Development and Validation of an Electronic Application (FoodEapp) to Assess the Dietary Intake of Adults in Karachi, Pakistan- A Pilot Study

**Presenter Name**
Umber Khan
Aga Khan University

Outline

- Background

- *Rationale of Developing a New Tool* Second level

- *Method*
  - 1st Objective- *Development of FoodEapp*
  - 2nd Objective - Validation of the Electronic application against the conventional 24-hour recalls
  - 3rd Objective - *Feasibility of the Electronic application against the conventional 24-hour recalls*

- *Results*
  - 1st Objective- *Development of FoodEapp*
  - 2nd Objective - Validation of the Electronic application against the conventional 24-hour recalls
  - 3rd Objective - *Feasibility of the Electronic application against the conventional 24-hour recalls*

- Outcome

Background

Mortality Due to NCDs in Pakistan: Approximately 58% of mortality cases in Pakistan are attributed to noncommunicable diseases (NCDs)!!!

Pakistani Population
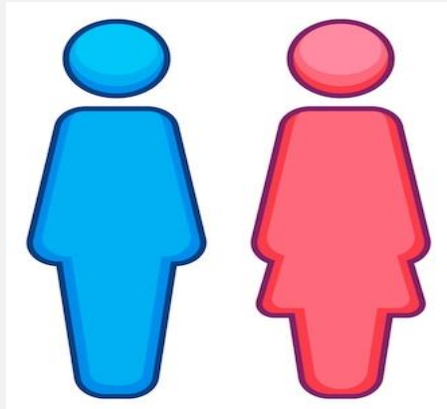
WRA = (15-45 years)

37%   16%   17%   69%

Undernourished: 14.4%
Overweight/Obese:
- Ages 25-34 - 26%
- Ages 35-45 - 43%

Importance of Dietary Assessment in Public Health

The assessment of habitual dietary intake is important for understanding the etiology of most diseases affecting mankind. Also important for management of many chronic diseases.

Dietary exposures are difficult to measure because the amount and the variety of food consumed varies between individuals.

Dietary assessments (DA) are essential to understanding dietary habits. However, they are time-consuming and resource-intensive.

Most of the develop countries have regular dietary surveys to report the dietary habits

In Pakistan, so far, we have limited data on dietary intake

Very limited dietary data available in Pakistan

Lack of locally developed dietary assessment tools- assessing Pakistani diet

Dietary Assessment Tools

Three main types of diet assessment tools are widely used

- Food frequency questionnaire (FFQ)
- Food record (or diary)
- 24-hour dietary recall

Each has its own strengths and weaknesses

1. Gibson, R.S., *Principles of nutritional assessment*. 2005: Oxford university press, USA.

Solutions: Automated 24-Hour Recall Tools

Some of the Automated 24-hr recall tools, used in studies are:

Interactive self-administered, self-reported web-based

- *ASA24*
  Mobile application method Tool
  TECH app
  myfood24 app
  Health Watch 360

Dietary Assessment– 24-HR Dietary Recall (DR)

- *Open ended- Prospectively*

Strengths

- *Yields detailed dietary information*
- *Less recall-related bias*
- *Considered the gold*

Limitations:

- *Resource Intense:*
  - *Human Resources/qualified Nutritionist/Dietician*
  - *Time in data collection*
  - *High amount of back-end work*
  - *One recall does not reflect the usual intake of an individual*

1. Gibson, R.S., *Principles of nutritional assessment*. 2005: Oxford university press, USA.

Rationale of Developing a New Tool

Automated tools cannot used readily in Pakistan owing to;

- *Differences in the profile users*

Food Composition related:

- *Type & variety of food items*
- *Differences in cooking techniques/recipes*
- *Nutrient/food composition differences*

10

Aims & Objectives

To develop an Eapp based 24-hour Dietary Recall (DR) tool (FoodEapp) for assessing dietary intake in socially diverse adults, with applicability to urban and rural areas of Karachi, Pakistan

To validate the Eapp based (FoodEapp) application

administered by less skilled data collectors against the conventional 24-hour DR administered by highly skilled Nutritionist.

