Tackling Obesity by Diet Quality, Technology and Social Networks

Anjum Razzzaque

Management Information Systems Department, Ahlia University, Manama, Kingdom of Bahrain
Email: arazzaque@ahlia.edu.bh

Tillal Eldabi

Arts & Social Sciences, College of Business, Brunel University, London, United Kingdom
Email: tillal.eldabi@brunel.ac.uk

Abstract—**Obesity has been a research area that has been of scholars' interest since decades. Still obesity seems to be reported to be a rising global epidemic. Past research empirically assessed the role of genetic, economic and social environments interventions on obesity using research strategies like quantitative, simulation and social networks cross sectional and longitudinal analysis. This article critiques a review of current literature and describes how obesity is recently tackled from the point of view of adolescents' social networks: specifically from journal articles' various pronounced research gaps. Hence a model solution is proposed; viable for future empirical assessment for this study's research in progress. Theoretical and practical implications to this model are also suggested in this paper.**

Index Terms—**food quality, obesity, social capital theory, social networks, technology interventions, quality of life**

I. INTRODUCTION

Obesity is a severe global public health threat: a hot research topic. In the US over 15% of children are obese from low income families and in Australia 20 - 25% of children and more than half of Australian population are obese. Obesity cascades to other health concerns. Obese children face obesity at a young age and carry such an epademic to adulthood. Later they suffer from cancer, stroke, type 2 diabetes, heart attack, etc. like diseases and psycho-social concerns Obesity is also a global concern: tripled in 2005 and doubled since 1980 since and such that obesity arose in Europe since past decade. Obesity in adults is ≥ 60 is expected to rise 37% by 2010: making obesity a critical situation considering that such a situation increases HC cost, lowers productivity and quality of life as well as risks the rise in mortality [1]-[5].

Obesity has been assessed from various dimensions. Recent literature focused on the social and environmental determinants of obesity, i.e. on income inequality, Social Capital (SC), social cohesion and environmental quality focused on Socio-Economic Status (SES): declining SES give rise to obesity [6]. The rising use of technology caused sedentary behavior leading to lacking exercise and thus obesity even though technology improves health through eHealth and m-Health (smartphone are most popular technological devices with mobility and Web connectivity: services and information sharing among peers and experts on the Web [7], [8]. To curb the effect of obesity, research applied cross-sectional, multi-level interventions and social determinants: i.e. health factors (age or gender, ethnicity, etc.) to tackle obesity. Obesity research shifted to social platforms to investigate social interventions on obesity: through social cohesion (cultural settings influence health in a community), trust, SC (tackling obesity from network's resources), collective efficacy (relations united and willing to do good) and social networks (relations influencing health outcomes) [1]. Interventions, like exercising and dieting, have short term effects since weight regains after few years. This suggests a simultaneous change in health behavior preventing obesity [9]. Those obese suffer from mental disorder, Social Anxiety Disorder (SAD): fear of how others perceive them in social settings. Obesity is measured using Body Mass Index (BMI) and SAD using social anxiety level [10].

Research assessed effect of food consumption of the rich and the poor on obesity, i.e. poor versus rich peoples' eating behaviors. The poor consume more fast food than the rich as they are influenced by obesogenic environments that encourage food consumption and discouraging physical activated. Research speculates that area scarcity affects obesity [6]. Hence, these scholars assessed the area measure of SES and density of fast food restaurants per population head in Melbourne, Australia. 267 postal districts were studied by identifying fast food restaurants within given districts.

Reference [5] later assessed causes of food consumption, high fat foods like fast food restaurants, etc. and lack of physical activity, i.e. replaced by video games, television, etc. Ample adolescent research reported that social environments, in schools, family, peers, etc., influence behaviors manipulating obesity, such that, friends influence obesity risking behaviors. There is a need for friendship roles should be studied through ties,

beyond examining dyads. These scholars reported that social interactions are influential on peers, group norms and share resources and that peer weight status is influenced by social ties, e.g. smokers prefer befriending smokers.

