Developing Components of an Integrated mHealth Dietary Intervention for Mexican Immigrant Farmworkers: Feasibility Study of a Food Photography Protocol for Dietary Assessment.

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Abstract

Background: Rural/urban disparities in access to health services and burden of diet-related non-communicable diseases (DR-NCD) are wider among Mexican immigrant farmworkers (MIFW) due to work demands, social and geographical isolation, literacy issues, and limited access to culturally- and language-competent health services. Although mHealth tools have the potential to overcome structural barriers to health services access, efficacious mHealth interventions to promote healthy eating have not considered issues of low literacy/health literacy, and food preferences/norms in the MIFW population. To address this gap, we conducted a series of preliminary studies among MIFW with the long-term goal of developing a culture- and literacy-specific smartphone application integrating dietary assessment through food photography, diet analyses, and a non-text-based dietary intervention. Here we report on the feasibility of a food photography protocol for dietary assessment among MIFW women.

Objective: To examine adherence and reactivity to a 14-day food photography dietary assessment protocol in which MIFW women were instructed to take photos of all foods and beverages consumed using a smartphone camera application.

Methods: We developed a secure smartphone application with an intuitive graphical user interface to collect food images. Adult MIFW women were recruited and oriented to the food photography protocol. Adherence and reactivity were examined by calculating the mean number of food photos/day, differences between first and second week, and between weekdays and weekends. Three days of food photos were compared to three 24-hour dietary recalls to further characterize adherence by type of foods and meal type.

Results: Sixteen Mexican farmworker women took a total of 1,475 photos in 14 days, with a mean of 6.6 photos/day per participant (standard deviation [SD] 2.3). On average participants took one less photo/day in week 2 (mean= 6.1, SD 2.6) compared to week 1 (mean= 7.1, SD 2.5) (P=.03) and 0.6 photos less per day on weekdays versus weekends (mean= 6.4, SD 2.5 vs. week 2 mean= 7, SD 2.7; P=.5). Of individual food items, 352 foods and beverages in the recalls matched foods in the photos (71%). Of all missing food items (138) and meals (36) in the photos, beverages (54%) and tortillas (11%), snacks (44%) and dinners (28%) were the most frequently missed. Most of the meals not photographed (75%) were in the second week of the protocol.

Conclusions: Dietary assessment through food photography is feasible among MIFW women. For future protocols, substantive adjustments to reduce the frequency of missing foods and meals will be introduced such as a shorter assessment period and the use of automated text message prompts. Our preliminary studies are a step in the right direction to extend the benefits of mHealth technologies to a hard-to-reach group and contribute to the prevention and control of DR-NCD.

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Developing Components of an Integrated mHealth Dietary Intervention for Mexican Immigrant Farmworkers: Feasibility Study of a Food Photography Protocol for Dietary Assessment.

Introduction

Mexican immigrant farmworkers (MIFW) are vital to the U.S agricultural industry [1], yet they and their families are among the poorest, most isolated, marginalized, and underserved groups in the United States [2,3]. While rural Americans face inequities in access to health care resources [4] and burden of diet-related non-communicable diseases (DR-NCD) [5,6], those gaps are deepened when considering MIFW as a distinct rural population [7, 8]. MIFW have high levels of poverty [9, 10] and food insecurity [11] while experiencing long and unpredictable work hours at physically risky and demanding jobs [12,13]. MIFW often live and work in socially and geographically isolated conditions with scarce access to transportation [14], lack of health insurance, and limited access to culturally and language competent health services [4] and to health-related safety net programs [8,15,16]. Additionally, first generation MIFW families describe changes in their dietary intake reflecting acculturation to the US dietary pattern [17-21]. Within this context, we would expect MIFW experience disproportionate rates of DR-NCD. However, documentation on the health status among MIFW is inconsistent, often limited to selected or regional samples, heterogenous in country of origin and farmworker status, rendering the quantification of disparities elusive. Estimates of the prevalence of diabetes, hypertension, and overweight/obesity are 11%, 14%, and 32%, respectively [22], in a sample of farmworkers (31% children) with access to federally funded Migrant Health Centers. In contrast, regional and local estimates report prevalence of diabetes of 17% and prediabetes of 60% [23], 55-69% of hypertension [23,24], and of 64% to 92% [23,24] of overweight and obesity among adults MIFW. Since dietary intake is among the key modifiable factors that contributes to DR-NCD [25], efficacious interventions to promote healthy eating and overcome

structural barriers to health care access – particularly health promoting care - in this population will contribute to the primary and secondary prevention of DR-NCD.

Culturally adapted mHealth tools that take into account MIFW's unique constellation of personal (e.g., cultural meanings, level of health literacy), economic (e.g., food insecurity) and environmental (e.g., limited transportation, long work hours) constraints to improve access to health services and reduce health inequities have been suggested [26,27]. While access to weight control and healthy eating interventions has improved as the Internet and cell phones have become a common mode of delivery, these interventions have been most effective in persons of high socio-economic status [28], have not considered the issue of low literacy/health literacy [29], and have failed to address cultural food preferences and food/eating norms [30]. Although there is evidence of high rates of cell phone ownership and willingness to use mHealth devices among MIFW [31,32], the unavailability of mHealth dietary intervention for MIFW have become another source of increasing disparities. For example, self-monitoring of dietary intake, one commonly used online intervention [33] requires detailed documentation of food intake using complex word-based programs that generally do not include ethnic-specific food choices.

Further complicating access to effective mHealth diet interventions in MIFW is the need for a reliable dietary assessment, a critical first step to the delivery of tailored dietary interventions. Currently, self-reported dietary assessment methods require literacy (e.g., food records), the ability to average out frequency of eating over time (e.g., food frequency questionnaires); or require bilingual-bicultural interviewer (e.g., 24-hour dietary recall) [34]. Diet assessment through food photography, although still in its infancy, has the potential to overcome these limitations [35]. The development of a food image recognition diet assessment tool linked with a non-test based culturally adapted healthy eating intervention as a smart-phone application is a highly innovative step toward the delivery of nutritional care to underserved, difficult to reach populations and to the prevention and control of diet-related health inequities.