To assess the feasibility and end-user experience in using FoodEapp - Focus group discussion & in-depth interview

FoodEapp Development

1) *Portion Size Estimation – Mini Survey*

- *To estimate the portion size of the population*
- *Different socio-economic representation*
- *eight categories food items*

2) *Food Atlas*

- *Three portion sizes*
  blue background
  standard angle & height

3) Generic recipes were created for mixed dishes and beverages containing more than one ingredient

- Collected multiple local recipes for each mixed dish/beverage from several different socioeconomic status households.
- Followed by calculating the median recipe of each food item and adjusting each ingredient per 100 g

The FCDB included the nutrient breakdown of food items

- Moisture, macro-nutrients (protein, fat, and carbohydrate), and micronutrients (calcium, iron, and vitamin
- We used Bangladesh Food Composition Table (BFCT) and the Indian Food Composition Table (IFT) to borrow nutrient values.
- Adjustments for nutrient retention and yield after cooking were made using the appropriate retention and yield factors to calculate the nutrient values of the cooked food items.

Features of FoodEapp

FoodEapp is an interviewer-administered application, used by data collectors with no nutrition background..

Standardized questionnaire with Multi-pass technique in Urdu language

Probing question

Selection of food item name through drop down list

picture selection for portion estimation

Dashboard reports total nutrient computed, automatedly of each Dietary Recall

14

Features of e-app – Output on Dashboard

- *Table 1 – Meal information*   *Table 2 – Total Nutrient Analysis*

Show 10 entries   Search: Copy   CSV   Excel

Study ID	Water	Energy	Protein	Total Lipid	CHO	Ca	Iron
0101001	0	1324.0600000000002	45.38	35.199999999999996	187.74	275.17	12.2800000
0101002	0	794.5699999999999	27.270000000000003	17.235	123.475	288.17499999999995	8.7099999
0101005	0	1571.75	56.25	36.95	231.60999999999999	377.07	19.4000000
0101006	0	1705.17	63.959999999999994	47.56	230.45999999999998	424.91999999999996	19.01
0101008	0	1097.315	39.25	28.945	154.11999999999998	435.29499999999996	11.835
0101010	227.005	1462.5724999999998	45.36750000000001	33.36	227.185	277.6825	14.8775
0101011	0	844.2249999999999	24.294999999999998	27.085000000000004	118.995	225.53	9.03
0101014	621.55	2000.835	50.98500000000001	37.599999999999994	352.51	258.46500000000003	17.665
0101015	0	683.715	979.8800000000001	18.205	114.55	96.835	7.195
0101016	298.39	1274.7749999999999	33.775000000000006	30.589999999999993	206.18	181.46499999999997	13.5450000

APP VS CONVENTIONAL DIETARY RECALL METHOD

Study Design	Mixed methods- Validation & feasibility assessment
Study Site	Urban Site - Karachi University Residential Colony (KURC) Rural Site - Gadap
Sample Size	Total 360 participants 326 + 32 (10% margin for lost to follow 180 in each site (KURC & Gadap • Range: 0.2-0.8 • Difference 0.2 • Level of significance: 5% • Precision: 0.15
Population	Adults 18-70 years old – Both Males & Females
Sampling Strategy	Simple random sampling
Eligibility Criteria	Inclusion • Residents of KU residential area and Gadap town • Age - 18-70 years Exclusion • Mental Disability (memory loss) • Serve sight disability
Study Duration	• 1-year (started 15th July 2019)

Flow Chart

Flow chart of Study Activities

Quantitative Method- Validation Study

3Food Eapp - 2Conventional

Each Data Cycle -3 moths Cover all seaon

Dietary Data Collection

Days randomly selected for DRs

| 1st DR 360 | 2nd DR 340 | 3rd DR 327 |

Initial plan- 4 cycle of data collection

| 1st DR 182 | 2nd DR 162 | 1st DR 124 |

| Repot Distribution | Repot Distribution | Repot Distribution |

Random sequence of Eapp & conventional DC

Qualitative Method- Feasibilty Study

In-depth interviews

Semi-structured

Resechers - Nutrition & non nutritioanl background

Data Collectors

Particpants- validation study

Method
3rd Objective
Feasibility of the Electronic application against the conventional 24-hour recalls

