



Final Report for SUNAR Funded Project

1. Project/PI particulars/Title of the study

Title of Project	“Food Choices of Adolescents and Testing the Efficacy of Smart Phone Aided Nutrition Education Program”
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Project Duration	3 month

2. Introduction:

Adolescence, a period of rapid growth and development, a transitional period between childhood and adulthood, it is a critical time in human development where new habits and behaviors are developed. [1] Almost 20% of the world’s population are adolescents between the ages of 10-19 years and out of which, 90% live in low & middle income countries.[2, 3] In Pakistan, adolescents comprises of 25% of the total population which is much higher in comparison to the world statistics in terms of adolescents. [4] In the past, numerous efforts were made to address few nutritional issues among adolescent females but no nationwide initiatives have addressed the various nutritional issues of this important age group.[5] In addition to this previously nutritional surveys have not been able to capture any nutritional relevant statistics in adolescents. [6] Therefore, in May 2017, the Nutrition Wing in the Ministry of National Health Services, Regulations & Coordination, in collaboration with WHO Pakistan initiated a forum to discuss issues and solutions for addressing adolescent nutrition in the country.

Urbanization in Pakistan has shown to have a relationship with high intake of low nutrient dense foods and lower intake of fresh fruits, raw vegetables and milk among adolescents.[7]Improving lifestyle behaviors among adolescents requires significant multi-factorial changes including physical, socio-cultural, educational and environmental at the governmental, community, school, family, and individual levels. Schools play an essential role in improving life style behaviors among adolescents given the amount of time they spent at school. [1, 8]

The association between health and education is well established and plenty of evidence is available to show that poor health and poor nutrition of adolescents affect their cognitive growth and thereby impede their educational achievement.[8]

With increasing trends of fast food consumption and decreasing levels of physical activity amongst the adolescent, unhealthy lifestyle patterns have now become a great concern for public health due to its tendency to lead to non-communicable diseases.[9] Behavior change strategies among adolescent has been found to be an effective means to reduce the burden of malnutrition among this population group.[10] Various methods have been employed to bring change in behaviors, like use of my plate messages through use of technologies such as smartphones apps and text messages services has evoked interest in bringing healthy behavior change.[11] Studies conducted around the world have showed that the use of mobile health (mhealth) based education tools holds a promising behavior change and improvement in the health literacy in youth.[10]

There is enough evidence from researches in developing countries that behavior change intervention using mobile health during adolescent years can bring improved health outcomes and also prevent NCD during adult years.[12] In spite of burgeoning evidence, there are not enough researches focusing adolescent nutrition specifically using mobile apps in Pakistan.

3. Aim of the Study

Improving the health of adolescents was the overarching aim of this research which sought to identify the adolescent's dietary habits and their nutritional status, and to look for a solution through the use of an innovative nutrition educational tool, that will inspire and direct them, and their caregivers, towards healthier lifestyles.

4. Objectives of the study:

To assess the nutritional status & lifestyle behaviors including anthropometric measurements, dietary habits, physical activity, screen time and sleeping patterns and see the acceptance of nutrition education delivery by smartphone technology among school going adolescents.

5. Research Methodology

a. Study Design, Setting and Population

The study was a cross sectional study with an interventional arm. The study population consisted of students from O/A level schools, Intermediate/college and undergraduate background from different schools and universities of Karachi East District. The study was conducted by attaining the list of private institutes for one of the six districts (East) of Karachi from the Sindh Education Department. Data was collected by visiting the school after consent was obtained from the school and parents.

b. Sample Size

Sample size was calculated using Open-Epi calculator with a confidence of 95%, anticipated prevalence of eating fast food and snacks more than 43% once a week in participants with a margin of error of 8%. The minimum sample size calculated was 148 and an approximate sample of 150 was deemed sufficient. A total sample of 150 adolescents was obtained for the study.

c. Sampling Technique

The sampling technique used was multi-staged random sampling. The listed institutes were stratified according to the fee structure and educational system. The first step after identification of institutes was to correspond with the school authority to discuss the study purpose. Invitation letters were sent to schools through email or hand delivered. The schools that accepted the invitation had meetings organized and arranged by the supervisor between the Principal Investigator and Principal of the selected institutes to inform and brief them about study objectives, and methods involved during the study period.

