


# Gamification of nutrition: A preliminary study on the impact of gamification on nutrition knowledge, attitude, and behaviour of adolescents in Nigeria

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## Abstract

**Background:** In Nigeria and many parts of sub-Saharan Africa, the availability of foods that are high in salt, sugar, and saturated fat is steadily increasing. This has led to an increase in the consumption of such foods among Nigerians, particularly among adolescents. **Aim:** This pilot study was undertaken to understand whether, and how, gamification of nutrition can have an impact on addressing the problem of unhealthy eating among Nigerian adolescents. **Methods:** Gamification of nutrition through board games, clubs and vouchers was introduced in three secondary schools in Abuja, Nigeria over a span of three to four months. Semi-structured focus groups were conducted with grade 11 and 12 students in the three secondary schools. Participants were asked about their perceptions of the intervention and how it influenced their eating behaviour, attitudes and knowledge about nutrition. **Results:** A total of 31 students participated in four focus groups. Participants reported that the intervention shifted their perceptions and preferences, leading them to alter their behaviour by incorporating more nutritious foods (such as fruits and vegetables) into their diet and engaging in more physical activity. Five themes emerged from the analyses: improved eating behaviour; increased physical activity; improved overall well-being; increased nutrition knowledge; and influencing others. **Conclusions:** The results from the focus groups suggest that gamification of nutrition can lead to improvements in dietary behaviour among adolescents over the short-term. More studies are needed to evaluate the long-term effects of nutrition interventions that use gamification techniques.

## Keywords

nutrition, adolescents, behaviour, attitudes, perceptions, fruits, vegetables, Nigeria, Africa

## Introduction

Excessive consumption of foods high in salt, sugar and saturated fat (defined loosely as ‘unhealthy eating’ for the purposes of this paper) is a global public health challenge with rising concerns voiced over the increase in overweight and obesity among youth. These projections stem from the rapid shift in dietary patterns happening in many parts of sub-Saharan Africa where people have gone from consuming traditional diets high in cereals, fibre, fruits and vegetables to a more Western diet consisting of foods high in sugar, saturated fat, salt, and animal proteins. This change in diet that occurs as countries develop is what is generally referred to as the nutrition transition.

The nutrition transition involves five phases: collecting food; famine; receding famine; nutrition-related non-communicable disease (NCD); and behavioural change. Many low- and middle-income countries – including those in sub-Saharan Africa – seem to be in what Popkin (2002)

describes as the fourth stage (nutrition-related NCDs), which is characterised by a diet lacking sufficient fibre yet is high in fat, processed carbohydrates, and sugar (Haggblade et al., 2016; Popkin, 2002).

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The nutrition transition that many sub-Saharan African countries are experiencing has also imposed on them a double burden of diet-related disease whereby underweight and obesity coexist (Hagglblade et al., 2016; Popkin, 2002). This transition is affecting a significant number of youths comprising approximately 33% (344.4 million people) of the population in sub-Saharan Africa, and this demographic group is set to double in population to reach 605 million by 2050 (Population Reference Bureau, 2013). In West Africa, unhealthy eating starts early with parents feeding their children (as young as 6 months old) sweetened pap (a popular breakfast cereal and infant weaning food in Nigeria made from fermented maize) and sugary snacks (Bosu, 2015). These children may grow up and adopt these poor eating habits, which could also include the inadequate consumption of fruits and vegetables (Craigie et al., 2011; Lake et al., 2006; Mikkila et al., 2004; Olson et al., 2007). For example, in Ouagadougou, Burkina Faso, this is exemplified by a mere 4% of 12-year-old children who reported eating fruits or vegetables daily (Bosu, 2015).

In North America and Europe, a number of evidence-based interventions have been proposed at the national, community, and school level to reduce the incidence of obesity and improve nutrition (Centers for Disease Control and Prevention 2011; De Bourdeaudhuij et al., 2011; Fung et al., 2012; Gortmaker et al., 1999; Pem and Jeewon 2015; Veugelers and Fitzgerald, 2005). One common approach is the use of educational multimedia games and board games to improve the nutrition knowledge of youth.