Qualitative study for Feasibility Assessment

Indepth interviews with data collectors

Indepth interviews with Researchers with nutritional & non nutritional background –

Semi-structural interviews with study Participants

Unified theory of acceptance and use of technology model (UTAUT) for the in-depth interviews

- Performance Expectancy
  Effort Expectancy
  Social influence
  Facilitating Conditions

Results
1st Objective
Development of FoodEapp

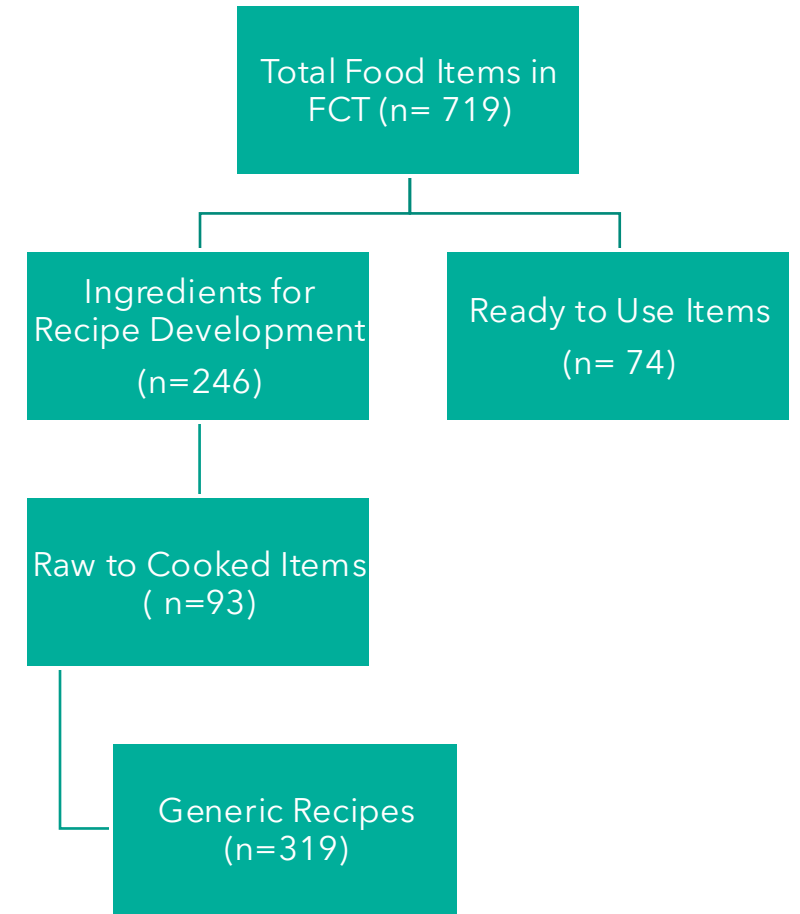# Development of FoodEapp

Food Atlas

Food Atlas for portion size estimation

- *food items including recipes, fruits, ready to eat food items (e.g. biscuit, soft drinks etc.)*
- *Three portion sizes of each food item*
- *Option to add multiple serving*

Photoshoot with blue background & standard angle & height

Food Composition Database

Total Food Items in FCT (n= 719)

Ingredients for Recipe Development (n=246)

Ready to Use Items (n= 74)

Raw to Cooked Items (n=93)

Generic Recipes (n=319)

Results
**2nd Objective
Validation of the Electronic application against the conventional 24-hour recalls**

Demographic Distribution

Table 1 - Distribution of demographic characteristics

Demographic Characteristics		
Characteristic	Mean	SD
Age	38.27	14.68
Characteristic	n (n=360)	%
Sex		
Male	113	31.1
Female	250	**68.9**
Education		
Illiterate	121	33.3
Primary	49	13.5
Secondary	124	**34.2**
Graduate & up	69	19.0
Marital Status		
Unmarried	112	30.9
Married	251	**69.1**
Employment Status		
Employed	106	29.2
Retired	11	3.0
Housewife	216	**59.5**
Student	23	6.3
Unemployed	7	1.9

Mean Intake of Nutrient and Correlation

Difference between FoodEapp and Conventional 24HR DRs.