Once the school agreed, to participate the students from aged 14-19 years were randomly chosen and consent forms were distributed to them. After obtaining consent from the parents, a final list of students was made and participants were stratified into two groups for the purpose of this study (Control and Intervention)

d. Inclusion Criteria – first phase of study:

- Children attending school
- Either sex
- Aged between 14 to 19 years
- Having smart phones
- Demonstrates understanding of the study and readiness to participate as evidenced by subjects' parents and/or legal guardian's voluntary written informed consent.
- Good general health with (in the opinion of the investigator) no clinically significant and relevant abnormalities of medical history

e. Exclusion criteria:

- All who do not fall into the inclusion criteria.

f. Study Method

The study was divided into two phases for convenience. Phase I consisted of identifying the schools and collecting the data from the students which was done in the time frame of one and a half months. Phase II consisted of applying the intervention and obtaining the feedback from the students. This phase took additional one month.

i. Phase I (Data collection)

During the Phase I of the study the team of trained data collectors including the PI visited the institutes to collect the data. The process of data collection included baseline socio demographic, dietary, lifestyle behaviors and anthropometric assessment of 150 participants studying in private institutes.

a) Data Collection Process: Data collection was setup in to two different stations at the selected schools.

1. Sociodemographic, Lifestyle and Dietary behavior data collection station
2. Anthropometric Indices Measuring station

1. Sociodemographic, Lifestyle and Dietary Behavior Data Collection

The socio-demographic indicators including the parent's education, occupation and household income were documented on the questionnaire. Indicators for lifestyle behaviors such as physical activity sleep habits, screen time and substance abuse was also collected. Dietary behaviors related to food habits and preferences were obtained by an interviewer assisted structured questionnaire.

Anthropometric Measurement Tools:

Various tools were used to obtain anthropometric information. Portable stadiometer Seca 213 was used for height which was measured to the nearest 0.5 cm, Weight was measured to the nearest 0.1 kg by the calibrated scale/ Tanita Bioelectrical Impedance Analysis machine. Waist circumference was measured with a measuring tape at the narrowest diameter between the coastal margin and the iliac crest for waist. Neck circumference was measured with a measuring tape. For boys, the circumference of the neck was measured by placing a measuring tape directly on the skin just below the larynx -- also known as the Adam's apple -- and extended the tape horizontally all the way around the neck to the nearest 0.5 cm. Measurements for girls were taken by locating the mid neck position and measuring the circumference of the neck directly. All anthropometric measurements were taken by trained data collectors supervised by Principal Investigator.

ii. Phase II (Intervention stage):

Once the baseline information was collected, participants were randomly allocated into two groups (ratio 1/1) for the Phase-II (Intervention arm of the study).

a. The Control Group

This group included participants who were given nutrition and healthy lifestyle behavior education through conventional techniques of using print media- brochure and verbal communication based on multimedia presentation, during the intervention phase which was easy and generally comprehensible among the control group.

b. The Intervention Group

This group included participants who received nutrition and healthy lifestyle behavior education through conventional techniques of using print media-brochure and verbal communication based on multimedia presentation. In addition to this during the intervention phase they were also given education training through electronic telecommunication tool also more commonly known as the mobile (smart phone) app.

Health and Nutrition Daily guidelines for Youth (HANDY) App:

Based on the need for providing the basic health and nutrition literacy to our adolescent population through m-health, the smartphone app by the name of ‘HANDY’ was developed for this particular project. The app was designed for the participants to fill in their basic/personal details and lifestyle behaviors upon the first installation of the software.

Message/Reminder Frequency

The message-sending system was designed by a software company and the program was run on the separate system throughout the intervention time. The app being in its testing/initial phase had a single component of health and nutrition related messages known as “Advice Corner” where individual messages were designed to pop up on phone interface after every 4-6 hours. The intervention lasted for 10 days, with 3-5 messages sent every day, and 30 messages/reminders in total. The app was provided to the students by sending them a message (*This message is from Dow University of Health Sciences for the participants of the school study Below please find the link with reference to the survey that was conducted in your/your child's school. once you download the app kindly fill in the personal details about you/your child other lifestyle behaviors please save and give us your feedback at the end <https://drive.google.com/open?id=13RWXT7jIHkLFvIV0cDqvKLrGs4Ppghn>*) through their contact numbers where it was available for them to download at the online platform through Google Drive in an APK service format. The messages were sent as reminders throughout the 10 days and on the last day they were followed up by a feedback from participants that appeared within the app at the end of the intervention.

Messages Content:

The app comprised of short healthy lifestyle and nutrition related advices with illustrations and was consistently encouraging. Table 1.1 elaborates the messages of the advice corner;

Message Type	Message
General Health and Nutrition	1. Water: Don't forget to drink 8-10 glasses a day!
	2. Fresh Fruits: Eat fresh fruits every day!
	3. Bakery Products-Too Much Bad Fat: Avoid eating too many bakery products like bakery biscuits/samosas/ patties etc. It has bad type of fat.
	4. Eat your Fruit and Veggies: Don't forget to eat at least one fruit and two vegetables today!
	5. Milk: Drink milk every day to become taller and have healthy bones!
	6. Fruit instead of Junk food: Grab a fresh seasonal fruit instead of snacking on chips or cookies!