In the next section related works describe the obesity research area to understand how researches tackled obesity through various research designs. Section 3 expressed the methodology of this article's research in progress. Section 4 did a re-cap of the problem at hand; to propose an evidence based rationalized conceptual model; viable for future quantitative assessment. Finally, Section 5 discusses the implication and limitations to the solution and the conclusion expressed the importance of the paper's knowledge contribution.

II. RELATED WORKS

Obesity often leads to mortality. In US obesity consumes 17% of medical cost: predicted to increase to 51% by 2030 - with 1/3 population with type 2 diabetes by 2050. Obesity causes diabetes cardiovascular diseases, non-alcoholic fatty liver disease or strokes. Obesity can be prevented by sufficient sleep, physical activity, fat control and diet maintenance. Such interventions are advised under clinic and social settings but ineffective if participants drop out. These interventions are not proven successful as clinic provided interventions face low participation; where dropout rate is high for the community provided interventions.

A. Assessing Obesity by Social Networks

When speaking about social networks, obesity is affected through peer behavior: thus harmful for spreading bad influences like over eating or low physical activities where social networks are effective for individuals' behaviors and health outcomes like obesity or depression influenced by network ties. Past research assessed positively influencing individuals' behaviors, like quitting smoking. However, no study identified social ties patterns correlating between health traits across network ties [10], [11]. Reference [11] did so and their findings indicated a positive significance of BMI on all examined social networks. Reference [12] also reported that social network analysis helps realize the complex social and biological relations influencing learning, friendship and unhealthy or healthy behaviors. The obese are reserved and likely unfriendly; compared with those healthy; thus depressed and deteriorate their health conditions: especially in middle or high schools social circle of similar BMIs, where inflective beliefs and behaviors trickle from one to another in network ties.

Reference [12] suggested that many interventions, even though knowledge contributions, to tackle obesity are mainly ineffective since there still is a demand for novel approaches to treat childhood obesity [13]. This is where reference [13] examined the social influences among adolescent using social learning theory, i.e. friendship networks where peers observed and imitated one another's behavior. Validation of proposed model based 100 simulations concluded that peer influence is a buffer to obesity where friendship ties aid diet as long as group norms practice good health behaviors. Still, simulations of reference [13] failed to provide practically implacable solutions tackling obesity; leaving room for technological interventions to study how to control obesity as analytical research struggles to investigate the complex longitudinal interplay between social, environments, behavioral and biological factors [14].

B. Assessing Obesity by Technology & Quality of Life

Technologies could be self-monitored, consoler moderated, group supported, individual customized or a structured program since research should assess computer and mobile technologies cased just on weight change: intervention to obesity. A systematic literature review of reference [8] indicated that technology based interventions are web based weight management tools, social network platforms, smartphone apps, personal digital assistants, phone calls and messaging, emails or video games. Also, quality of life is reflected through weight loss. Unfortunately just 2 studies assessed quality of life, an incentive to weight control. This is why technology can practically intervene to improve quality of life. Recent obesity research focused on the social and environmental determinants of obesity.

Reference [15] reported that smartphone apps are technologies that should adhere to 13 evidence based indicators or standards: (1) weight assessment - BMI, (2 and 3) daily scored and tracking of fruits and vegetables intake, (4) scored daily/weekly physical activities, (5) daily water consumption tracker, (5 and 6) daily logging of food diary and calorie balance- calculate food; consumed vs. used-up calories balance for recommended weight control, (7) recommendation system for weight control/maintenance goals, (8) portion controlling – recommending food portions, (9) nutrition labels interpreter / reader, (10) weight tracker – with over time mean calculated, (11) daily logging of physical activity diary, (12) recommended diet menu planner and (13) social support seeker – through emails, forums, etc. To narrow the research gap: minute research has understood the efficacy of smart phone apps; of the 204 investigated app in 2009 on iTunes; none of the apps followed all 13 recommend evidence based practices and all these apps fell in 3 categories: assessed weight using BMI, tracked weight accompanied with journals or apps provided diet advices. Very few apps provided means for social support from friends, family or professional advising. In conclusion it was also reported that research needs to catch up on smartphone apps and more research is needed on promoting research led smartphone apps to tackle obesity.