Nutrients	Conventional		FoodEapp		Pearson Correlation	Intraclass Correlation
	Mean ± SD	Range (min – max)	Mean ± SD	Range (min – max)	Rho (p Value)	ICC
Total energy (kcal)	1358 ± 453	2810 (66-2876)	1338 ± 421	2630 (90-2720)	0.88 (<0.001)	0.93
Protein (g)	45 ± 17	103 (2-105)	43 ± 16	100 (2-102)	0.81 (<0.001)	0.89
Lipids (g)	40 ± 21	145 (3-147)	37 ± 16	114 (4-118)	0.73 (<0.001)	0.83
Carbohydrates (g)	209 ± 77	500 (6-506)	186 ± 65	453 (11-465)	0.68 (<0.001)	0.80
Calcium (mg)	428 ± 195	1369 (19-1387)	404 ± 180	1285 (54-1339)	0.70 (<0.001)	0.82
Iron (mg)	13 ± 5	29 (0-29)	12 ± 5	44 (0-45)	0.70 (<0.001)	0.82
Vitamin C (mg)	28 ± 35	292 (1-292)	27 ± 39	445 (1-446)	0.66 (<0.001)	0.79

Measure of Agreement

Figure 1 - Bland Altman plot for difference in energy

Figure 2 - Bland Altman plot for difference in protein

Energy

Protein

Measure of Agreement
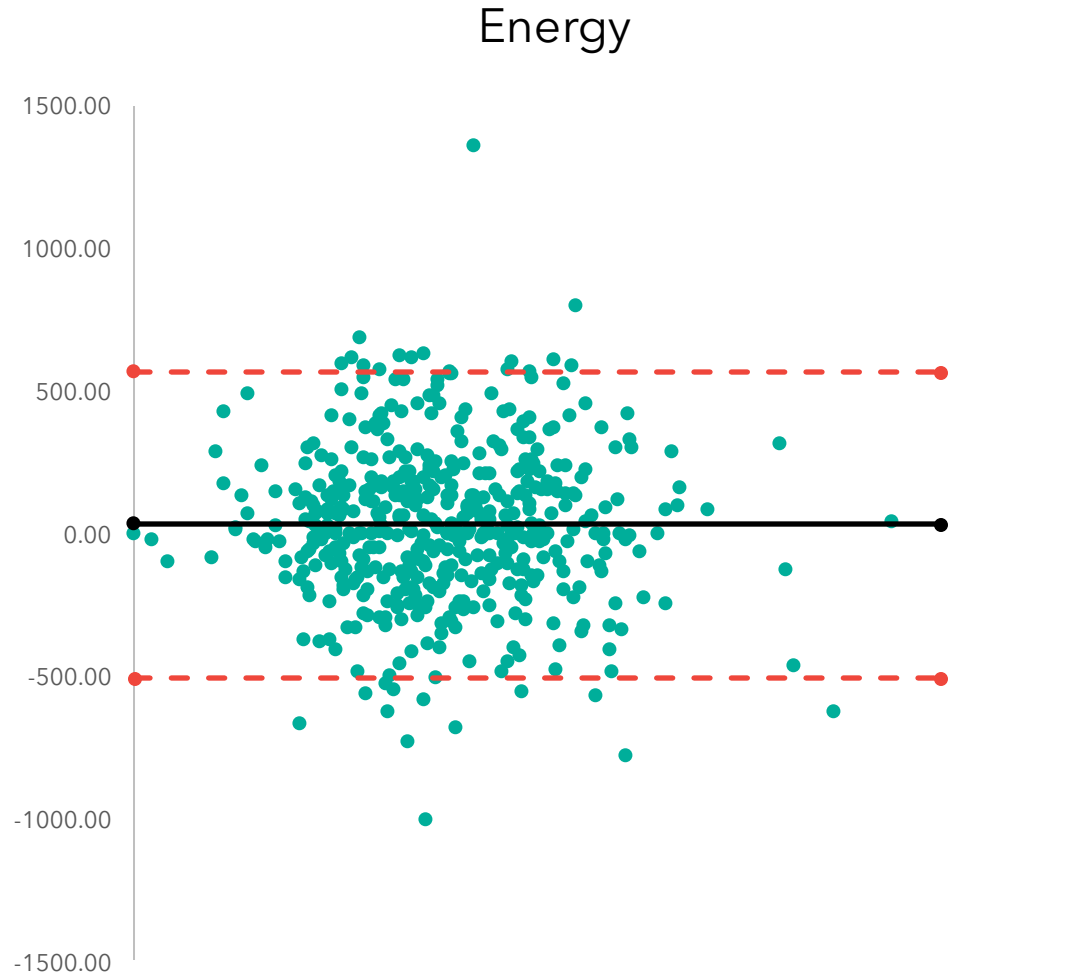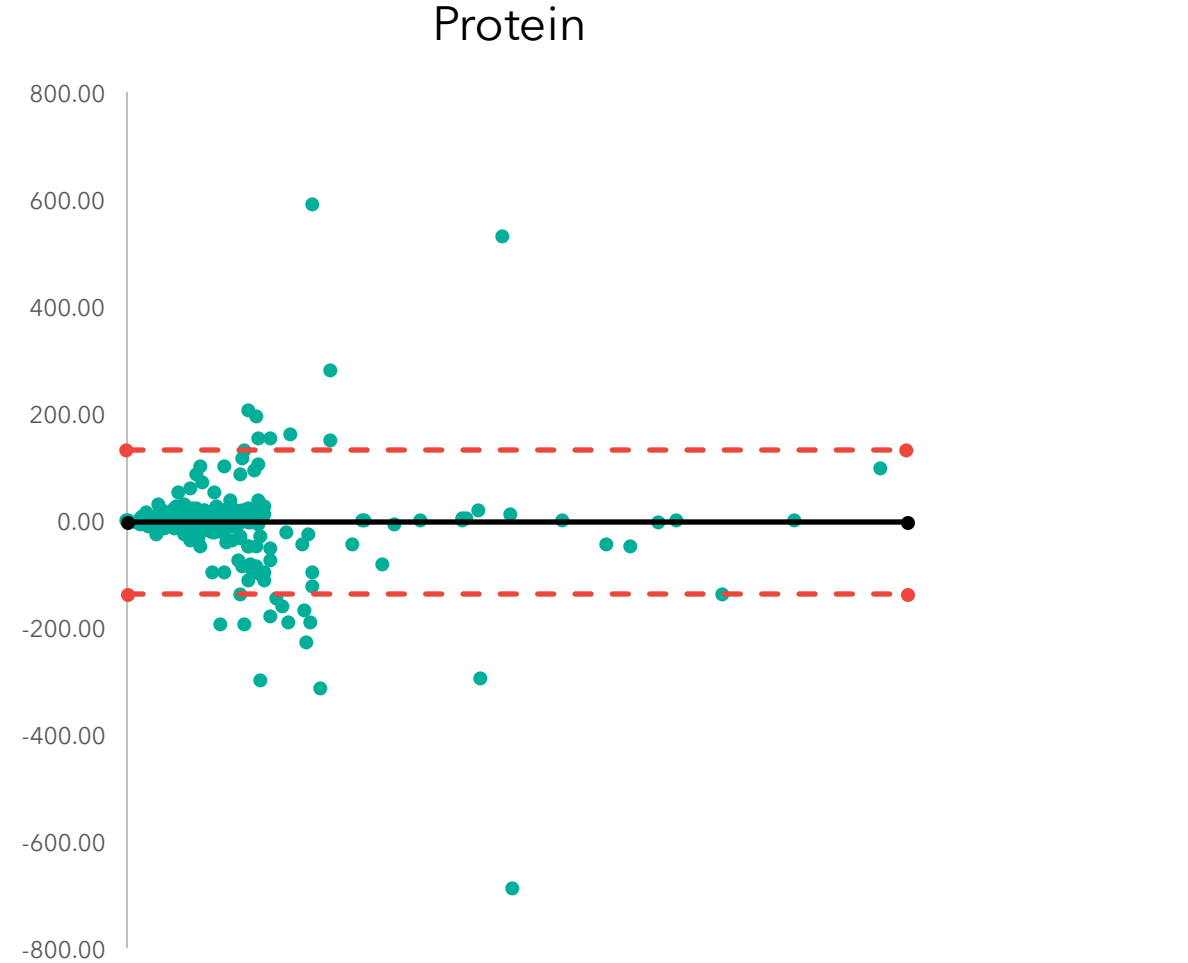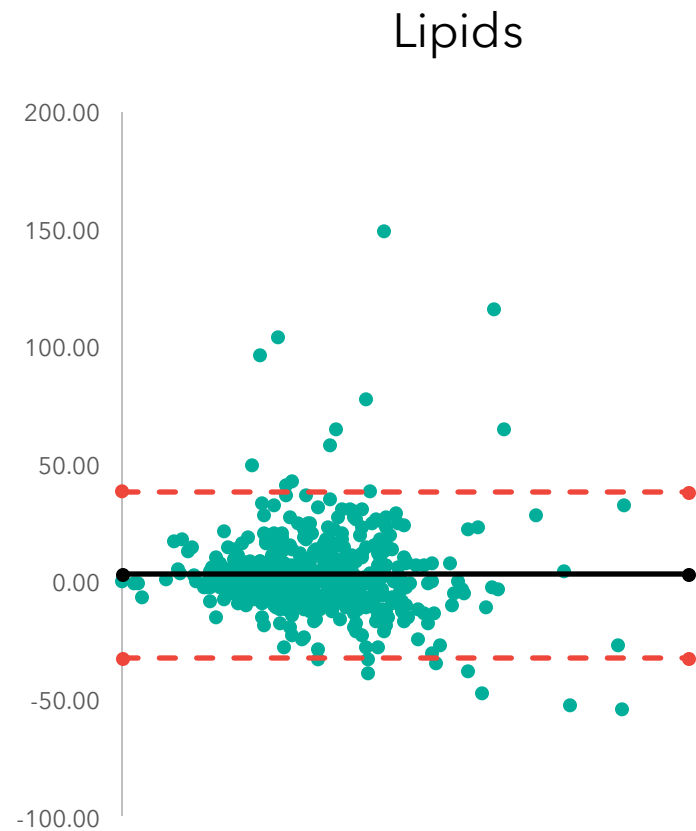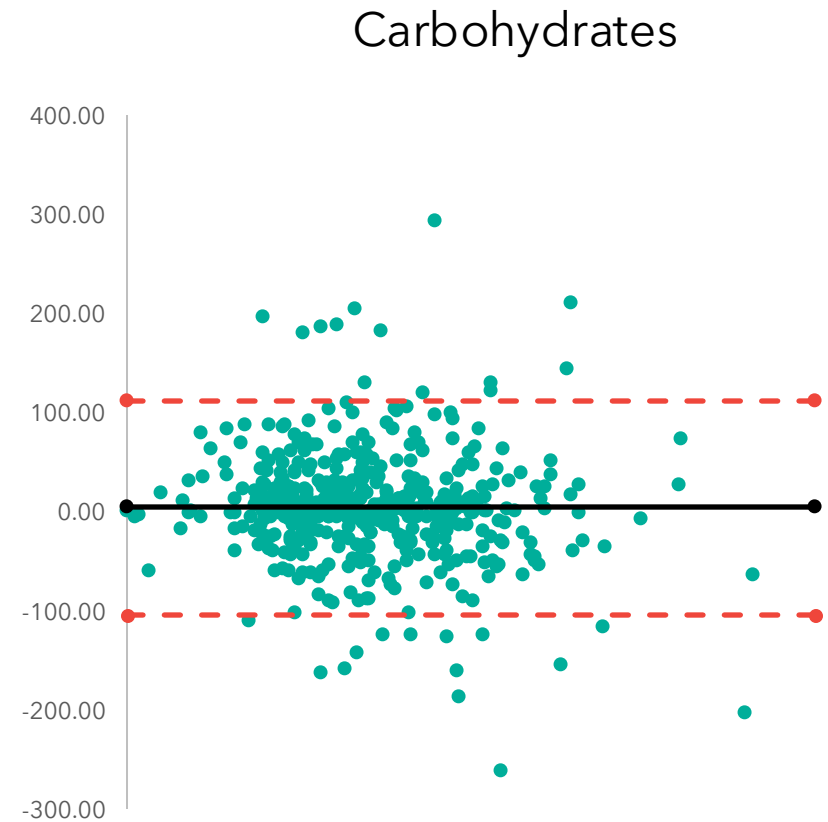
Figure 3 - Bland Altman plot for difference in energy