To address this critical gap, we conducted a series of preliminary studies among MIFW to test the feasibility of collecting dietary intake data through a smartphone camera application and to develop a working draft of a preventive dietary intervention that integrates behavior change strategies with cultural (Mexican food traditions and preferences) and socio-economic factors (i.e., work demands, limited transportation to grocery stores) influencing their intake patterns. Our long term goal is to leverage mHealth technologies to reduce the gaps in access to nutrition preventative services and contribute to the primary and secondary prevention of DR-NCD by developing a culture- and literacy- specific smartphone application with three integrated components: dietary assessment through food photography, analyses of dietary intake to identify problem intake, and a tailored and culturally relevant dietary intervention that is accessible across varying levels of literacy/health literacy. Here we are reporting on the feasibility of using a smartphone camera application to assess long term dietary intake in a sample of farmworker women of Mexican origin. Specifically, we examined adherence and reactivity to a food photography protocol and characterized adherence by type of foods and eating occasions by comparing the content of the food photos with a validated dietary assessment method. We focused on women because of their worries about body weight and related diseases [17], and their central role in procurement and preparation of food for themselves and their families [36-38]. This study was approved by the University of Rochester Research Subjects Review Board.

Methods

Study Overview

The study was conducted in farming communities in Western New York from April 2017 to August 2018. The study consisted of a 14-day food photography period during which participants were asked to take photos of all food and beverages consumed using a camera app on a project-loaned Android smart phone. Fourteen days of food photos including 2 weekends allowed us to examine

differences in adherence between weekday and weekends. It also enabled examination of reactivity to the food photography protocol, defined as changes in adherence caused by the recording process [39] to identify the number of days needed to obtain details on dietary patterns while minimizing participant burden. Three 24-hour dietary recalls (24H-DR), a validated dietary assessment tool [34,40,41] were administered during the food photography period to further characterize protocol adherence by identifying missing foods and eating occasions (e.g., dinners). These observations will inform the design of the final food photography application.

Participant Eligibility and Recruitment

Study participants were women who met the following eligibility criteria: 1) self-identified as being of Mexican origin, 2) 21 to 45 years old purposively targeting an age group typically balancing outside the home and multiple family responsibilities, and 3) living in a farming community in Western New York. Women were ineligible if pregnant or lactating, and/or following a medically prescribed diet (e.g., diabetic diet, weight loss diet).

Women were recruited by native Spanish speaking bilingual data collectors who had established relationships with the regional farmworker communities. The data collectors were well known in the communities through employment-related outreach and advocacy. Study participants were recruited based on the data collector’s knowledge of the community, a modified snowball recruitment technique [42] and referrals from cooperating community-based organization and community leaders. Data collectors contacted women by phone or in person to inform them of the study, determine interest in participating and, for those interested, complete a brief screening interview. To reduce the risk of coercion, two additional visits were offered. For women eligible and interested in participating, a second meeting was scheduled to discuss the study, review the informed consent and answer questions. For those who preferred to discuss participation with friends and family, a copy of the consent was provided and a third visit to complete the consent was offered.

Women interested in participating completed the process of informed consent. Due to risks for undocumented participants: 1) consent was verbal and witnessed by data collector's signature, and 2) no identifying information was collected.

Study Procedures

The study protocol consisted of a total of five face-to-face data collection visits at the participant's home or a location of their choice (e.g., private room in public library). All written materials were prepared at a 6th grade reading level and were read aloud by the data collector. The orientation visit took approximately one hour and included hands-on instruction on overall use of the phone, how to use the camera app, and how to photograph foods and beverages. Participants were asked to always carry the cell phone with them to take photos of all foods and beverages in all meals (including snacks) before consumption and to avoid capturing human faces in the photos. After completing the orientation, questionnaires were administered verbally, and participants had weight and height measured to calculate body mass index (BMI, weight in kg/height in m^2).

Three face-to-face visits occurred during the 14-day food photography period. The meetings were scheduled based on the participants' availability and approximately equally distributed across the 14-day period (e.g., days 3, 7 and 10). During these visits, the data collector began by reviewing the quality of food photographs with participants. Images that were duplicates, non-food relevant, or included faces or other identifiable information were removed. At each face-to-face visit, participants were administered a 24H-DR (a total of 3) by a trained diet technician using the Nutrition Data System for Research (NDSR) software and multiple pass methodology version 2016 developed by the Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN [43]. The data collector served as a translator and assisted with portion size estimation using common kitchen measuring tools. The final face-to-face visit occurred within one week of completing the food photograph protocol. During that session, new photos were reviewed, the incentive for participation was paid (a

total of $77) and the project smart phone collected.

Data Collectors and Training Activities

Training of the data collector consisted of approximately 46 hours of activities including: 1) CITI/human subjects modules/testing, 2) university specific training; 3) project specific instruction on participant recruitment, informed consent processes, data collection and management, 4) role-playing and 5) observation in the community of participant enrollment and data collection sessions. All training was done by the project manager and/or the PI.

After 9 participants were recruited, irregularities in processes and questionnaire responses (e.g., identical responses for all participants) were identified during routine monitoring. Initial efforts to address the problems were unsuccessful. Therefore, enrollment and data collection activities were stopped at month 2 of the project and additional training for the data collector was provided. Shortly thereafter, the data collector resigned. A second data collector was hired and trained using the same processes described above. Data collection resumed in December 2017.

Measures to Characterize the Sample.

Demographic questionnaire included standard items (e.g., age, educational level, country of origin). *Weight and height* were measured with participants wearing light clothing and in privacy with a portable auto-calibrated digital scale to the nearest 0.1 kg (EatSmart model ESBS-03) and Shorr Infant/Child/Adult Height/Length measuring board stadiometer to the 0.1 cm, respectively. Measures were used to calculate body mass index (BMI) as weight in kg/height in m^2.