	7. Variety is Healthy: Remember to eat variety of foods to ensure a healthy diet!
	8. Add colors to your Plate: Let Fruits and vegetables add color & variety to your plate!
	9. Fish is Healthy: Eating fish is healthy and yummy too! Did you eat fish this week?
	10. Raw Veggies: Eat fresh raw vegetables such as cucumbers, tomatoes, carrots in salads.
	11. Avoid Sweets and Caffeine Avoid sugary and caffeinated drinks.
	12. Green is Healthy: Make sure you include green leafy vegetables in your daily diet
	13. Portion size: While eating out watch out for portion sizes!
	14. Don't Peel the Skin: Try to eat at least one fruit or vegetable with skin
	15. Baked Vs. Fried Food: Replace fried food with steamed or baked food! Much healthier for the whole family!
Screen Time	16. TV watching: Keep a distance of at least 4 feet between you and the television for safe vision
	17. TV watching and other screen activities: Did you know, people who watch TV or use phone during a meal consume more calories than those who don't? You don't want to get fat!
	18. Too much of Screen time is not Good: Limit your TV watching, or video gaming, or using cell phones to no more than two hours per day!
Sleep Habits	19. Eat and Sleep Duration: Eat your last meal at least 2 hours before you sleep.
	20. Sleep helps Digestion: Sleeping helps the digestive system to rest while sleep
	21. Good night Sleep: Avoid screen time or any other activity before going to bed to have a good night sleep
	22. Dinner and Bedtime: Eat dinner at least 3 hours before going to bed. You will have a good sleep.
	23. Sleep Time: Make sure you sleep 6-8 hours a day for your body to be strong!
	24. Sleep is good: You need at least 6-8 hours of sleep every day!
Physical Activity	25. Exercise makes your mind strong: Did you know that exercising everyday improves your memory and attention span as well as multitasking skills?
	26. Physical Activity with Family: Pick on a sport activity that everyone in your home likes and make it a family activity every week!
	27. Be Fit: Did you know you need to work out for one hour every day to be physically fit?
	28. Playing sports/games outdoor: Are you busy in outdoor physical activity for at least two and a half hour a week?
	29. Sunshine is good for you: You need sunlight for more vitamin D production in your body. Go out and play!
	30. Active is new Healthy! Be physically active every day.

Table1.1

b) Data Editing:

All forms were manually checked by research associate for completeness, missing data and consistency.

c) Data Entry:

Data entry was done on SPSS software. Data was coded, processed, and analyzed.

6. Statistical Analysis:

Data Analyses was conducted using the Statistical Package for Social Sciences (SPSS) version 21. Descriptive analysis was carried out by computing frequencies and percentages for categorical variables, and the mean and standard deviation for continuous variables for baseline results.

7. Preliminary Results:

Socio-Demographic Characteristics

A total of 148 adolescents took part in this cross-sectional study which included 121 females and 27 males. Table 2 shows the descriptive characteristics of the participants. The mean age of the adolescent in this study was found to be 18 years +/- 2 years. Most participants came from a middle – high socioeconomic background where the average household income was greater than Rs.50,000/- and a vast percentage of both parents had acquired education of up to graduate level and beyond (65% of mothers and 75% of fathers).

Table 2 - Baseline socio-demographic characteristics of the participants	
Age (mean), yrs	18 (+/-2)
Gender (%)	
Male	18.2
Female	81.8
Average Income (%)	
<50 000	26.4
50-100 000	40.5
100 - 150 000	14.9
>150 000	18.2
Fathers Education (%)	

Primary	1.4
Secondary	2
Metric/O levels	3.4
Intermediate/A levels	17.6
Graduate	40.5
Masters and above	35.1
Mothers Education (%)	
No formal Education	2
Primary	6.1
Secondary	1.4
Metric/O levels	6.8
Intermediate/A levels	17.6
Graduate	41.9
Masters and above	24.3