Figure 4 - Bland Altman plot for difference in energy

Lipids

Carbohydrates

In-Depth Interviews with the Researchers

Researcher's indepth interviwers about Food Eapp following UTAUT model

Themes	Sub Themes	Code
Performance expectancy:- Expectancy to attain in job performance by using the system	Utility:(Applicability/ Practicality:	Convenient and useful tool.
Effort expectancy:- Expectancy as the level of easiness related while using any system	Automated calculation of nutritional analysis:	Automatic and instant calculation at the back end of macro and micro nutrients.
	Standardized questions:	Multipass questionnaire
Social influence:- Others (peers, etc.) beliefs may affect some one's thought about using the new system.	Nutritionist & Non-Nutritionist community:	Very much acceptable especially to researchers with no nutrition background.
Facilitating condition:- Individual believes in organizational and technical infrastructures required to use the intended system.	Diseases prevention	Facilitating condition for Diseases prevention

In-Depth Interviews with the Data Collectors

Data collectors indepth interviwers about their experience FoodEapp following UTAUT model

Themes	Sub Themes	Code
Performance expectancy:- Expectancy to attain in job performance by using the system	Work efficiency	App saves automatically. Written record needs to be stored manually
	Workload	Less workload in app
Effort expectancy:- Expectancy as the level of easiness related while using any system	Data quality	Error and correction on mistakes at the same time.
Social influence:- Others (peers, etc.) beliefs may affect some one's thought about using the new system.	Technology Preference	Times of technology , most work done via technology
Facilitating condition:- Individual believes in organizational and technical infrastructures required to use the intended system.	low cost data collection	Inclination towards technology due to less time and effort.

Semi-Structured Interviews with Validation Study Participants

Paricipants semi-structured interviews about their experience with food Eapp & manual data collection

Theme	Sub Themes	Code
Food Eapp as compare to manual dietary recall method	Time	Quick, immediately done, time saving.
	Manual Preference:	Manual method more reliable
	Repeated Reminders:	In between meals
	Technology Impact:	Efficient, effective, accurate, understandable. Good but dangerous.

Outcome

Outcome

For Dietary assessment, 24-hour dietary recall through FoodEapp is highly & moderately correlated with conventional 24-hour dietary recall method.

Easily administered and instant estimation of nutrient feature is working

Food items & nutritional values on dashboard

Less time required – time (20 mins)

Less trained field staff is being able to use it/user friendly

Researcher's Suggetions for improvement

Addition of more nutrients for analysis (Vit A, D, B6, B12, folic acid, Zinc, Phosphorus, Oxalate, Citrate, Saturated fats)

Physical Activity level.

Validation for all age groups; including children & teenagers.

Use of FoodEapp in Clinics to collect data as Food diary.