Usability of smartphone apps is a very important factor for the success of smartphone apps, which is based on the users' ability to understand the app, learn the app, .operate the app and be appealed by the m-Health app. Of these usability factors past research indicated that users should be able to easily understand and operate an app in order to enjoy using it: simpler apps catered for

older adults and novice users by incorporating, variance in text sizes, tutorials and training sessions. If app is attractive then the user will be appealed to it and continue using the app [7].

C. Assessing Obesity by Diet Quality

When it comes to understanding the effect of food intake on obesity control, Reference [3] assessed obesity risks of obese adults since few American studies assessed factors touching adult overweight. So reference [3] assessed associating behavioral factors, i.e. vegetable, fruit consumption, alcohol consumption and inactivity and smoking, i.e. quitting smoking causes a rise in BMI. Empirical findings from their interviewed survey on 12, 610 adults, BMI and health risk behavior factors recordings; indicated that obese men were former smokers and drinkers who were less active than those healthier. Females were 55 were less likely of be obese if they consumed alcohol versus non-alcohol consuming females.

Healthy men consumed more fruits and vegetables and engaged in more physical activities than those obese. More healthy women were smokers while more obese women were non-drinkers. Like healthy men, healthy women consumed 3 to 4 servings of fruits and vegetables daily and performed physical activities compared with the obese. Also, a former smoker was a cause for men but not for women to get obese. Furthermore, reference [6] assessed the social determinants (i.e. SES) and environmental determinants (i.e. density of fast food restaurants in a district) of obesity. Their findings suggested poor are more exposed to energy-dense foods as the poor have 2.5 times more exposure to fast food restaurants than the rich. This does not mean energy density foods in a particular area cause obesity.

Scarce research assessed diet quality on weight change. Past studies applied weight loss tools based on foods and nutrition or those based on diet guides, etc.: defeating weight loss as successful tools need to correctly represent diet change. Such was based on Food Choices Score (FCS)'s, a "clinical research tool" designed for assessing diets through 17 food categories linked with their health outcomes upon consumption and process of preparation. This was made possible by designing FCS based on scoring food categories by aligning their associating energy, nutrition and set targets for food categories. This tool promotes higher diet quality by not consuming high energy intakes but instead specific foods that are based on lower energy intakes leading to weight loss. Validity and reliability tests on FCS, tested on 189 overweight and obese participants, indicated that better food quality advised by FCS led to weight loss [16].

Also, to wonder about the association between social network ties and food intake, reference [6] indicated that food intake has nothing to do with attracting friends with similar food consumption patterns. Students tended to befriend similar individuals to their own race, gender and those who have similar amounts of pocket money to spend on food. Through statistical models evaluating networks, cognition and food intake; it was empirically realized that friends' food intake does not predict changes in adolescents beliefs on such food intake. There was no association between adolescents' belief of versus actual food intake.

D. Measures of Obesity on Quality of Life

While BMI is a popular measure of obesity, i.e. an indicator mentioned in various studies, Obesity is measured using BMI that be ≥ 30 for an obese. BMI is a poor measure. It does not differentiate fat from muscle, bones and other lean body mass, such that, BMI over-estimates fatness in muscular beings. E.g. African Americans' BMI portrays them obese when they actually are otherwise. There are three other alternative measures: (1) Total Body Fat (TBF), (2) Waist Circumference and (3) Waist to Hip Ratio that are more accurate than BMI. However research has yet to investigate to what extent these 3 measures more accurate than BMI. There is a call for future research to enrich better understanding of alternative measures to BMI [17].

As reference [17] explained, if fat were the only determinant of diseases, like type 2 diabetes, then TBF would be most efficient since location of fat matters more than amount of fat. E.g. fat in the abdomen causes morbidity. Hence Waist to Hip Ratio is the best predictor of a risk to heart attacks. Still, past research did not recommend Waist to Hip Ratio as an effective predictor to heart attacks. BMI is less accurate: compared with TBF since far less people are classified obese when measured by BMI but not when measuring by TBF: especially females. Males hold muscle more than females [2]. Reference [17] empirically indicated that BMI hinders the aim to tackle obesity: hence needing more accurate fatness measures: TBF is more accurate.