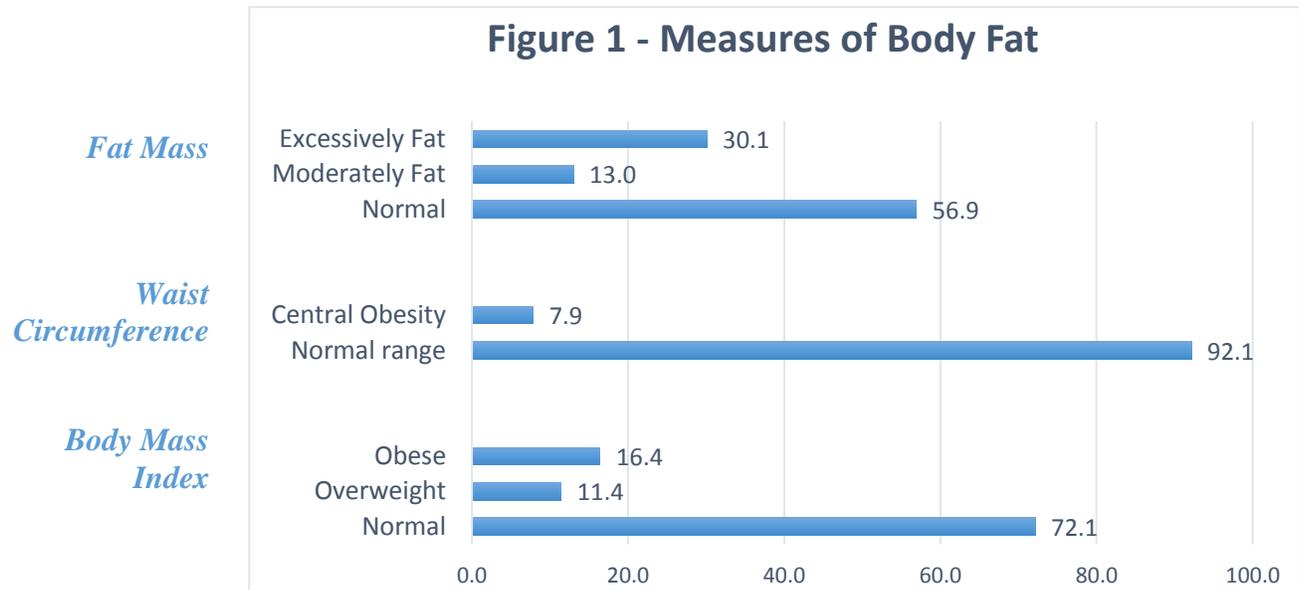
General Lifestyle Behaviors

While looking at lifestyle behaviors (Table 2), 68.2% of participants had met the criteria of physical activity that is carrying out at least 60 minutes of physical activity per day. However, there was an excessive use of screen time observed in this population where almost 70% of the participants spent greater than 2 hours on screen which included the use of television, mobile phones and computers/laptops. Another significant finding was that 17.6% of participants were involved in some form of substance abuse within which 4.1% were using at least 2 types of substance. Smoking was the most prevalent form of substance abuse in the adolescent group where up to 8.8% were found to be smokers followed by the use of Shisha (3.4%).

Table 2 – Lifestyle Behavior Characteristics of the participants	
Physical Activity Criteria(%)	
Met Criteria	68.2
Didn't Meet Criteria	31.8
Use of Screen Time(%)	
Optimum	30.4
Excessive	69.6
Use of Substance Abuse (%)	
None	82.4
Cigarette Smoking	8.8
Shisha	3.4
Paan	2.0
Chaliya	2.0
Gutka	1.4