Strengths and limitations

Strengths

- *Noval tool is developed*
- *Reduced biases by*
  - *random sampling*
  - *random sequences of DR for validation*
  - *Automated nutrient analysis*
  - *A wide range of all seasonal foods are included in the app*

Limitations

- *Only validated for Karachi population*
- *Only validated for the adult population*
- *COVID impact – only three cycles of recall were completed*
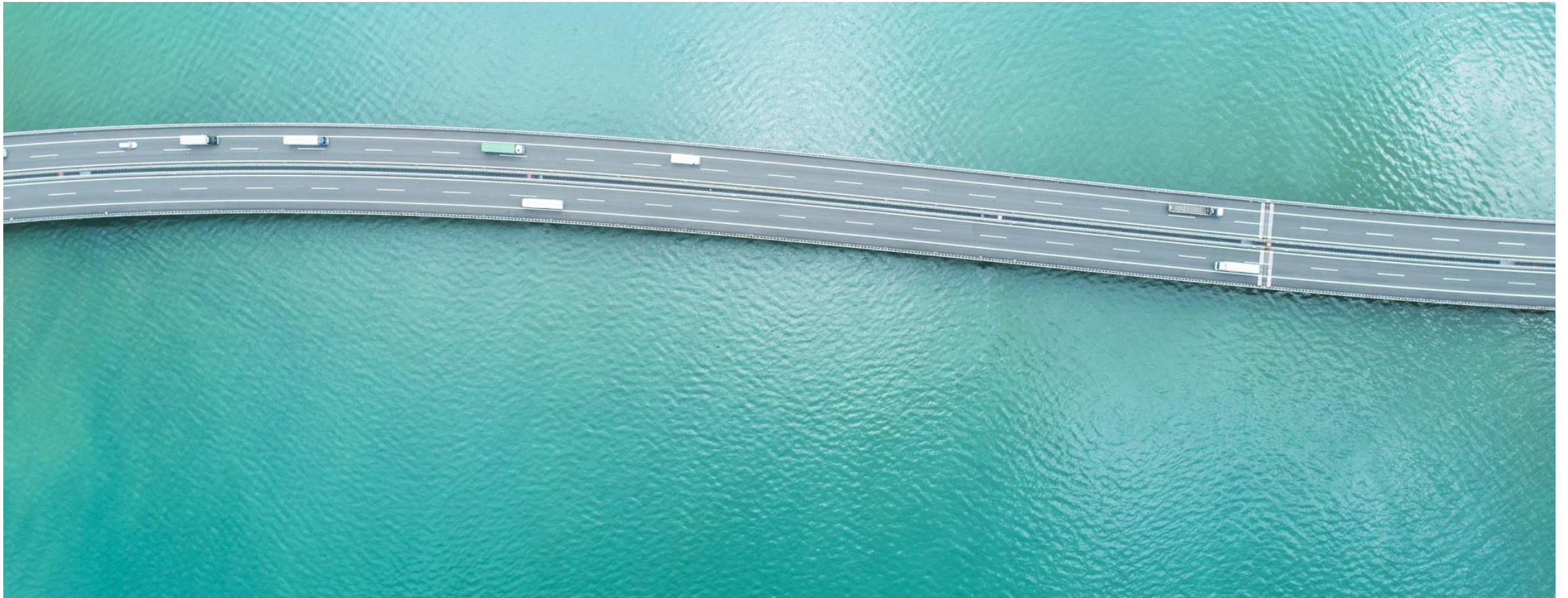
Implications

FOOD EAPP Data collection - Less resource intense

Dietary data collection for larger dietary surveys.

Multiple DRs of each participant for larger studies-

Reflect the usual intake of an individual

Thank you

Acknowledgement

- *Dr Romina Iqbal (Supervisor)*
- *Dr Rehana Siddiqui & Sir Iqbal Azam Committee members)*
- *AKU – URC Funded*
- *AKU – Dean's Fund Supported*
- *PHC Global*
- *Epi & Bio Program Office*