According to Reference [18] current research understood quality of life via (1) SCT, i.e. resources shared in social networks like communities, like more social clubs in a community and (2) collective efficacy, i.e. norms and networks enabling collective actions through social control and collective cohesion of community members looking out for one another. Obesity depends on individual level and community level characteristics such influenced directly (diet and exercise) and indirectly (social control and influence). Individuals in low communal efficacy suffer from obesity since they are alone tackling obesity problems, effected by high BMI levels. High collective efficacy neighborhoods tend to have exercising halls, better quality low calorie food serving restaurants and safer compared to low collective efficacy neighborhoods.

Reference [18] aimed and measuring neighborhood collective efficacy levels with their associated BMI in youth, i.e. adolescents since they are reliant on their social environments considering that they are not rooted in their years of hard-to-change habits. Empirical results indicated that adolescents from high collective efficacy neighborhoods showed BMI 1 unit less than adolescents from low collective efficacy neighborhoods, who hence were 52% more likely to at risk of suffering from obesity. Hence, there is a significant relationship between

collective efficacy and BMI as well as group level factors of individuals are associated with the net energy intake of neighborhood adolescents.

III. METHODOLOGY

This article is based on a literature review of selected relevant and current journal paper aided in the understanding of the obesity research area. After achieving a general awareness of the obesity, a specific research target was set to appreciate the influence of various interventions to tackle obesity: especially in the case of adolescents. At this stage, the research focus was realized to draw out most appropriate solution from a holistic point of view. This is a research in progress, which has initiated with a general understanding of obesity. It is anticipated to empirically test the proposed model (depicted in Fig. 1) in this article.
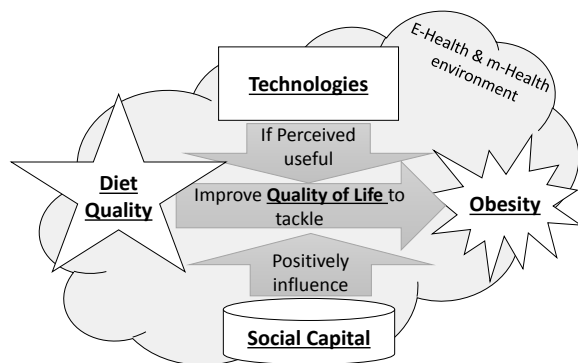

Figure 1. Concept model: proposed solution

IV. PROPOSED SOLUTION

Ample social science outcomes are affected by health, i.e. obesity causes heart disease, cancer, stroke, diabetes, etc.: thus important research area. Since reference [13] called out for a investigating the role of technological interventions on quality of life; as depicted in Fig. 1's proposed model; diet quality improves quality of life, which in turn is a facilitator to obesity control. This is possible provided there is a positive influence from SC's network ties. This is the peer advising of appropriate dietary quality via eHealth and m-Health platforms based on smartphone apps. Such technologies are best adapted if they follow 13 evidence based principles reflective of earlier-mentioned FCS. Such a model is viable for empirically assessed. Technology can be used by individuals to get advises on diet and strategies to promote luring away from environment that promote obesity [3].

This model portrays a holistic approach as recommended by reference [9] who stated that the public health programs should intervene at the social ecological level, not from the individual but community and organizational level, aimed at effectively reducing the risk of an individual's obesity. There is lacking support from social networks, compared with individual support. So, even though previous research assessed the role of SC and social networks on obesity, there is no translation

of how such phenomenon is described through social interventions. Also, future research needs to understand how collective efficacy is produced and what interventions could increase collective efficacy and future research should look into how technologies can be future interventions to control weight by facilitating virtual interactions to harness the positive effects of collective efficacy to fight obesity at a community level [18]. This is why this model is a valuable contribution by this article.

V. DISCUSSION & CONCLUSION

Obesity is the most important concern in the US for its negative health outcomes, mortality, morbidity, high HC costs − 75 billion USD: a global problem in most industrial countries. Still causes and feasible solutions are vague in research. This not a genetic cause as there have been no genetic mutations discovered in the last 2 decades [18]. Even though adolescents have access to health diets influenced by parents; they indulge in junk foods, Low Nutrient Energy Dense (LNED) foods: influenced by friends. In US and Australia there is an increase in LNED foods consumption since decades: causing long and short term health concerns e.g. increased BMI [19].