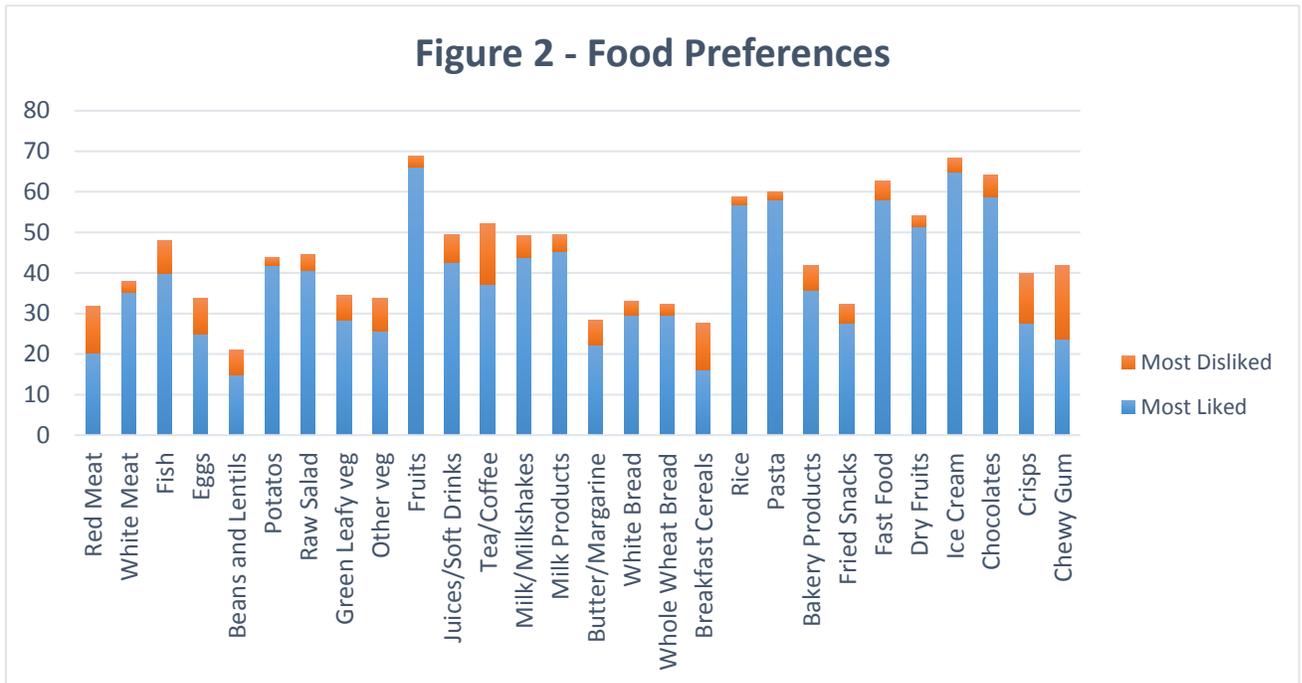
Anthropometric Indices

Measures of body fat were obtained in this group of adolescents with findings shown in Figure 1. The cut-offs for these indices were adjusted according to the age category of the participant and summed to be grouped into the respective categories. Waist circumference indicated the lowest amount of obesity in the population study with almost 8% having central obesity. On the contrary, the most sensitive indicator for obesity was Fat Mass or in other words body fat percentage. This showed a prevalence of 30.1% obesity as compared to 16.4% acquired using the standard technique of Body Mass Index (BMI). Similarly, percentage of overweight participants were greater identified by Fat Mass (13%) in contrast to the percentage attained using BMI (11.4%). This may indicate that Fat Mass may be a more sensitive indicator for measures of obesity as compared to the standard BMI.