The Acculturation Rating Scale for Mexican-Americans II (ARSMA-II) [45] measured bicultural acculturation with two orthogonal subscales, the Mexican Orientation Scale (17-items) and the Angelo Orientation Scale (13-items) with evidence of its reliability and validity with Spanish speaking Mexican adults. The measure is behaviorally focused and addresses spoken language and

identification in everyday activities. Items are rated on a 5-point scale anchored by “not at all” and “almost always”. The scale scores are computed by averaging across items.

Newest Vital Signs [44] addressed reading and numeracy aspects of health literacy particularly related to food labels and nutrition with evidence of its reliability and validity. Participants were presented with a nutrition label from a container of ice cream and asked to answer six questions to test ability to read basic text and perform simple mathematical computations. One point is assigned with each correct response with a score of 0-1 indicating high likelihood of limited literacy, 2-3 a possibility of limited literacy and a score of 4-6 indicating adequate health literacy.

The 24H-DR is a validated tool to measure self-reported food and beverage intake over the previous 24-hour period that does not require respondent’s literacy [34,40,41]. Participants are asked to recall the time of intake, type of meal (e.g., dinner), type of food and beverages and portion size. The 24H-DR served two purposes: 1) to characterize adherence to the food photography protocol by comparing the type and timing of food items and eating occasions captured by the photos against the recalls and 2) to describe participants’ dietary intake by analyzing the data using the using NDSR software version 2016 [43].

Mobile Food Photography Application

An *Android mobile application* was developed by our collaborators in computer science to collect food images. The password protected app uses the built-in camera and provides an intuitive graphical user interface to display simple prompts and take and review pictures. The app resembled a typical camera app but was redesigned for ease of use and the protection of food imaging by storing them in a separate location different from the standard cell phone photo folder. Photos were automatically identified by participant ID number, date, time, and photo ID number only and stored in the cell phone password protected gallery, separate from the typical photo gallery, accessible only to the data collector during the 14-day recording period. After completion of data collection, the photo images

were downloaded to secure servers. Photos were then examined for quality (deleted blurred photos) and deleted duplicates (e.g., 2-3 photos a noodle soup based on the time stamp) and non-food photos (e.g., photo with a pair of glasses).

To enhance photo protocol adherence, two features were built into the app. One was a daily summary text message automatically sent from the participant's project cell phone to project staff detailing the number and timing of photos taken each day. If changes in the pattern of photos were noticed, a phone call from the data collector followed. The other feature consisted of three text message reminders per day sent at fixed times encouraging participants to take photos of all food and beverages.

Data Analysis and Management

Questionnaires were checked for completeness and manually entered into REDCap by a study staff and later checked by another study member for accuracy. The distributional properties and the presence of outliers were examined for each variable. A research team member did a final review of the photos dataset to remove duplicates (based on the time stamp), blurred photos and photos containing no food items (e.g., a photo with a pair of glasses).

We described the demographic characteristics and the BMI of the sample (means, medians, ranges, and proportions) and computed scale scores for the health literacy and acculturation measures (New Vital Signs, ARSMA, respectively). Additionally, dietary data from the three 24H-DR were averaged to estimate the number of servings of fruits and vegetables (in cups equivalent), proportion of grains as whole grains, and percentage of total calories from sugar added and saturated fats. We contrasted those dietary intake estimates to current dietary recommendations [46].

We did not establish an a priori definition of adherence to the food photography protocol because daily meal patterns of our MIFW were previously unknown and understanding them was part of our investigation. To answer whether farmworker women adhere to a 14-day

food photography protocol and if there were signs of reactivity to it, we computed the mean number of photos taken each protocol day and compared mean number of photos between week 1 and week 2, and the mean number of photos between weekday and weekend days with a t-test ($P < .05$). We additionally plot the mean number of photos in a given hour of the day, starting at midnight and ending at 11 p.m., averaged for each person across the 14-days and then averaged across all participants to identify general daily mealtime pattern among participants (no formal test performed).

To determine the completeness of the food photographs content we compared the number and type of food/beverage items (herein food items) between the 24H-DR (the reference) and the food items in the photo images taken over the same 24-hour period (3 days of food photography per participant compared to the same 3 days recalled in the 24H-DR). For this study, a food item was defined as a distinct food independently of the ingredients involved (i.e., a bowl with rice, beans, and cheese equals one food item; a plate with a fried egg and French fries equal two items). Two of the co-authors (KY and AK) independently matched the number and type of food items between the photos and 24H-DR (the reference) using the time/date stamped in the photos and 24H-DR date/times of food intake recalled and later met to compare results. Any disagreements were resolved at a team meeting by consulting a senior researcher (IDF). We first computed the percentage of total number of food items documented in 3 days of photographs out of the total number of food items in the concurrent three 24H-DR (total number of food items in photographs/ total number of food items in the recalls). Second, we calculated the percentage of food items in the photos that match in type of food and time of intake to the food items in the recall (number of food items in the photos matched to food items in the recalls/ total number of food items in the recalls). Unmatched food items were due to missing food items in the photos or to food items that matched in time of intake but differed in the type of food item. We examined the frequency and characteristics of unmatched food items and meals (breakfast, lunch, dinner, and snacks) from the photos (e.g., participant recalled roasted chicken at dinner time that was not photographed).

Results

A total of 25 women were enrolled in the study. However, data from the first 9 participants (obtained by the first data collector) were not included in our analyses due to missing all demographics except for age and birthplace, and questionable quality of surveys (e.g., all participants had the same responses). Consequently, the analytic sample for this study is 16 women. Compared to the analytical sample, excluded participants did not differ in median age (non-parametric test p-value: 0.08) and 6 of them (66%) were born in the US (Chi square test p-value <0.001). Participants were early and middle-aged women, all of whom were born in Mexico. Most participants had either overweight or obesity, less than a high school diploma, retained a Mexican cultural orientation and were of limited or possible literacy. Both the age at immigration to and the length of stay in the US varied considerably across the sample. (Table 1). All cell phones were returned. No participant dropped out of the study.