Gamification refers to the application of game or game-like elements and principles in a non-game context. Gamification of nutrition can be referred to as the strategy of employing game design elements to improve dietary behaviour. According to Sailer et al. (2013), the most common design elements in gamification are: points (rewards accumulated for certain actions), badges (visual representations of achievements that can be collected), leaderboards (lists of all players, usually ranked by their success – based on points or badges awarded), progress bars (information about a player's current status towards achieving a goal), performance graphs (information about a player's performance compared to previous performances) and avatars (visual representations of players).

Using some of these elements, we designed a gamified nutrition platform, called *Nutrido*, that consisted of a nutrition board game tied to a school club as well as vouchers that were redeemable for fruits and vegetables. The board game consists of: the game board, stacks of playing cards, dice, playing pieces, play money and a sheet containing the rules of the game. Players must navigate scenarios such as choosing whether to purchase a healthy meal or an unhealthy meal (depending on how much play money they have) or landing on an action card that requires them to perform physical activity exercises (e.g. 10 push-ups). The core strategy of the game is to buy healthy food cards in order to get as many points as possible. Points gained in the game translate into vouchers through a voucher system

integrated in the game that enables players to buy real food (including, but not limited to, apples, grapes, watermelon, bananas and oranges) from partnering tuck shops.

We then implemented this program in three secondary schools in Abuja, Nigeria and assessed its impact on students' knowledge, attitude and behaviour towards nutrition. To our knowledge, there is no study on the effectiveness of gamifying nutrition for adolescents beyond board games to include vouchers, clubs and provision of a school environment conducive to healthy eating.

Our study aims to fill a gap in the literature by exploring the potential of nutrition board games, voucher systems and clubs on the eating habits of adolescents in Nigeria during a time in which many countries in sub-Saharan Africa are undergoing a nutrition transition. In doing so, we assessed the impact of the *Nutrido* board game – including its integrated voucher system and physical activity component – on adolescents' (1) nutrition knowledge, (2) attitude towards healthy foods and (3) eating behaviour (specifically, intake of fruits and vegetables).

## Methods

### Procedure

We used semi-structured focus groups in order to obtain a comprehensive understanding of participants' perceptions of the nutrition gamification system and its impact on their overall health and lifestyle. Participants were recruited from the *Nutrido* clubs established at each of the schools and did not receive any incentives for their participation in this study. An element of the gamification system was an educational and culturally-relevant board game that teaches children and youth about proper nutrition.

### Selection criteria and participants

The most important criteria used in the school selection process included: availability of a Nutrition department, proximity to the city centre, and access to a large pool of students. The rationale for having the availability of the Nutrition department as one of the criteria was primarily logistical, as it made coordination of the *Nutrido* Clubs – through which the nutrition intervention was implemented – much easier. Five schools met these criteria. We contacted all five schools, and three of these were willing to participate. The three secondary schools included: The African International College (AIC), Kingsville College and Olumawu Secondary School. For each school, we launched a *Nutrido* Club, which met once a week and comprised interested students and a nutrition teacher.

Participants from these three schools were then recruited from the *Nutrido* Clubs and comprised male and female students in grades 11 and 12 (between the ages of 13 and 17 years). Each participant took part in a game session (20–30 min) once per week over a period of 4–12 weeks (the mean and median number of weeks being approximately

7 and 5 weeks, respectively). Students who were interviewed for the study had played at least three full sessions over the course of 3 weeks. Approximately 6–13 students were interviewed for each of the four focus groups. In total, there were 31 participants (10 males and 21 females).

### Data collection

Our data collection relied on four face-to-face semi-structured focus group discussions with the participants drawn from the aforementioned three schools. Two focus groups were conducted at AIC while the other two were conducted at Olumawu and Kingsville College. The focus groups were conducted 2 weeks (on average) after the game-playing sessions were carried out in English, and lasted anywhere from 20 to 60 min. The focus group discussion questions were developed in a way that would provide insight on the overall impact the game had on the participants. Participants were asked to describe their general perceptions of the game, and how the game had influenced their eating behaviour, attitudes toward healthy foods, and knowledge about nutrition. The following questions were used as discussion prompts: ‘What are your views of *Nutrído*?’ ‘What has changed for you from playing *Nutrído*?’ ‘What has been the impact on your lifestyle?’ The flexibility of the interview guide allowed the interviewers to pursue issues that arose spontaneously, and gave participants opportunities to share information on the basis of personal insights and/or experience. Follow-up questions were also asked to provide more insight into their initial responses, resulting in the elucidation of a broad set of results from playing the board game. All focus group discussions were digitally audio-recorded with consent from the participants.