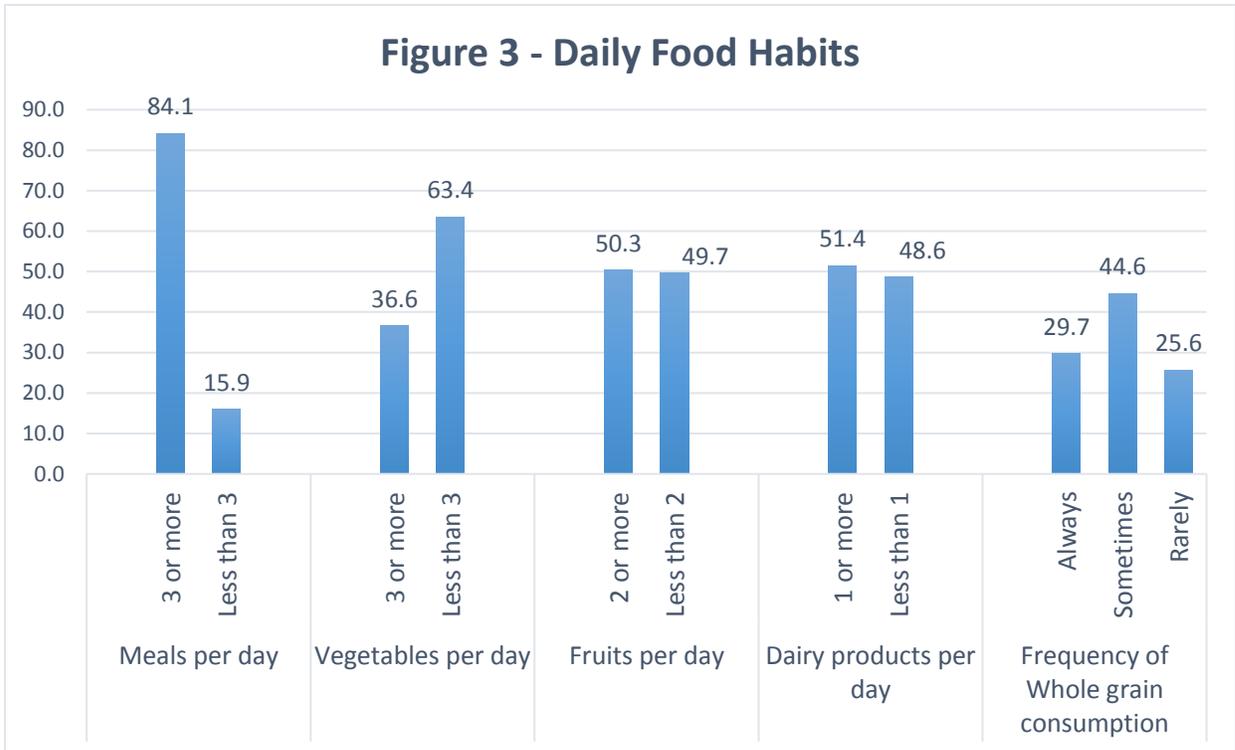
Food Preferences amongst Adolescents

Figure 2 represents the percentage of the most and the least liked food items amongst the adolescent group. Fruits were considered the most preferred food item among this age group (66.2%) followed by Ice Cream (64.9%) and Chocolates (58.8%). Out of the least liked food items, Chewy Gums were found to be most disliked (18.2%) followed by use of Tea/Coffee (14.9%) and Crisps (12.2%).



Food Habits in Adolescents

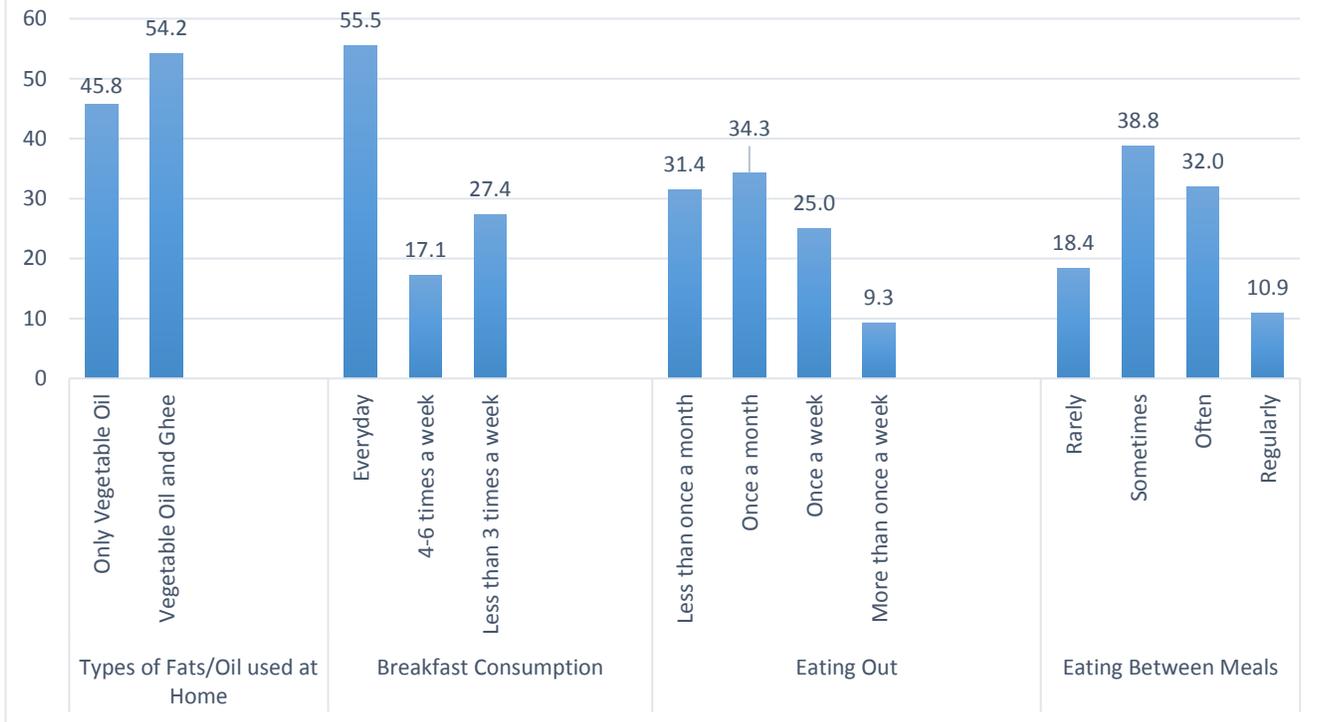
Questions regarding food habits were classified into daily, household related and specific food habits. Figure 3 shows the trends in the daily food habits of the adolescent participants. Majority (84.1%) had their meal times divided into 3 or more per day. The criteria of having at least 3 vegetables per day set by World Health Organization was met by only 36.6% of the sample population however 50.3% met the fruit criteria of 2 or more fruits per day. Just over half the



participants (51.3%) had 1 or more intakes of dairy products per day and the greater amount (44.6%) consumed whole grain products several times during the week

Household related food habits (Figure 4) indicated a greater consumption of a mixture of vegetable oil as well as ghee in the types of fat used for cooking purposes at home. Most participants (55.5) consumed breakfast daily however there was a significant portion of just over one-fourth participants (27.4%) who did not consume breakfast regularly (less than 3 times a week). Eating out is popular on a monthly basis (34.3%) while 25% ate outside food at least once a week. Snacking was also found to be regular amongst adolescents where 38.8% sometimes ate between meals and 32% snacked often between meals.