Obesity research empirically tackled obesity through various dimensions critiqued through key journal articles in this paper. While this article is restricted to only citing key journal articles, which helped the authors portray a general landscape of how obesity is considered an epidemic: agenda for serious research using varying types of interventions (technology based, social studies base, environmental based, etc.) and research designs (simulations, quantitative methodology like regression, social network analysis, etc.) described earlier in this paper. While social networking and social networking analysis seem to dominate the obesity research arena, as observed by the authors of this study, it is now evident why technology interventions continue as promising intervention in tackling obesity, especially from the perspective of eHealth.

This is especially since web based technologies were reported facilitators in controlling weight even though not much research has been done to understand the role of technology interventions on quality of life [8]. This is the rationale why this study proposed a facilitating and a controlling role of quality of life between social capital theory and controlling obesity: i.e. by reducing and controlling weight. This is a research in progress. It proposed a solution framework depicted in Fig. 1, which is suitable for future qualitative assessment in a broad range of case settings. While this model is a theoretical contribution, future research should also focus on evaluating current eHealth technology interventions to assess how such technologies utilize all of obesity measures to control obesity.

Reference [6] suggested that future research can assess if fast food restaurants are abundant in low income districts doe to a local demand of that district or is it the

appearance of such a fast food restaurant that drives the demand. Another research question can be if it is the poor to tend to visit these fast food restaurants since it is the low income areas that are more at risk of causing obesity. Reference [8] call for future research, i.e. focus on the role of technological interventions on quality of life as not enough research has been conducted in this area even though technological intervention lead to greater adherence to a program. This is imperative since there was no significant reported on the relationship between weight loss and devotion to a program while there was a significant relationship between technological interventions and devotion to a program and when so there was a higher reported loss in weight.

From the perspective of the quality of food intake as a determinant of obesity. It is the authors' view that while BMI is considered as a measure for obesity and popular on the m-Health platform, as cited earlier in this article, other mentioned alternative measures can also be utilized by introducing relevant hardware's enabled by user friendly smartphone connective via the World Wide Web. This way the 13 evidence based indicators could be 14 when future apps could also be evaluated on other means of measuring obesity.

REFERENCES

[1] . S. Leroux, S. Moore, and L. Dube, "Beyond the "I" in the obesity epidemic: A review of social relational and network interventions on obesity," *Journal of Obesity*, vol. 2013, no. 2013, pp. 1-10, 2013.

[2] H. S. Shi, T. W. Valente, N. R. Riggs, J. Huh, D. Spruijt-Metz, C. P. Chou, and M. A. Pentz, "The Interaction of Social Networks and Child Obesity Prevention Program Effects: The Pathways Trial," *Obesity*, vol. 22, no. 6, pp. 1520–1526, 2014.

[3] J. Kruger, S. A. Ham, and T. R. Prohaska, "Behavioral risk factors associated with overweight and obesity among older adults: The 2005 national health interview survey," R*eventing Chronic Diseqse*, vol. 6, no. 1, pp. 1–17, 2009.

[4] J. Demongeot and C. Taramasco, "Evaluation of social networks: the example of obesity," *Biogerontology*, vol. 15, pp. 611–624, 2014.

[5] K. Hayea, G. Robins, P. Mohrd, and C. Wilsone, "Obesity-related behaviors in adolescent friendship networks," *Social Networks*, vol. 32, pp. 161–167, 2010.

[6] D. D. Reidpath, C. Burns, J. Garrard, M. Mahoney, and M. "Townsend, An ecological study of the relationship between social and environmental determinants of obesity," *Health & Place*, vol. 8, pp. 141-145, 2002.

[7] B. C. Zapata, J. L. Fernández-Alemán, A. Idri, and A. Toval, "Empirical Studies on Usability of mHealth Apps: A Systematic Literature Review," *Journal of of Medical Systems*, vol. 39, no. 2, p. 1, 2015.