### Data analysis

Digitally recorded interview transcripts were transcribed verbatim, then analysed and coded as described below. The coded transcripts were then used to create a compelling and rich narrative on the impact of the *Nutrído* board game on participants. Our analysis of the interviews included any issue that the participants categorised as personal or group-related, as well as participants’ suggestions for addressing these issues.

The software tool Atlas ti3 (Scientific Software Development 1999) was used for the analysis of the transcripts. Members of the research team then coded the transcripts and conducted the analysis. Codes were organised into broad categories under which sub-categories were created, along with descriptive properties, including relevant quotations. This coding process allowed team members to organise and interpret 33 pages of interview text. These qualitative research methods were selected due to their strong potential to reveal complexity and capture the richness of collected data (Miles and Huberman, 1994).

After analysing the transcripts, team members followed up with the participants cited in this paper by verifying their quotations to ensure accuracy. All participants gave permission to be quoted. Anonymous participants chose not to be linked to their quotations but agreed to be listed among the study’s participants.

The focus groups were semi-structured and field guides were developed to help lead the discussion around broad themes. The interviewers were encouraged to probe for additional relevant information that emerged during the interviews and discussions.

## Results

The use of qualitative methods garnered diverse and detailed responses from the participants and provided valuable insight into the *Nutrído* game’s overall impact on their lifestyles. Five themes emerged from the data, which are described below.

### Improved eating behaviour

This theme presented three inter-connected sub-themes focused on an increase in fruit and vegetable intake, a reduction in junk food consumption and purchase of healthy foods. One of the most prominent results of playing the game was an increased intake of fruit and vegetables. For instance, while recounting her understanding of health, a female participant from AIC emphasised that *‘fruit we take more regularly makes us more healthy [sic] so we reduce the intake of junk food and take more fruits so it makes us more healthy.’*

In addition, while describing her intake of fruits before and after the game, another participant stated, *‘I used to skip fruits sometimes, like give it out, but now, I take my fruits. I don’t waste time to take fruits anymore.’* When asked exactly how her consumption of fruit had changed, she explained that *‘on a daily basis, I will say like one or so, but after the game, like five to four times.’* In other words, the game had influenced her to increase her servings of fruits and vegetables from one serving to five servings per day.

Participants were also willing to try new fruits and vegetables they had previously not tolerated, had not known were readily available, or had reservations about at home and at school. One female student revealed, *‘I never knew they used to sell fruits in tuck shop or things like that. Ever since [playing *Nutrído*] I started buying fruits . . .’* One participant had previously described carrots as *‘disgusting’* until she tried some and found them to be *‘sweet.’* Other fruits mentioned by the participants include mango, watermelon, paw-paw, and guava, along with green vegetables such as cucumber and broccoli.

There was also a change in behaviour whereby students spent their own money to buy fruits from the tuck shop while forfeiting junk food, thereby increasing their intake of fruits. For example, a female student at AIC noted:

'when we go there [store] every week day there's a section for fruits and all that, but then when nobody ever used to look at that area but now that Nutrido started coming around, people like fruits like apple, people begin to like and learn to have some bit of fruit.'

By extension, participants also redeemed their *Nutrindo* vouchers to purchase fruits from participating merchants at tuck shops.

An increase in the consumption of fruits and vegetables among participants also led to a reduction in their consumption of junk food. For instance, a participant noted that:

'Nutrido has helped me... to eat more fruits because before I started this club I didn't like fruits, I always like to eat sugar raw, and take Milo, all these sugary stuffs but now I put all that aside and eat fruits most times... I even ask my mum to buy a lot of fruits.'

A reduced intake of junk or fast food seemed to be associated with a growing aversion to junk food. For instance, a female student from AIC repeatedly stressed her increasing distaste for junk food (such as ice cream) when she stated that '*... ever since I started playing Nutrido, it has made me to stop eating too much of junk foods... because junk food is not good for the body.*' On further probing, she narrated that:

'... before I started playing Nutrido, I was eating a bit kind of junk food, but when I started playing Nutrido, anytime I pick a meal card or a gym card [in the board game] I always see that junk food is at our detriment... Before I took them at a very fast rate I took them like on Monday, on Wednesday, like that, but now I've cut it down... like in a whole month I may take ice-cream only twice.'

