source:** OECD (2012)

5.2 Socioeconomic status
According to McLaren (2007) several studies have proven the relationship between socioeconomic status and obesity worldwide. Friis and Sellers (2014) have also emphasized the increased prevalence of overweight and obesity affecting developing, industrial as well as transition economies around the globe affecting life expectancy (Eastwood, 2013). Significantly, the differences in socioeconomic status have increased the risk of obesity affecting individuals (Ball and Mishra, 2006).

Monteriro *et al*. (2004) carried out a study on the socioeconomic status and obesity populations of developing countries. This study was strategized to estimate the prevalence of obesity among adult populations. However, in the study, obesity was found more among the poor adults, more in women than men, due to economic development in both genders. This also reconciles with a more recent study that also reported increased prevalence of obesity among women than men (McLaren, 2009). Monteriro *et al*. (2004) accentuated that women had a more rapid prevalence of obesity occurring due to high health inequalities attributed to maternal and perinatal conditions, deficiencies in nutrition, and infectious diseases occurring among them.

Inequalities occur as a result of disabilities, age, health, socioeconomic status (Klenke, 2008). Generally, obesity is closely related to social and economic deprivation which occurs mostly among those within the lowest income quintile (Bambra *et al*., 2012). Bambra *et al*. (2012) established that socioeconomic inequalities are embedded in gradient and as a result life course which has a close relation to obesity due to individuals' lifestyle. As a result, several studies have reported increased obesity due to socioeconomic inequalities (Ogben *et al*., 2012).

The National Obesity Observatory (NOO) (2012) data factsheet reported an increased prevalence of adult obesity due to socioeconomic status. The report revealed a high risk of obesity among women of lower socioeconomic status. However, women with high-income status had a low risk of obesity. Nevertheless, men of lower socioeconomic status have also been reported to be at risk of obesity. Education attainment, deprivation, social class, type of occupation, and level of household income have been seen as contributory factors to the risk of obesity (NOO, 2012).

6. Place and Time

Place and time are major key determinants of how cases of adult obesity are distributed geographically and the time of occurrence (Behan and Cox, 2010). However, in geographical distribution, the frequencies of occurrence of disease vary from time to time, one place to another (Metha and Chang, 2009). It also varies from one population group to the other in different times and locations (Bailey and Handu, 2013). Basically, the characteristics of place and time of occurrence of cases such as adult obesity include the incidence and prevalence in terms of global, regional, national and local places (Meacham and Vieira, 2012).

7. Incidence and Prevalence

7.1 Global Impact:

Globally, adult obesity has impacted negatively to the health and economy of the population, with incidence and prevalence reaching and crossing projections (Shiromani *et al*., 2013). Several studies have shown a continued increase in adult obesity in different places as well as different times, indicating the places of highest prevalence (Klenke, 2008), where prediction has indicated that prevalence could reach 80% of the population having obesity (Ngunye *et al*., 2010). Figure 6 shows the global prevalence of obesity in adults.

The United States of America (USA) was reported to have the highest prevalence in obesity. However, currently, the highest prevalence of obesity is no longer in the United States of America (OECD Health Data, 2012). A Pacific Island called American Samoa with 700,000 populations in the 2013 census has been found to have the highest prevalence in obesity with 74.6% of the population being obese (Ngunyen *et al*., 2010). According to World Health Organisation, the reason for this increase in the prevalence of obesity in America Samoa has been attributed to cheap unhealthy fast food and a sedentary lifestyle (WHO, 2012).

However, the rates in the United States of America and Europe are reported to be generally high (Shiromani *et al*., 2013). Obesity has not only affected low and middle-income countries, it now affects high-income countries (Ogden *et al*., 2012). Moreover, obesity has also been attributed to be the problem of the western world (OECD Health Data, 2012). Male and female adults of different localities have been affected (Shiromani *et al*., 2013).

7.2 National and local impacts

Adult obesity has exerted a great health risk impact on the health of adults in different parts of the world (Fletcher and Fletcher, 2014). In the US over 35% of women and men were found obese in the years 2009-2010. Epidemiology did not reveal any significant difference between the prevalence of obesity in US men and women at their different ages. However, more adults from 60 years and above had the likelihood of being more obese. Men had no significant difference by age but women aged 60 and above had 42.3% of obesity compared to women aged 20 – 39 who had 31.9% (Ogden, 2012).