TABLE 1. CHARACTERISTICS OF PARTICIPANTS (N=16).

Age (years) (mean, min-max)	37.1 (21-45)
Birthplace Mexico, n (%)	16 (100%)
Age at Immigration (years) (mean, min-max)	24.5 (3-37)
Years in US (mean, min-max)	13.5 (2-22)
BMI[a] (median, 25Th-75th Pc; min-max)	30.2 (26.9-33.7; 24.2-41.3)
Normal Weight (BMI 18.5-<25), n (%)	1 (6.3%)
Overweight (BMI 25-<30), n (%)	7 (43.8%)
Obese (BMI ≥30), n (%)	8 (50.0%)
Education level, n (%)	
6th grade or less	6 (38%)
Middle school	6 (38%)
Some high school	3 (19%)

Graduated high school	1 (6%)
Work type, n (%)	
Farming or food processing	16 (100%)
Other	0 (0%)
ARSM[b], n (%)	
Very Mexican oriented	13 (81%)
Mexican oriented to balanced bicultural	2 (13%)
Slightly Anglo-American to oriented bicultural	0 (0%)
Very Anglo oriented	1 (6%)
New Vital Signs, n (%)	
Limited literacy	2 (13%)
Possible literacy	9 (56%)
Adequate literacy	5 (31%)

[a] Body Mass Index; [b] Acculturation Rating Scale for Mexican-Americans II

Dietary Intake by 24H-DR

Two recalls were excluded from analyses due to implausible values (daily caloric intake < 500 and > 3000) [47]. Compared with the 2020-2025 Dietary Recommendations [46], approximately 50% of our participants exceeded the guidelines for percent of total calories from saturated fats and added sugars. The majority of women (75%) were below recommendations for percent of all grains as whole grains. None reached the recommendations for fruits and vegetables intake based on a 2000 calories/day diet for women with moderate physical activity [46].

Table 2. Dietary Intake[a] (n=16). Comparison with 2020-2025 Dietary Guidelines for Americans [46].

	Dietary Intake	**Dietary Guidelines for Americans 2020-2025** [46]
Total Calories from	10.7 (9.6-11.7)	< 10%

Saturated Fat % (25^{th}-75^{th} Pc) (min-max)	(5.8-13.8)	
Total Calories form Added Sugars % (25^{th}-75^{th} Pc) (min-max)	12.6 (9.4-14.8) (5.4-26.5)	< 10%
Grains as Whole Grains % (25^{th}-75^{th} Pc) (min-max)	39.9 (32.8-57.1) (10.0-87.1)	50%
Fruits and Vegetables Cups equivalents (25^{th}-75^{th} Pc) (min-max)	2.0 (1.1-2.7) (0.5-3.6)	4.5[b]

[a]Average of three 24-H DR; [b]Based on a 2,000 calories/d diet (caloric requirement for moderate physical activity women aged 21-25 is 2200 and aged 26-45 is 2000).

Adherence to food photography protocol

A total of 1,475 photos were taken by 16 participants over the 14-day food photography protocol (minimum of 63 total on day 14 and maximum of 131 total on day 9). Fourteen participants took at least 1 photo each day (minimum 1, maximum 16). Two participants took 0 photos on protocol day 14 (data not shown). The mean daily number of photos participants took per protocol day is 6.6 photos/day (standard deviation [SD] 2.3, median 6.5, 25^{th}-75^{th} Pc 6.1-7.3). There is no decreasing nor increasing monotonic trend in daily mean number of photos across the 14-days (Figure 1). The last 5 days of the protocol, however, the mean and median number of photos per day is below overall mean and median across the 14 days. The last day of the protocol had the poorest adherence (2 participants took 0 photos and 8 participants took 1-4 photos) (data not shown). On average participants took one less photo per day in week 2 compared to week 1 (week 1 mean= 7.1, SD=2.5 vs. week 2 mean= 6.1, SD= 2.6; t-test -2.47, degrees of freedom (df) 15, *P*=.03) and the differences were minimal between weekdays and weekends (weekdays mean= 6.4, SD=2.5 vs. weekends

mean= 7, SD= 2.7; t-test -1.15, df 15, *P*=.50) (Figure 2). Eating episodes occurred continuously throughout the day especially between 6:00 am and 10 pm with a clear cluster around noon. No clear evening mealtime was evident across the sample (figure 3).

Figure 1. Mean number of photos across 14-day protocol (n=16).