From her words, it is evident that learning about proper nutrition led her to change her eating behaviour, cutting down on unhealthy food.

### **Increased physical activity**

It is important to note here that, while the *Nutrindo* game focuses mostly on improving nutrition, it also has a physical activity component to reflect the importance of physical fitness in overall health and well-being. Some participants acknowledged the positive impact *Nutrindo* had on them in terms of raising their interest in physical activity and team sports. In the words of an AIC participant, the game '*educate[s] us more on the importance of exercise.*' Elaborating further, she noted that:

'so, most at times when it was time for sport we didn't pay attention to them, but now that Nutrido is helping us to keep fit because we can come downstairs and play basketball but normally we didn't pay attention to them.'

Another female student at AIC also responded that '*I come down when we are meant to come down for sport and try to*

*engage myself now on more sport and sporting activities as I can.*'

Male participants from Olumawu noted a renewed interest in exercise. For instance, one student narrated that, as a child, he used to '*jog around the house*' but after playing the game he '*started doing exercises like pull up, push up*' and '*started jogging.*' Similarly, his peer noted his own distaste for personal exercises in the past but he, too, is now involved in '*pull up[s], push up[s], jogging and running.*'

As illustrated above, playing the *Nutrindo* game appeared to improve participants' knowledge about the benefits of physical activity, which has, in turn, increased their participation in team sports, perhaps increased their fitness levels and a created a renewed interest in exercise.

### **Improved overall well-being**

Participants also discussed a reduction in sick days and increased energy levels. What is interesting, however, is that participants directly attributed their improved health to their playing the game. For instance, insights about food and exercise directly impact participants' health as noted by a female participant at AIC. Her understanding of this concept is expressed through her statement that eating more fruits '*help to boost our immune system... blocking us from sicknesses. Before I could fall sick like 4,5, 6 [times] in a term. This term I have fallen sick like once.*' Similarly, her female classmate stated that '*[B]efore I used to take foods that cause problems to my chest but now cause [sic] of junk food, I started eating more healthy [sic].*' In addition, another classmate recollected that '*I usually go to the sickbay more frequently because, I usually have back pain and stomach pain, but when I started playing Nutrido, I started doing exercises that helped me, so I stopped having back pain.*' Also, health tips provided in the board game – such as '*eat fruit daily*' – caused a male student at Kingsville to carry out this activity when he went home during the holidays, resulting in his '*feeling much better at the end... more nourished!*'

At AIC, two female participants reported experiencing increased energy levels after following the tips found in the game that recommend daily intake of fruit and vegetables. In the words of one participant, the game '*gives us energy to do things we weren't able to do before.*' In addition, she stated: '*I have more energy to do other important things. If I don't feel tired, I don't wake up tired. I now have energy almost all the time.*' In response to our probing on what '*more energy*' signified, another participant succinctly narrated her ability to stay '*alert for like seven, eight hours*' at a stretch. Furthermore, she pronounced that '*I won't be feeling sleepy, I'll have enough energy and I will be able to do like everything I want to do. Go to classes, write my notes and do my assignment all at once.*' At Kingsville, a male student also corroborated the above statements by describing his energy levels after playing *Nutrindo*: '*I started taking fruits like banana and apple... I noticed that I had more energy than before.*'

### Increased nutrition knowledge

This theme revolved around nutrition knowledge participants gained after playing the game. Some of the participants from all three participating schools made a number of connections by themselves. For instance, a participant at AIC made the link between sport, exercise, and reduced fat and commented that *'Nutrido has help [sic] us to know that all junk food like candy that has too much sugar, they cause diabetes and NCDs, food sickness and food reactions.'*

A female student from Olumawu noted learning that *'fruits . . . can prevent a lot of diseases like cancer'* while another female participant recounted how *Nutrido* enabled her to distinguish between healthy (*'vegetable salad, fish salad, potato salad'*) and unhealthy (*'doughnut, burger, ice-cream, shawarma, fried chips, chocolates'*) foods. In addition, a female student at Kingsville discovered that carbonated or soft drinks *'makes you much fatter'* and that *'instead of taking mineral<sup>1</sup> you can take water at least to like . . . cleanse your system and to flush down every fat in your body.'*