[8] L. C. Raaijmakers, S. Pouwels, K. A. Berghuis, and S. W. Nienhuijs, "Technology-based interventions in the treatment of overweight and obesity: A systematic review," *Appetite*, vol. 95, no. 2015, pp. 138–151, 2015.

[9] K. Titchener and Q. J. Wong, "A weighty issue: Explaining the association between body mass index and appearance-based social anxiety," *Eating Behaviors*, vol. 16, pp. 13–16, 2015.

[10] L. J. Matthews, P. DeWan, and E. Y. Rula, "Methods for Inferring Health-Related Social Networks among Coworkers from Online Communication Patterns," *PLOS ONE*, vol. 8, no. 2, 2013.

[11] S. Nam, N. Redeker, and R. Whittemore, "Social networks and future direction for obesity research: A scoping review," *Nurs Outlook*, vol. 6, no. 3, pp. 299–317, 2015.

[12] D. R. Schaefer and S. D. Simpkins, "Using Social Network Analysis to Clarify the Role of Obesity in Selection of Adolescent Friends," *American Journal of Public Health*, vol. 104, no. 7, pp. 1223–1229, 2014.

[13] J. Zhang, L. Tong, P. J. Lamberson, R. A. Durazo-Arvizu, A. Luke, and D. A. Shoham, "Leveraging social influence to address overweight and obesity using agent-based models: The role of adolescent social networks," *Social Science & Medicine*, vol. 125, pp. 203–213, 2015.

[14] M. G. Orr, S. Galea, M. Riddle, and G. A. Kaplan, "Reducing racial disparities in obesity: simulating the effects of improved education and social network influence on diet behavior," *Annals of Epidemiology*, vol. 24, no. 8, pp. 563–569, 2014.

[15] E. R. Breton, B. F. Fuemmeler, and L. C. Abroms, "Weight loss— there is an app for that! But does it adhere to evidence-informed practices?" *Translational Behavioral Medicine*, vol. 1, no. 4, pp. 523-529, 2011.

[16] S. J. Grafenauer, L. C. Tapsell, E. J. Beck, and M. J. Batterham, "Development and validation of a food choices score for use in weight-loss interventions," *British Journal of Nutrition*, vol. 111, pp. 1862–1870, 2014.

[17] R. V. Burkhauser and J. Cawley, "Beyond BMI: The value of more accurate measures of fatness and obesity in social science research," *Journal of Health Economics*, vol. 27, no. 2, pp. 519–529, 2008.

[18] D. A. Cohen, B. K. Finch, A. Bower, and N. Sastry, "Collective efficacy and obesity: The potential influence of social factors on health," *Social Science & Medicine*, vol. 62, pp. 769–778, 2006.

[19] K. Haye, P. Mohr, G. Robins, and C. Wilson, "Adolescents' intake of junk food: Processes and mechanisms driving consumption similarities among friends," *Journal of Research on Adolescence*, vol. 23, no. 3, pp. 524–536, 2013.

Anjum Razzaque is a *Ph.D.* and an assistant professor at College of Business & Finance: Ahlia University, Bahrain. Anjum teaches Management of Information Systems courses. He attained his Ph.D. from Brunel University's Business School, UK. Anjum's research interests: Healthcare Knowledge Management and Informatics, Obesity, medical Decision making, Social Computing and Higher Education Research. Anjum attained research grants in higher education research and actively publishes reviewed intellectual contributions in conferences, journals and book chapters. Anjum served as reviewer for journals and on various technical committees of conferences as well as contributed as conference chair, session chair and keynote speaker. Furthermore, Anjum is Bahrain's Director for the KS Global Research SDN BHD, Malaysia. Please email him for inquiries. E-Mail: arazzaque@ahlia.edu.bh

Dr. Tillal Eldabi is a senior lecturer at Brunel University. He has B.Sc.in Econometrics and M.Sc. and Ph.D. in Simulation Modeling in Healthcare. His research is into aspects of healthcare modeling and simulation. He developed a number of models and bespoke packages to support health economists and clinicians to decide on best treatment programs. Dr Eldabi has published widely in the field of modeling in healthcare and edited a number of special issues in highly respected journals. E-Mail: tillal.eldabi@brunel.ac.uk