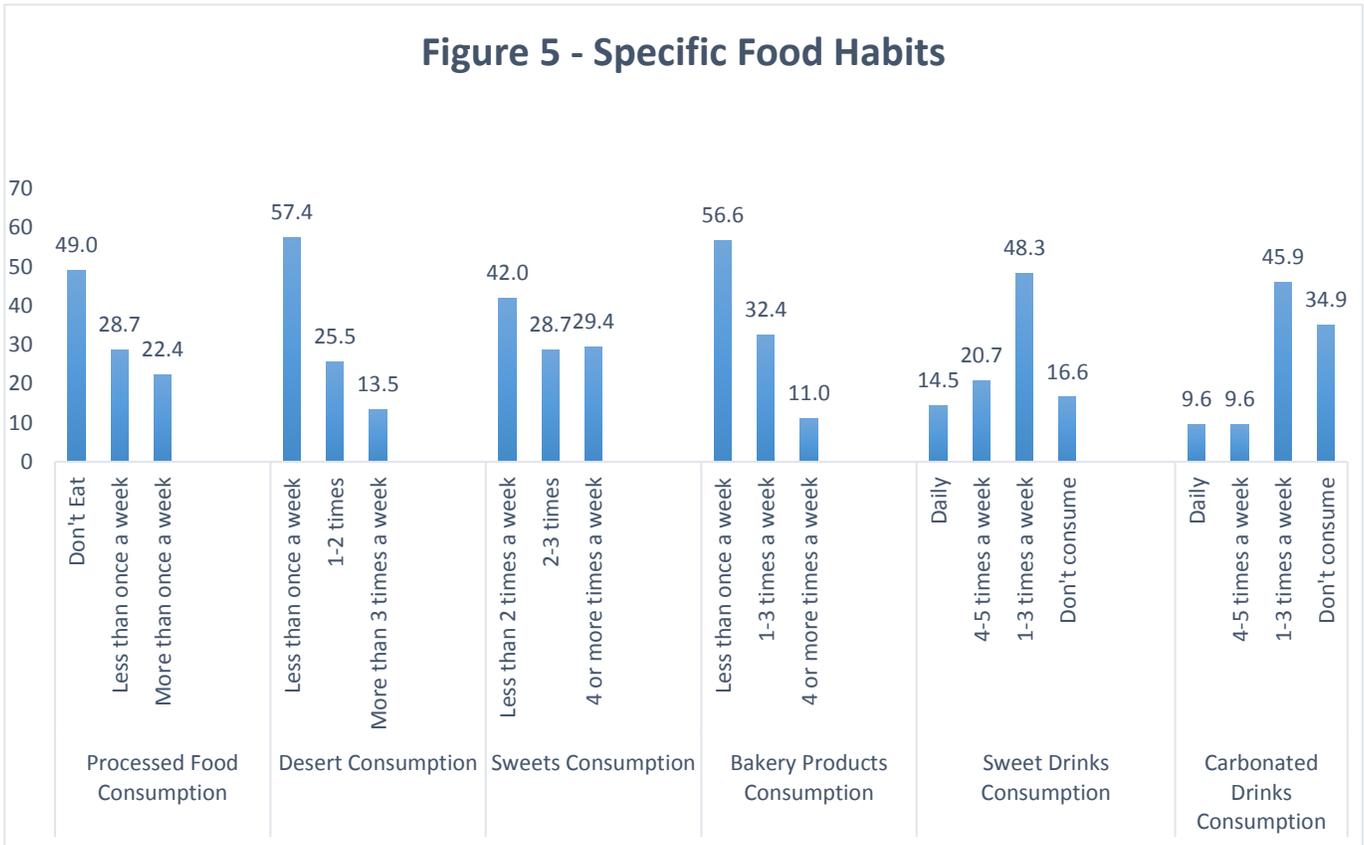
Figure 4 - Household Related Food Habits