Another participant at AIC attributed her poor diet to the cause of serious headaches. In her words, she remarked that *'I used to have very, very serious headache that I would just have to sleep or that when I started playing Nutrido, I cut down on my junk foods and I sensed some junk I ate used to add up.'* Finally, by verifying the link among food, sickness, and undesirable food reactions, she explained that *'when you have an imbalance eating protein and other of your food categories, you tend to have a disease, if you have a deficiency in eating protein you get kwashiorkor.'*

An additional sub-theme that emerged after another round of analysis was the appreciation for farmers and producers of foods in general. One participant stated, *' . . . ever since I started playing Nutrido, I started appreciating those that help to produce all these things . . . I actually see the use like those apples how they help, like how they help to keep us healthy.'* While this participants' newfound appreciation most likely developed because of the small farming component in the game, this firmly acknowledges the way in which participants' perceptions of food can change as a result of learning important topics presented in a board game.

In summary, participants made a number of realisations in terms of discovering the links between unhealthy eating and disease; distinguishing between healthy and unhealthy foods; and ascertaining the origins, and appreciating the producers, of the foods they consume.

### Influencing others

An encouraging theme that emerged from our focus group discussions was participants' desire to influence the eating behaviour of their peers and families. Armed with more *'intellectual awareness,'* a few participants extended the benefits of *Nutrido* to their friends and families by directly involving them and/or conversing with them about healthy

behaviours. For instance, a participant from AIC extended her knowledge to a friend who was constantly constipated. In her words, *'I knew what could help reduce constipation. I introduced it to her that she should buy fruits from the tuck shop that it usually helps reduce constipation.'* In addition, according to a Kingsville student, following the post-survey questionnaire: *' . . . I started dealing with some of them [poor nutritional habits] and I started informing my friends at home.'* Another female participant at AIC, while describing the benefits of the game on her increased interest in sports, stated that *' . . . I invite some of my friends I know they don't like sport to like join me so we can like have more sets.'* Another Kingsville student implemented changes at home by telling his dad how they should be eating, which resulted in the following: *'So, right now in my house we don't have any carton of or any bag of normal rice we only have Basmati rice which is actually good for the body . . .'*

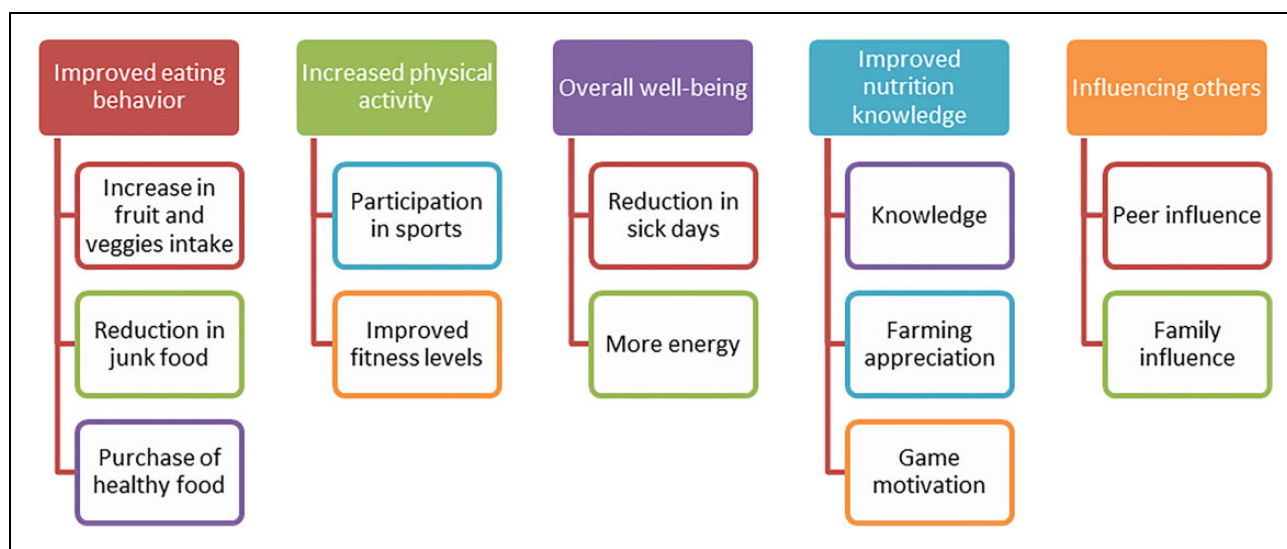
Further, a female student at Kingsville expressed her desire to extend the conversation to an even bigger audience as she cited the benefits of *Nutrido* in *'teaching [your] friends the right thing.'* An AIC participant adequately sums up this discussion by proposing that *Nutrido* *'be introduced to many other schools which will really help other kids and teenagers like myself, because I know that presently most people in my age don't really fancy fruits, don't really fancy exercises'* and all the benefits that go with them. Although it is beyond the scope of this study to measure the effectiveness of these kinds of outreach activities, these ideas provide researchers ample opportunities to extend this study to its impact on a variety of beneficiaries.