8. Determinants

Individuals are affected by the environment they were born, grew up, and work (Kleiser *et al*., 2009). They are also engulfed with other circumstances such as power level, income level and distribution of resources according to affordability (Monasta *et al*., 2010). Obesity has been found to affect people due to different factors in life such as urbanization (Rennie *et al*., 2005). However, several studies have claimed excessive intake of calories leads to obesity (Fletcher and Fletcher, 2014).
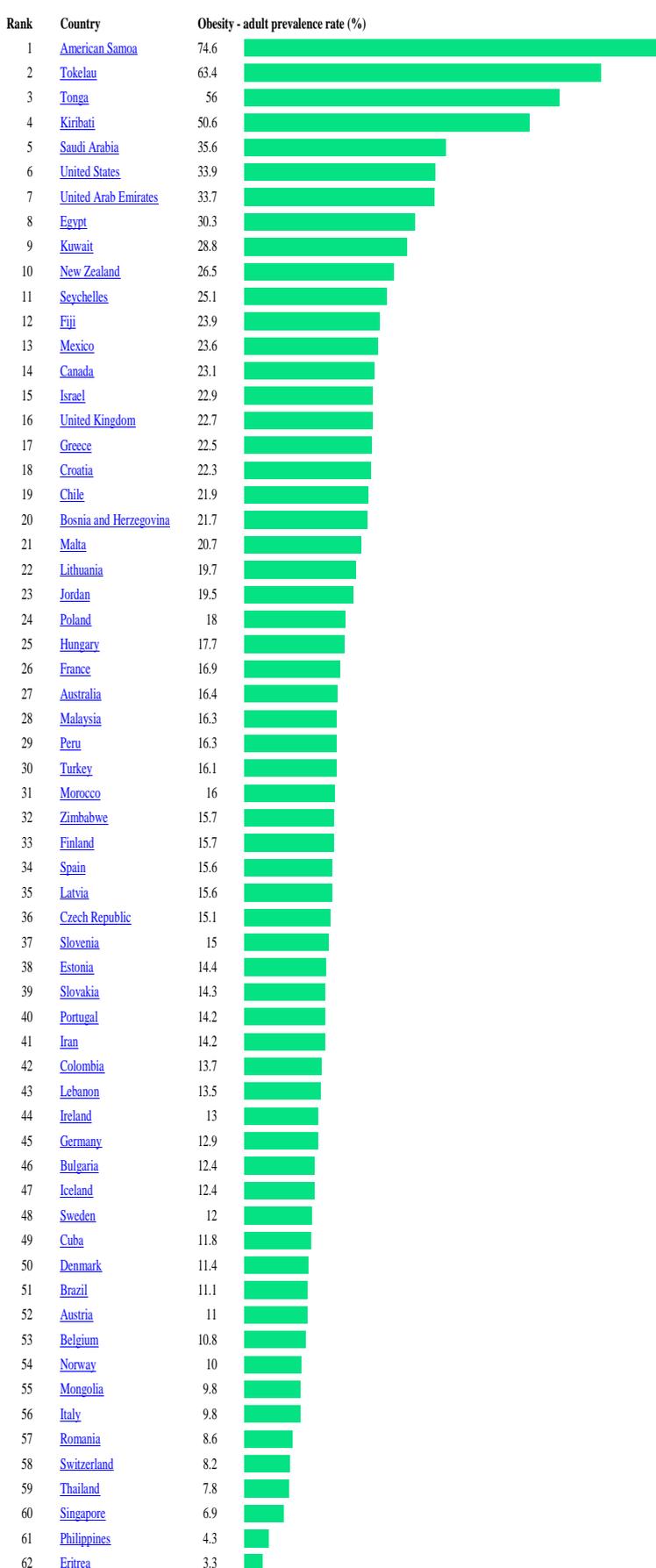
Rank	Country	Obesity - adult prevalence rate (%)
1	American Samoa	74.6
2	Tokelau	63.4
3	Tonga	56
4	Kiribati	50.6
5	Saudi Arabia	35.6
6	United States	33.9
7	United Arab Emirates	33.7
8	Egypt	30.3
9	Kuwait	28.8
10	New Zealand	26.5
11	Seychelles	25.1
12	Fiji	23.9
13	Mexico	23.6
14	Canada	23.1
15	Israel	22.9
16	United Kingdom	22.7
17	Greece	22.5
18	Croatia	22.3
19	Chile	21.9
20	Bosnia and Herzegovina	21.7
21	Malta	20.7
22	Lithuania	19.7
23	Jordan	19.5
24	Poland	18
25	Hungary	17.7
26	France	16.9
27	Australia	16.4
28	Malaysia	16.3
29	Peru	16.3
30	Turkey	16.1
31	Morocco	16
32	Zimbabwe	15.7
33	Finland	15.7
34	Spain	15.6
35	Latvia	15.6
36	Czech Republic	15.1
37	Slovenia	15
38	Estonia	14.4
39	Slovakia	14.3
40	Portugal	14.2
41	Iran	14.2
42	Colombia	13.7
43	Lebanon	13.5
44	Ireland	13
45	Germany	12.9
46	Bulgaria	12.4
47	Iceland	12.4
48	Sweden	12
49	Cuba	11.8
50	Denmark	11.4
51	Brazil	11.1
52	Austria	11
53	Belgium	10.8
54	Norway	10
55	Mongolia	9.8
56	Italy	9.8
57	Romania	8.6
58	Switzerland	8.2
59	Thailand	7.8
60	Singapore	6.9
61	Philippines	4.3
62	Eritrea	3.3