Specific food habits

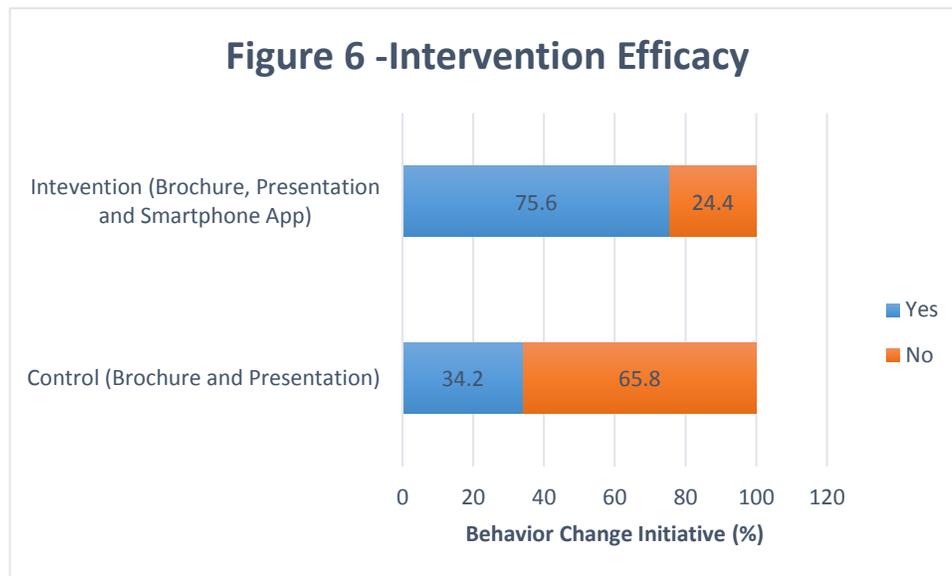
Questions asked in this category included asking about the intake of specific food items that were known to be unhealthy in general (Figure 5). The consumption of processed foods such as ready-to-eat items like nuggets and sausages were consumed on a weekly basis by 22.4% of the adolescent age group. Bakery products were consumed at a greater level with 32.4% of the participants eating it between 1-3 times a week and 11% consuming it more than 3 times a week. As correlating with the food preference, deserts and sweets also had significant high percentages of consumption of greater than 3 times a week (13.5% and 29.4% respectively). Sweet drinks such as juices and carbonated drinks were most commonly taken between 1-3 times a week (48.3% and 45.9% respectively). Thus, greater than one fifth of our study sample was found to be indulging in unhealthy food habits.

Figure 5 - Specific Food Habits



Intervention Efficacy

Feedback was taken from participants in both the control and intervention group to see which method of nutrition education was able to provide a greater chance of behavior change into their respective lives. The findings are shown in Figure 6. From the control group, only 34.2% of participants found the brochure and presentation to be useful while 65.8% found it to have no specific effect on their lifestyle patterns. On the contrary, in the intervention group, 75.6% showed a positive response towards behavior change where and said that the smartphone app contributed more towards initiating positive healthy lifestyle behaviors than the conventional methods. This shows a promising result that the use of smartphone app in adolescents may be readily accepted and more likely will be a greater contribution towards inculcating healthy lifestyle habits.



8. Strengths:

To the best of our knowledge, this is the first study to use a mobile nutrition and health based app to promote good health nutrition literacy in adolescent’s population in Karachi, Sindh Pakistan.

9. Barriers and challenges to the development, implementation, and evaluation of the HANDY App:

Every research work has limitations, challenges and issues. Some are controllable and others have to be adjusted. Following were some of the challenges that we dealt during the study:

a) Barriers During the Phase I of the Study:

1. School selection process was a bit slow as the PI and team had to wait for the schools to respond according to their own time schedule.
2. The data collection team had to adjust their visits on the basis of school’s academic calendar which included national and school holidays, extra co-curricular activities, school class assignments, midterms and exams.
3. Schools were reluctant to participate during the month of November and December as they had revision tests and preparatory classes for exams.

4. Being a community/school based project it was time challenging because the research team had to go according to school's academic calendar which caused slight delay in their own work timeline.

b) Barriers During the Phase II of the Study:

1. Our project intervention time was shortened as per the planned schedule of the project as students were going to have their exams during which parents didn't allow students to interact with any digital technology that could distract their study focus.
2. There were technical glitches in the software time to time which created few setbacks. But as this app was in its testing phase, with the help of feedback we can further enhance on its development/format.

10. Next Step/ Future Plan (if any):

Since this study was a pilot project, the potentiality of the app was found to be highly encouraging. Thus the future implications of this study includes: conducting it for a longer duration with a better representative sample size, in order to test the efficacy and effectiveness of this app in producing a healthy behavior change. Furthermore this app needs to be launched through a proper platform i.e. iOS and Android so as to cater a larger audience. In addition, the study result can motivate the software and food industry to develop interesting, innovative and viable nutrition educational tools as well as healthy food snack options to use among adolescents in Pakistan

11. Funding:

This project is funded by SUNAR and ASK development awarded to PI (details mentioned above). The funders played no role in the design of this study, collection, analysis and interpretation of the data or in writing this report

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