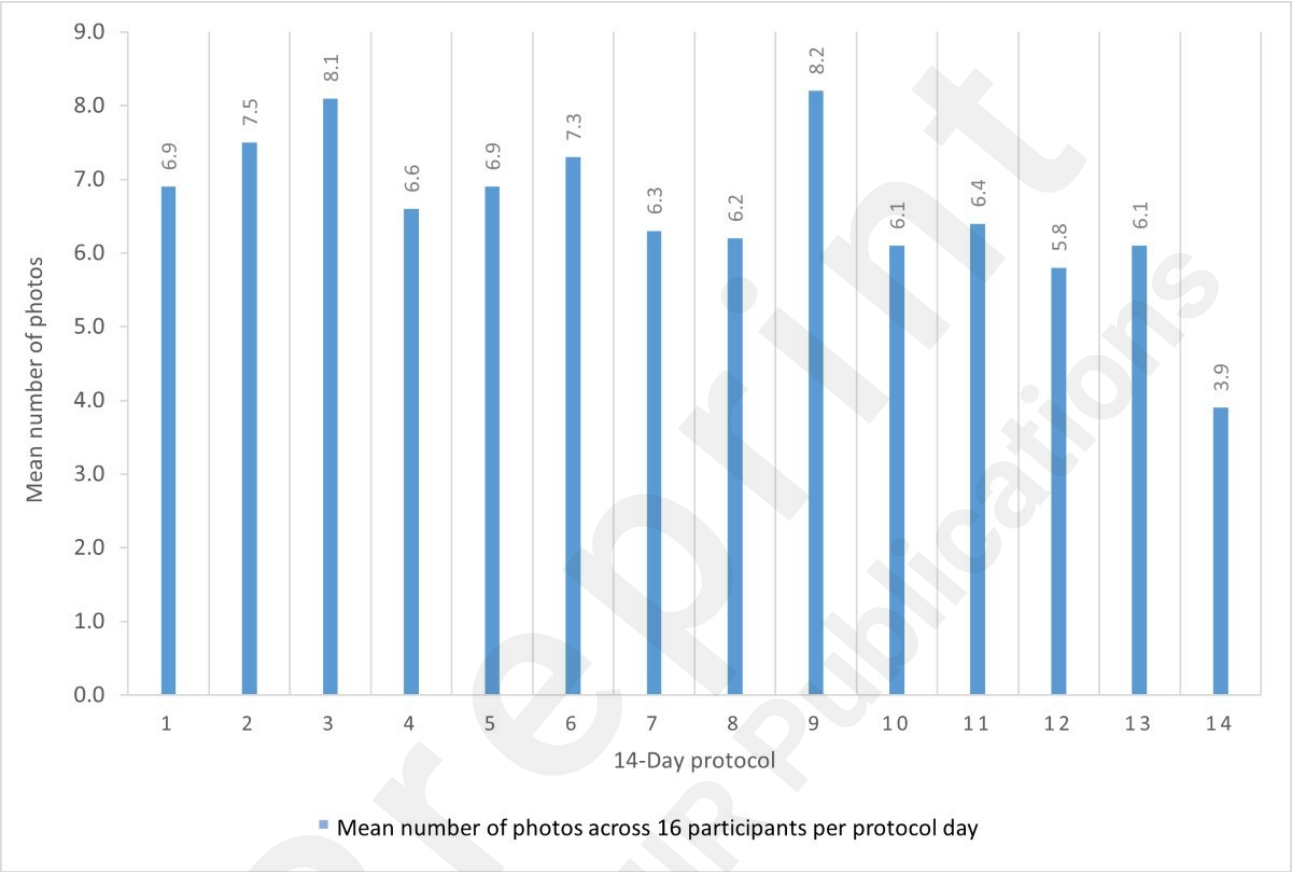


Figure 2. Mean total number of photos taken. Comparison week 1 vs week 2 and weekdays vs weekends (n=16).

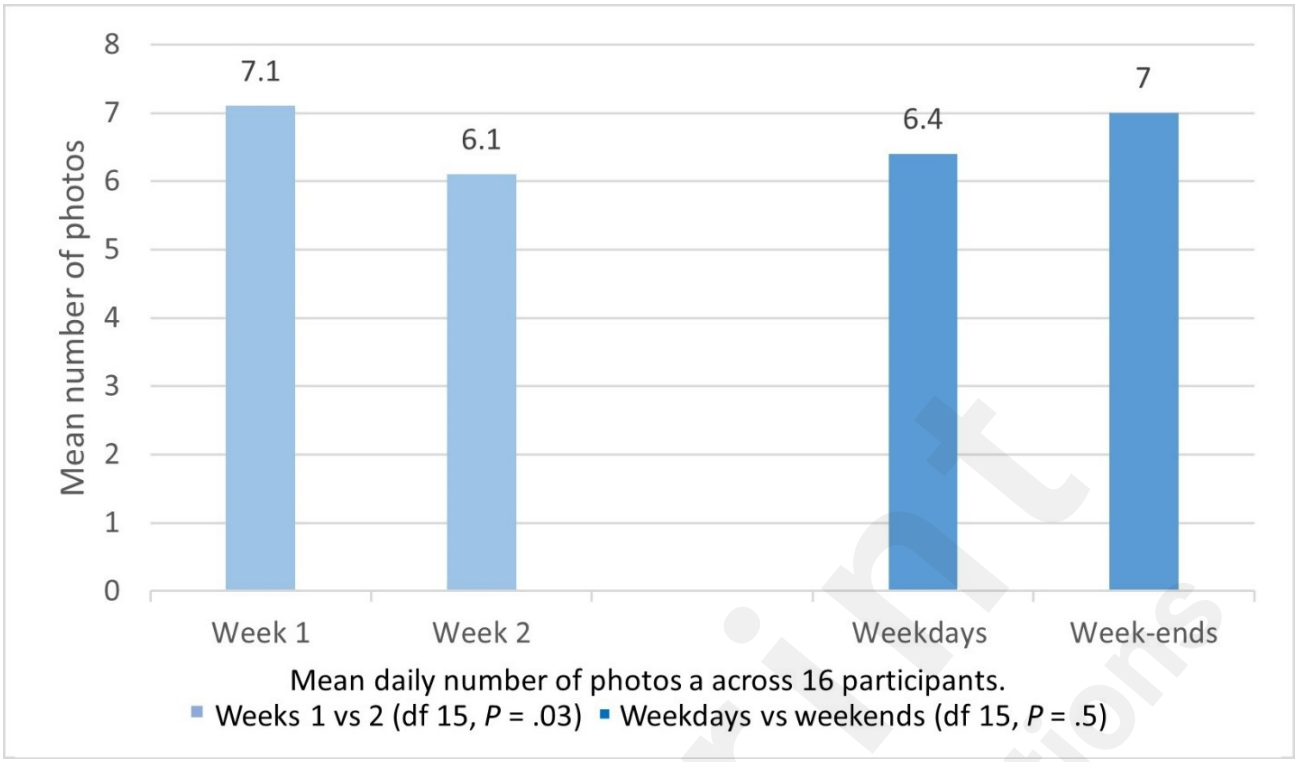
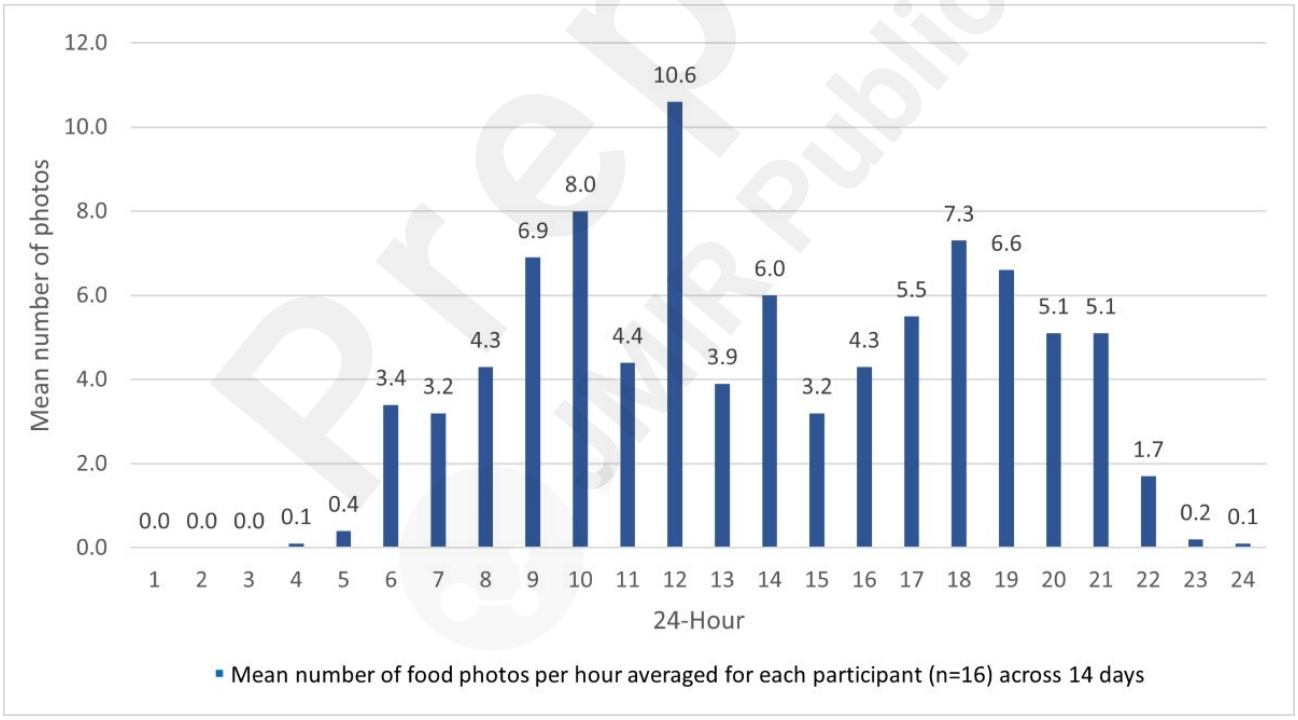


