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Microgreens Grow Kit -
A Novel Pilot Study to Improve Nutrition Awareness

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\textbf{ABSTRACT}

Obesity and associated non-communicable illnesses including coronary heart disease, type 2 diabetes, and stroke have steadily increased in prevalence over the last decade. Previous studies identified the involvement of individual, family, and community support intervention strategies used to prevent and manage obesity. Additionally, education on nutrition from the early stages of development is crucial for obesity prevention and control. Therefore, new preventative methods are needed to further engage and educate individuals and communities about health-conscious diets. Microgreen cultivation utilizes a reduced cost, low-footprint, recyclable, weather-independent, and transportable method to provide less nutrition-privileged communities with exposure to healthy foods within one week. A pilot microgreens outreach event, held at a medical school, tested for feasibility, and assessed for potential complications from utilizing microgreen cultivation as a teaching tool. Ninety-four first- and second-year medical students elected to participate in the pilot event and received a microgreen growing kit and a pre-and post-planting survey. Upon survey completion, nutrition attitudes and awareness levels were tracked. Analysis of survey results reveals that participants met this low-cost and easy teaching tool with enthusiasm, high levels of engagement, and minimal complications.

\textbf{INTRODUCTION}

Obesity is a chronic, common, and costly disease with increasing global prevalence. Factors contributing to obesity include genetic, behavioral, environmental, nutritional, and socio-economic inequities. Treatment and prevention of obesity is multifaceted and complex.\textsuperscript{1} In the United States, the prevalence of obesity has increased from 30.5% to 42.4% from 1999-2000 through 2017-2018, respectively. According to the CDC, the number of states where at least 35% of residents are obese has nearly doubled from 2018.\textsuperscript{2} This increase coincides with increased levels of fat, added sugars, high fructose corn syrup, and calorically dense foods, as significant contributing factors in the obesity epidemic.\textsuperscript{3} These changes in eating behaviors and lack of nutritional education are major contributing factors to the development of obesity.\textsuperscript{4} By 2030, it is projected that 78% of American adults will be overweight or obese, placing an enormous strain on our healthcare system.\textsuperscript{5,6} Currently, the obesity epidemic costs $190.2 billion per year in the US.\textsuperscript{7,8}

In addition to behavioral and nutritional factors, combined data from 2018-2020 also showed the crucial influence of racial and ethnic disparities in the prevalence of obesity in the United States. The disparities between populations in the obesity epidemic are heavily influenced by the presence of food deserts.\textsuperscript{9} Food deserts are predominantly low-income areas where a substantial number of residents do not have easy and affordable access to fresh produce. Food deserts lack suppliers of fresh foods such as meats, fruits, and vegetables and instead provide alternatives that are high in sugar and fats.\textsuperscript{10} These areas are mainly marketed to and inhabited by low-income and predominantly African American and Hispanic communities.\textsuperscript{11} These factors contribute towards higher obesity rates and widening disparities in these communities.\textsuperscript{12}

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With the rates of obesity and the need for accessible healthy food options increasing, it is crucial to develop novel methods to help communities increase awareness of healthy and affordable foods to facilitate better life-long eating habits. Previous studies have shown that interventions in early developmental stages facilitate better outcomes than later in childhood or adolescence where the burden of disease is larger. Recent publications support the “school-garden” program approach to educating youth about healthy diet habits. Due to budgetary, urbanized location, and seasonal weather constraints, year-round outdoor gardening is not feasible in many parts of the US. Therefore, we aim to educate young adults and students about healthy eating habits by employing microgreens as an engaging experiential teaching tool. Microgreens are the fastest-growing edible superfood available and are hardy enough to be grown by anyone indoors in under eight days. Recent studies highlight sunflower microgreens’ high nutritional value, antioxidant, anti-diabetic, and anti-cholinergic activity.

We hypothesize that creating a low-cost microgreen grow-kit for participants to take home and share with their families will increase appreciation and awareness of how fresh food grows. To test our hypothesis, we held a pilot event for first and second-year medical students to obtain feedback and learn how to improve the outreach event for community members.

**METHODS**

**Development of Microgreens Program**

Previously, community-based research studies have shown that planting vegetables in a neighborhood garden can be used as a tool to educate communities about food insecurity and even improve dietary intake. However, no comprehensive program has been developed as an outreach tool to help educate participants about healthy eating habits, food deserts, and nutritional awareness in a cost-effective and engaging manner. Drexel University College of Medicine supported the development of a program for participants to grow microgreen sunflowers at home over a week and track their attitudes and nutritional awareness using a pre- and post-planting survey. We hypothesized that creating a low-cost microgreen grow-kit for participants to take home and share with their families will increase appreciation and awareness of how fresh food grows. To test our hypothesis, we held a pilot event for first and second-year medical students to obtain feedback and learn how to improve the outreach event for community members.