A thematic analysis was then performed and a framework (see Figure 1) developed to understand the effectiveness of the *Nutrido* board game.

### Discussion

This study assessed how the gamification of nutrition through *Nutrido* impacted students from three metropolitan high schools in Abuja with respect to their nutrition knowledge, attitude toward healthy foods and eating behaviour. The five themes emerging from focus group discussions suggest that gamification of nutrition can positively affect the knowledge, attitude and behaviour of adolescents with respect to nutrition and healthy eating.

While the knowledge participants gained from the game led to a desire to consume more fruits and vegetables, the data on consumption is based entirely on self-reports and supplemented by observations made by the interviewers. It is important to note that there were no questions on the interview guide directly related to fruit and vegetable intake; only when participants brought up fruit and vegetable intake as an effect of playing the game did the interviewers ask follow-up questions. We also observed that there was approximately a 50% increase in demand for more fruits and vegetables, which created a change in the



**Figure 1.** Participants' views of the impact of playing the *Nutrido* board game.

environment in that tuck shops – in response to this new-found demand – started to stock more fruits and vegetables. In particular, students began buying fruits (such as apples and bananas) at the tuck shop where such items became available five times a week.

Secondly, the reported increase in physical activity may have emerged from the knowledge participants gained from the game that regular exercise is good for health. Yet, as there is a small component in the game that requires participants to act out certain movements and calisthenics exercises, it is unclear whether the increased motivation among the students to join more sports activities and exercise more emerged from the knowledge obtained or the inspiration gained from having fun doing the physical exercises in the game. Moreover, participants reported an improvement in their overall health and well-being because of playing the game. However, this may simply be a case of false attribution whereby participants are attributing the subsiding of their headaches, for example, to the game when there may be no correlation.

We also noted that participants showed an improvement in their nutrition knowledge after playing the game and also reported influencing the eating behaviour of their parents, siblings and friends. At the same time, there were comments made by participants during the focus group discussions that highlighted misinformation about nutrition; however, such comments were rare and our goal in the focus group was not to correct such misinformation. The overall improvement in nutrition knowledge most likely emerged from the fun facts on nutrition featured on the game cards, which were validated by a dietician. An example of a fact featured on one of the game cards is: 'Avocado contains healthy fats and vitamin E, which helps to maintain a healthy immune system.'

While these results may have emerged directly from the playing of the game, it is hard to say whether this kind of

knowledge and behaviour will be sustained for months and years to come or whether the game would have to be played over a longer period.

The results of this study, but particularly that which saw participants of the game implementing healthy changes in their homes and positively influencing the behaviour of their families and peers, have great potential to help curb the prevalence of unhealthy eating among not only Nigerian adolescents, but also in children and youth across sub-Saharan Africa.

Adolescents make up a huge demographic in sub-Saharan Africa (Population Reference Bureau, 2013) but are often overlooked in the fight against diet-related NCDs. Also, since food preferences and eating habits are likely to become established during adolescence (Craigie et al., 2011; Wadhwa et al., 2015), this presents a window of opportunity to implement effective interventions in nutrition. We believe that adolescents will be critical in national efforts to reduce unhealthy eating – and, in turn, prevent the onset of NCDs in sub-Saharan Africa – and that gamifying nutrition has the potential to make a positive impact in this arena.

There have been a number of studies conducted on the impact of gamifying nutrition on health outcomes. For example, Winett et al. (1999) examined the effects of an internet-based behavioural program on the nutrition practices of high-school girls – called *Eat4Life* – which showed relatively consistent changes in increasing the consumption of regular meals, fruits and vegetables and fibre and decrease the consumption of regular sodas (Winett et al., 1999).