Figure 3. Mean number of photos per hour across 24 hours (n=16).



Comparison of the food photographs content to the 24-H DR

Participants reported a total of 495 food items in the three days of 24H-DR and 414 food items in the 3 concurrent days of photos. Using 24H-DR as a reference, 352 food items in the photos matched in time of intake and content with the food items in the recalls (71% concordance), 5 matched in time

of intake but not in the content (1% mismatched items, table 3), and 138 were missing from the photos (28%). Beverages were the food items most frequently missing in the photos (n=74, 54%), primarily water (n=54), juice/soda (n=12), and coffee/tea (n=6). Other missing food items were tortillas (n=15, 11%), fruits (n=12, 8.7%), and snacks (n=11, 8%). Additionally, women did not take photos of 36 entire meals, 27 (75%) of them occurred in the second week of the protocol, of which 19 (70%) were in the last 5 days. Snacks were the meals women missed to photograph most frequently (n=16, 44%), followed by dinners (n=10, 28%), lunches (6,17%) and breakfasts (n=4,11%). Incidentally, we found 57 food items in the photos that participants did not report in the recalls, of which the most frequent food items were beverages (35%) (13 waters; 8 juices/sodas), snacks (n=5), and fruits (n=6).

Table 3. Mismatched Food Items.

Photo (414 food items)	**24H-DR** (495 food items)
Tortilla	Donut cake
Chicken Pasta	Spaghetti
Chicken soup, rice and vegetables	Chicken Veggies
Crackers	Croissant
Strawberry	Cherries

Discussion

The data presented in this paper is one of a series of preliminary studies leading to the development of a smartphone application with an integrated dietary assessment tool based on food photography, the capacity to analyze food intake and identify problem intakes, and the delivery of tailored evidence-based strategies for dietary modification adapted to MIFW culture and level of literacy. Here we investigated whether MIFW adhere to a 14-day food photography protocol to capture patterns of dietary intake during weekdays and weekends and detect if reactivity occurred. We found that this sample of 16 young and middle age Mexican farmworker women, the majority of which conserved a strong Mexican cultural orientation and had a varied level of reading and numerical

literacy, adhered to the food photography protocol albeit with evidence of change overtime, and considerably variability at the individual level. Using the 24H-DR as the reference assessment tool, women did not take photos of all the meals and foods reported as consumed in the recalls. Although to a lesser extent, the opposite was also true, women did not report in the recalls some of the foods that had been photograph.