Figure 6: Prevalence of adult obesity by country rates. Showing the current and recent country having the highest prevalence of obesity which is America Samoa (74.6%). **Source:** OECD Health Data 2012

Review article

According to Dahlgren and Whitehead (1991) model (Fig. 7), different factors can affect people and lead to disease conditions such as obesity. These factors include cultural and environmental factors, socioeconomic conditions, age and sex factors, social and community factors and the lifestyle of an individual. According to Monasta *et al*. (2010), the levels indicated in the social determinants of health are interconnected.
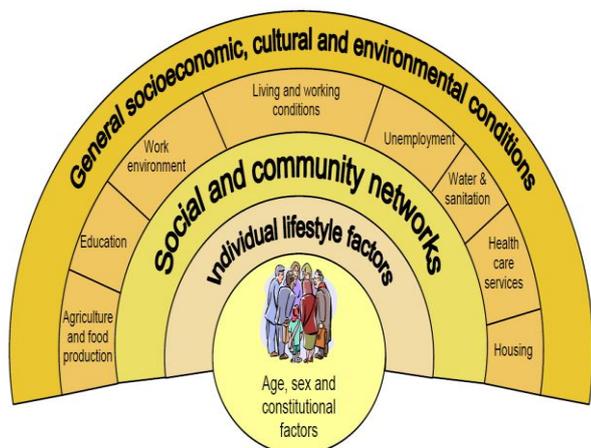

Figure 7: Social Model of Health – Dahlgren and Whitehead (1991) Model.

Nevertheless, level of education, housing status, unemployment, living and working conditions, inability to access healthcare services, lack of health advice have been attributed to sustaining diseases such as obesity (Dahlgren and Whitehead, 1991). According to Cox (2010) the above mention factors could result in not being able to purchase or eat the right food or not living a good lifestyle thereby leading to having obesity.

9. Risk Factors
According to Ngunyen and El-serag (2012) a number of risk factors to obesity or overweight have been identified (Table 4); these risk factors include genetics, inactivity, unhealthy diet and eating habit, family lifestyle, quitting smoking, pregnancy, certain medication, age, social and economic issues and medical problems. Generally, the social determinants of health are engulfed in the risk factors which affect the person, place and time. (Fletcher and Fletcher, 2014).

Table 4: Example of decrease and increase risk of developing obesity.

	Decreases Risk	Increases Risk
Convincing Probable	Physical activity Low energy-dense foods. Being breastfed	Sedentary living Energy-dense foods Sugary drinks. Fast foods. Television viewing

According to Kleiser *et al*. (2009), the lifestyle of an individual contributes immensely to developing obesity. In the above table, the people that develop obesity are those that eat unhealthy food and those that do not engage in active physical activities as in American Samoa making them have the highest prevalence of obesity worldwide (WHO, 2012; Ngunyen and El-serag, 2012). Consequently, the risk of developing obesity could lead an individual to develop the relative risks as indicated in Table 5.

Table 5: Relative risks associated with obesity.