Christison and Khan (2012) targeted obese children using a nutrition video game, and showed a significant reduction in BMI in children between the ages of 8 and 16 years who participated in the game. Jones et al. (2014) conducted a preliminary evaluation of a gamification



approach to increasing fruit and vegetable consumption in school through the Fit Game targeted at school children. The results showed that, on intervention days, fruit and vegetable consumption increased by 39% and 33%, respectively (Jones et al. 2014a, 2014b). There have also been web-based dietary interventions used in promoting healthier eating behaviour in the United States (Rolnick et al., 2009).

Unfortunately, these kinds of digital-based interventions are unsuitable for the sub-Saharan African context due to poor internet connectivity throughout the continent. This is where offline (i.e. off-the-grid) nutrition interventions become more relevant. A good example is *Kaledo*, one of the very few educational board games whose effects on eating behaviour have been studied. In a study, researchers concluded that the *Kaledo* game had significantly improved nutrition knowledge and dietary behaviour of 9- to 19-year-olds from 20 schools in Italy, over a period of 6 months (Amaro et al. 2006; Shaya et al. 2008). Similarly, a study showed that game-enhanced nutrition education programs in Ibadan, Nigeria had a positive effect on adolescents' knowledge, attitude and practice of healthy eating (Ogunsile and Ogundele, 2016). Specifically, board games themselves are rich in learning opportunities and enable both children and adolescents to acquire new skills and concepts while spurring their creativity and leveraging their competitive spirit. While board games have been used in a number of ways to educate adolescents on various topics including health and wellness (Bartfray and Bartfray, 1994), AIDS prevention (MacLachlan et al., 1997), dengue fever prevention (Lennon and Coombs, 2007) and academic study improvements (Russel, 1999), only a few studies – including the two cited above – have focussed on the use of board games for promoting behaviour change in nutrition (Bartfray and Bartfray, 1994; Corbett and Lee, 1992; Munguba et al., 2008).

These nutrition programs that use gamification can play a significant role in combating obesity and diet-related NCDs, which have traditionally been considered a 'Western' problem. With the exception of South Africa, where over 40 percent of the adult population is now overweight or obese (Haggblade et al., 2016), most countries in sub-Saharan Africa are still in the early stages of the nutrition transition. This offers a window of opportunity to capitalise on the latecomer advantage; taking proactive, early steps based upon lessons learned from other countries to mitigate potential damage to the health of the population, particularly among adolescents.

Although our results show the potential in nudging adolescents towards healthy eating, further studies would require more precise estimates of other factors such as engagement in physical activity, intake of fruits and vegetables, and change in nutrition knowledge. Also, measuring the effectiveness of such games on third-party beneficiaries is a natural follow-up from the discussions with our participants who expressed the desire to educate their families and friends about healthy eating. Achieving

this goal will involve the use of questionnaires and longer-term studies to determine any permanent changes in lifestyle. Our research also shows that gamifying nutrition through a board game intervention for youth and providing an environment conducive to healthy eating habits could be important in creating sustainable changes to nutrition in secondary schools. Nevertheless, the trend among Nigerian adolescents toward eating a more Western diet should be viewed within the wider context of the nutrition transition happening all across the globe. Any attempts at addressing the rise in unhealthy eating in sub-Saharan Africa should thereby be carried out with the understanding that the issue at hand pertains not only to public health but also to sweeping cultural trends, in which gamification of nutrition might be able to play a significant role.

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### Authors' contributions

OE and JO conceptualised and designed the study. OE and JO drafted the manuscript. OE and BW collected the data. OE, NE, JO and BW analysed and interpreted the data, and critically revised the manuscript. All authors read and approved the final manuscript.

### Availability of data and materials

The dataset supporting the conclusions of this study is available through contacting the corresponding author.

### Competing interests

The authors declare that they have no competing interests.

### Ethics approval and consent to participate

We obtained approval from the Federal Capital Territory Health Research Ethics Committee in Abuja, Nigeria to conduct this study. All participants provided written informed consent.

### Declaration of conflicting interests

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## Note

1. This word is commonly used to describe ‘carbonated’ or ‘soft’ drinks in Nigeria.

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