Comparison with Prior Work

Reports on adherence to image-based dietary assessment protocols in the US included participants of diverse socioeconomic [48-54] and racial/ethnic background [51-53], proficient in English [48-54], and, among those reporting education, most participants had a high school education and above [51-53]. Only two studies reported adherence data in a rural setting, one in low-income child/mother dyads [53] and the other in adults [54] but none of them represented the particular demographic characteristics and environmental challenges of MIFW. The protocols implemented differed from the current study in the length of the dietary assessment period (3-7 days) [48-54], the inclusion of photos of foods before and after consumption [48,50-54], inclusion of text or voice description of foods hard to identify from a photo [50,52,53], the type of meals requested to be photographed (only breakfast [52] and only dinner [53]), and measurement of protocol adherence [50,52-54]. We did not establish an a priori definition of adherence because daily meal patterns of our MIFW were unknown and understanding them was a goal of our investigation. Therefore, comparisons with such studies are not possible [49,52]. Among studies assessing full day of intake, those reporting number of photos as an adherence measure, had means ranging from 3 [49,51] to 10 [48] photos/day across a 7- and a 3-day protocol, respectively. Although our participants' mean photos/ day (6.6 photos) sits in the middle of previous studies, our protocol included only photos before consumption; thus, lessening participant's burden compared to previous studies. To our knowledge, no US studies examine reactivity to food photography protocols. In our sample of

MIFW women, we observed women took fewer photos during weekdays than weekends, perhaps due to known restrictions on cell phone use in the farms, and during the second week potentially due to fatigue. Participants did not seem to have a clear pattern of mealtimes. Outside of lunch time, there are food photos at every hour from 6:00 am to 10:00 pm. From our other preliminary studies, we learned that work breaks, and start and end times differ according to type of activity and season (unpublished data).

To our knowledge, previous pilot studies did not use other methods of dietary assessment to further characterize adherence to the food photography. Most of the food items not captured by the photos were foods consumed casually or during working hours when participants have cell phone use restrictions (e.g., beverages, snacks). Moreover, most of the whole meals not photographed were snacks and dinners, possibly indicating their unplanned nature (snacks), after-work fatigue or competing priorities such as family responsibilities (dinners). Comparable to another pilot study among adults [51], breakfast was rarely missed in the photos, perhaps due to its predictability in time and location. Supporting the presence of second week reactivity, the overwhelming majority of missed meals were in the second week of the protocol. Unexpectedly, some of the food items photographed were not reported in the recalls. Interestingly, the food items missing in the recall were of similar nature to those missing in the photos; namely, beverages and snacks. The latter may be due to memory [41] of foods eating casually and/or photos of foods women photographed but did not finally consume. Finally, the 5 mismatched items we found can be explained either by a faulty translation or an error in data entry in the dietary software. The presence of social desirability or eating behavior changes that can occur with both, recalls and food photography, cannot be rule out but none of them would have had an effect on adherence or reactivity to the protocol.

Conclusions

Based on these findings, we will make substantive adjustment to our food photography protocol.

Participants' training will include awareness of items and meals frequently missed (e.g., water, snacks). To avoid the fatigue observed in the second week, we will shorten the length of the assessment period to a week or less. Automated text message prompts adapting ecological momentary assessment (EMA) methods [55] will be sent at specific times (e.g., dinner time) as reminders to take photos. Since women have cell phone use restrictions at work and to record eating occasions forgotten to photograph, we will include an option to voice-record missed meals after the actual eating events occurred instead of in real time [56] and automatic reminders to do so. We expect the shorter assessment period, the automated reminders, and the voice recording option will reduce the frequency of missing food photos. The study reported here intended to broadly understand if and how MIFW women would adhere to food photography for dietary assessment and did not attempt to quantify actual amount consumed based on food photos. Thus, women were asked to photograph food only before consumption. We will enhance our next protocol by adding best practices for food photos [57], such as the appropriate photo angle and lighting, photos before and after consumption (plate waste) and of second servings for the correct quantification of foods and food groups intake.

The dearth of studies on all aspects of image-assisted and image-based dietary assessment including diverse population with limited English proficiency, literacy, and access to health services, such as MIFW, represent a missed opportunity for the use of technologies that have the potential to overcome those barriers. Our preliminary studies leading to the development of a culture- and literacy-specific smartphone application are a step in the right direction. We expect that in the context of MIFW environment, this type of application will contribute to reducing inequities in access to preventive nutrition services and, in the long run, to the prevention and control of DR-NCD.

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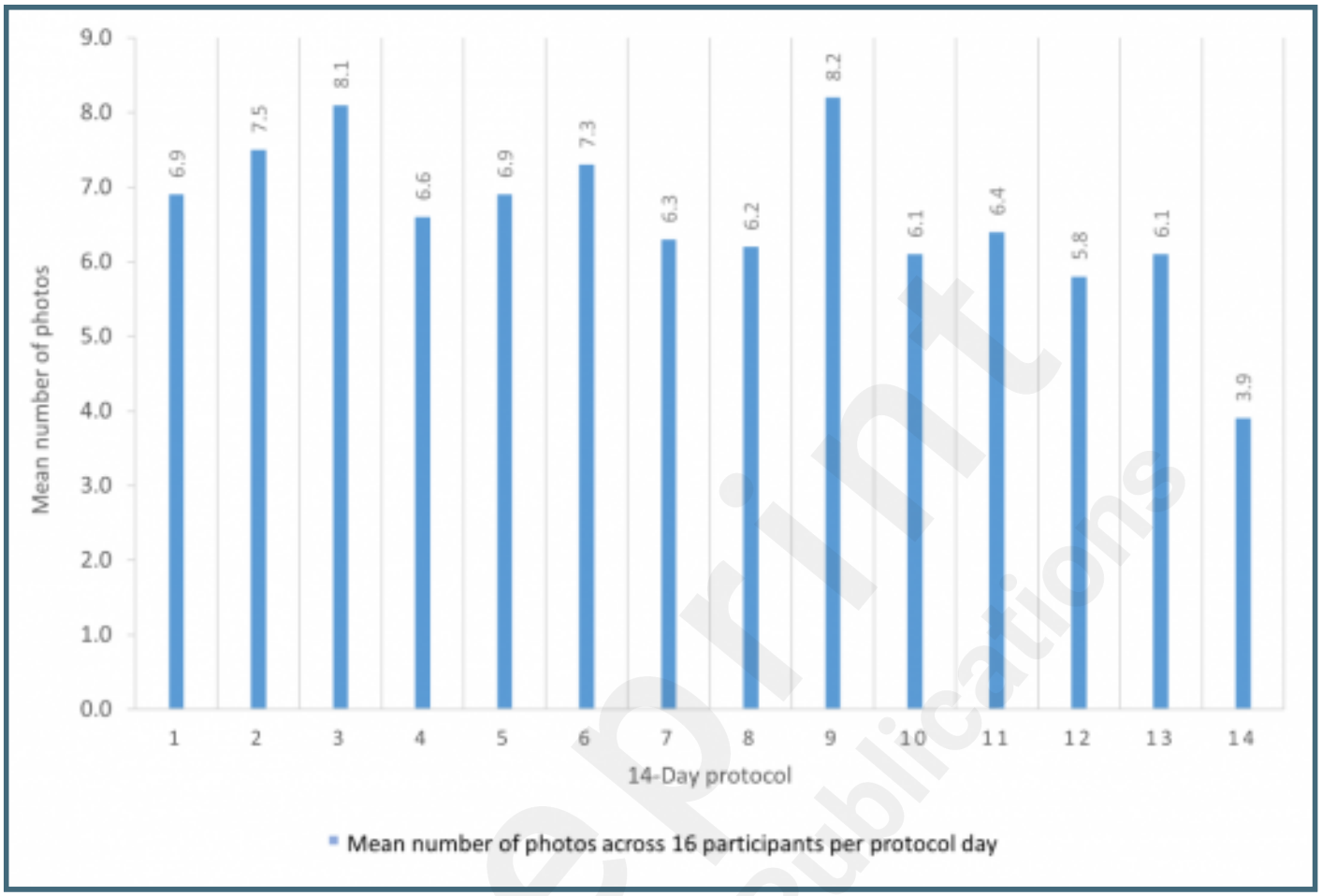
Supplementary Files