Relative risk greater than 3	Relative risk 2-3	Relative risk 1-2
Type 2 diabetes	Coronary heart disease	Cancer
Gallbladder disease	Hypertension	Reproductive hormone abnormalities
Dyslipidaemia	Osteoarthritis (knees)	Polycystic ovary syndrome
Insulin resistance	Hyperuriceamia and gout	Impaired fertility
Breathlessness		Low back pain
Sleep apnoea		Increased risk of anaesthesia complications Fetal defects (associated with maternal obesity).

10. Life Expectancy
Obesity has been identified as a source of lowering life expectancy (Waldron, 2007; Bleich *et al*., 2009). 40 years of age is the estimated life expectancy of an obese individual (Alley *et al*., 2010). However, it has been established that people classified as obese are expected to leave six to seven years lesser than those defined to have a normal weight (Glei *et al*., 2010). The reduced life expectancy of obese people has been associated with the risks from obesity as in the above table.

11. Application to Practice/Public Health Interventions
Spellman and Whiting (2013) emphasised that epidemiology underpins public health as a key quantitative discipline that reveals the causes of illnesses. Generally, public health organisations are designed to provide diverse epidemiological investigations of diseases and conditions such as obesity (Killewo *et al*., 2010; Somerville, 2012). Consequently, solutions to the outcome of their investigations are disseminated to stop or reduce a particular cause (Adams *et al*., 2010). In terms of obesity, to reduce preventable deaths and its adverse impacts, different levels of interventions have been applied as methods, strategies, policies to improve the health of the public (Bonita *et al*., 2006; Adams *et al*., 2010) as in Table 6.

Table 6: Strategies and policies used to prevent and manage obesity

S/N	Strategies, Methods and Policies	Interventions, Rationales and Benefits
1	Joint Strategic Needs Assessment	Joint Strategic Needs Assessment is a strategy developed to enhance the public to achieve a healthy weight. This strategy was divided into five tiers. Tier 1 was based on provision of health advice from health provisional through media adverts, in schools, in policies as well as influencers consisting of town planner, transport, and preventable measures in food policy. Tier 2 weight management based on community programmes. Tier 3 was weight management based on referral programmes for exercise and dietetic appointments. Tier 4 was based on multidisciplinary specialist weight management in the hospital and tier 5 was based on high cost intervention such as surgery (French *et al*., 2011).
2	Care Pathway	Care pathway was designed for overweight and obesity management among adults starting with assessment and history of the client consisting social, medical, physical activity, dietary histories to inform management. Consequently, a line of management will be established which comprises healthy eating, reduced calorie intake, increased physical exercise, a change in behaviour and lifestyle. Medical and surgical treatment will be given to extreme cases, then maintenance and monitoring programmes will be initiated (DoH, 2006; French *et al*., 2011).
3	Involving local authorities and health trainers	Partnership with health trainers and local authorities will facilitate the provision of safety physical and health activities through schemes, facilities, spaces for physical activities, safer routes for walk and cycling (DiMaggio, 2012).
4	Involving work places, schools and universities	Workplaces, schools and universities are involved regarding healthy lifestyle. They encourage increased physical activities, healthy choice of eating through Food Standard Agency (FSA) Guidance. They encourage active travelling, social activities for recreations, local facilities to enhance leisures (Summerfield, 2012).
5	Partnership with organisations and local authorities	Partnership with organisations and local authorities regarding behavioural factors and lifestyle. This will ensure adequate obesity related information dissemination, emphasizing on the benefit of healthy lifestyle and behaviour. Also ensures the adequate provision of counselling (DiMaggio, 2012).
6	Equality Impact Assessment (EIA).	Equality Impact Assessment has been designed to address issues regarding deprivations, inequalities, socioeconomic status, lack of access to health facilities and poverty to reduce the prevalence of obesity and improve health of the public (French *et al*., 2011).

12. Conclusion and Recommendations

Governmental and nongovernmental organisations have jointly provided several cost-effective and evidence based strategies, integrating both clinical

and preventive public health interventions in the management of obesity. This is necessary to enhance the concept of utilitarianism to uphold the health for all concepts, to avoid preventable deaths and reduce the increased incidence and prevalence of obesity. Therefore, it is recommended that further studies should be carried out on the incidence and prevalence of obesity and how public practice has been used to inform epidemiology practice to promote health.

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