Untitled.
URL: http://asset.jmir.pub/assets/bdd6689fe1be8a420c566967c703270b.docx

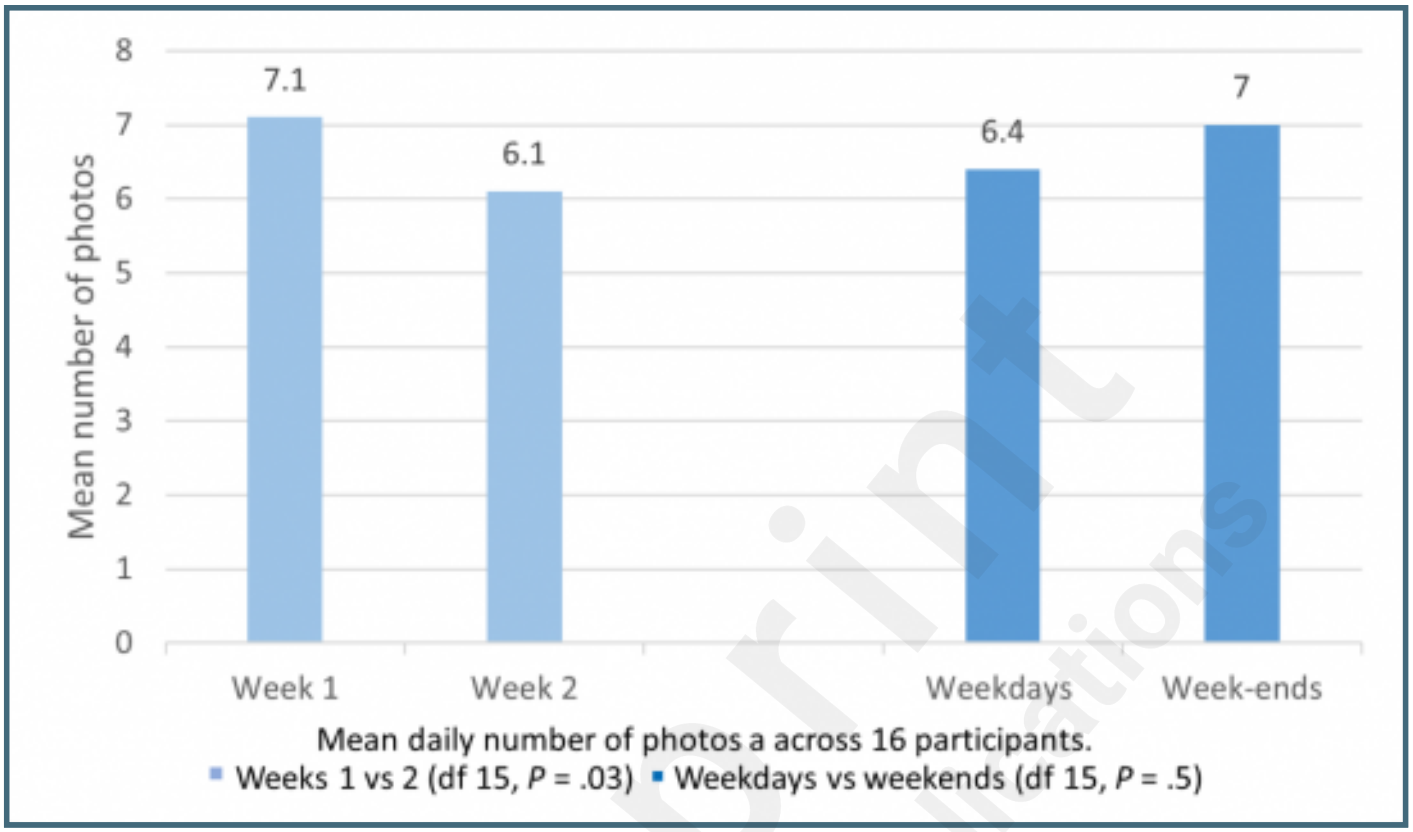
Untitled.
URL: http://asset.jmir.pub/assets/297a0f21c8fc9e8a4d8bfd5281f09de0.docx

Figures

Mean number of photos across 14-day protocol (n=16).



Mean total number of photos taken. Comparison week 1 vs week 2 and weekdays vs weekends (n=16).



Mean number of photos per hour across 24 hours (n=16).