**Survey Development**

A survey was conducted before and 8-9 days after the microgreens planting experience as a pre- and post-survey, respectively. The survey was scheduled to be completed after the participant’s home-grown microgreens were harvested. Supplementary Figure S1 presents the complete list of the questions asked in the pre- and post-surveys. The overall goal of the survey was to determine the impact of planting and growing microgreens at home on the participant’s awareness of healthy eating habits and nutritional awareness. First- and second-year medical students were invited to participate voluntarily in our pilot program and thus our survey dataset is composed of a self-selected cohort. No previous gardening experience or nutritional background was required to participate in this pilot study.

**Microgreens Event Planting Method**

We aimed to develop a simple yet robust growing kit containing hardy microgreen seeds that could quickly be fabricated for participants during outreach events. After participants completed their pre-survey using a QR code we provided, 2-3 participants were brought to the event tables. Then, participants were provided a 28-ounce black plastic tray and a clear plastic lid purchased from Amazon. Participants could elect to have the program leaders help them with the planting process or follow instructions themselves. The planting process involved adding Moisture Control Potting Soil Mix (Miracle-Gro from Home Depot) to the black plastic container until the inverted plastic lid could contact the soil to promote seedling root growth. Next, a second 28-ounce plastic container was filled with sunflower seeds (Sunflower Sprouting and microgreen Mix - Todd’s Seeds) until an equal confluence of seeds covered the bottom of the tray which predicted the coverage required for microgreens growth. The seeds were then submerged in 850 ml of water and shaken for 30 seconds to ensure adequate submersion in the water. Seeds were not pre-soaked due to recent studies correlating prolonged seed soaking with mold development and slower growth. Next, the water/seed mixture was added to the 28-ounce container and distributed evenly across the soil by hand. Students could then seal their grow kits by applying the plastic lid to prevent spillage during transport. Participants were instructed to invert the plastic lid to prevent spillage during transport.
tic lid and place it on the soil-seed-water interface once they arrived home. Additionally, participants were instructed to apply a 5-10lb weight in the form of a book, stone, or heavy household item to apply pressure on the lid to promote rootlet orientation in the soil as described previously. A take-home instruction PDF was emailed to all participants to aid them on their home-grows (See Supplemental Figure S2), and participants were also encouraged to reach out to our social media or email contacts if they had questions or encountered problems. Once the heavy household item was removed from the covered microgreen kit, participants were encouraged to keep the soil damp with light watering using tap water as needed. Due to the various rates of temperature, humidity, evaporation, heat exposure, and light exposure that each participant’s home had we could not provide explicit watering instructions for this phase. However, this anticipated issue was the rationale for using the Moisture control potting soil mix during the planting event which ensured the amount of moisture the sunflower microgreens grow kit was adequate for most of the growing period.

**Cost Per Participant**

The planting event was designed to be significantly less expensive than kits currently available. The total cost of the event serving 94 participants and 10 event leaders totaled $134.54. Thus, each complete microgreens kit cost $1.29 and provided participants with 2-3 servings of microgreens to enjoy at home.

**Statistical Analysis**

Survey data was collected using Google Forms, processed in Microsoft Excel, and analyzed and graphed using GraphPad Prism 8. An unweighted, unpaired, parametric t-test was used to compare the pre- and post-planting survey responses and statistically significant results are denoted with *P<0.05. The sample size obtained in the post-survey response compared to the pre-survey response yielded a margin of error of 8.5% for a confidence level of 95%.

**RESULTS**

Assessing the effects of growing microgreens on individuals’ perceptions of nutrition and healthy eating was conducted through analysis of pre- and post-surveys following a pilot event. This event took place at the Drexel University College of Medicine in Philadelphia. Participants were medical students in their first or second year of school and ranged in age from 21 to 30 years. Over 53% of the students who were contacted volunteered to participate in the surveys.

Demographic data about participants gathered from pre- and post-planting event surveys showed a female majority. Both gender ratio and average age were similar between pre- and post-planting surveys (Figure 1A-C). Analysis of survey data showed statistically significant improvements in the selected Likert Scale survey question (Figure 1D) indicating that participants increased their awareness of freezing fresh greens as a method to improve the shelf-life of vegetables. A full list of analyzed pre- and post-planting survey questions tracking awareness and attitudes of participants are presented in Supplemental Figure S1. Cost analysis indicate our microgreen kits are at least 8-fold less expensive than other available microgreens kits for sale on Amazon (Figure 1E).

A diagram of the microgreens planting process developed illustrates how the method reduces cost, waste, and is transferable to a participant’s home safely (Figure 2A). At the microgreens event, participants were provided with a lidded plastic tray, potting soil mix, sunflower seeds, and microgreens mix. Additionally, participants could elect to have program leaders assist them on the planting protocol described in detail above. Following the event, participants were given instructions on how to grow the microgreens at home and encouraged to contact program leaders with questions and progress images. Photos submitted through social media represent participant engagement and positive outcomes from the growing experience (Figure 2B). Participants incorporated their home-grown microgreens in various ways in their diets. Microgreens were harvested, washed, and integrated into meals such as tacos, open-faced sandwiches, and salads.

Many of the post-planting survey respondents positively rated their experience and requested similar events in the future (Figure 3). The predominant complaint or issue participants reported was the appearance of mold on their microgreens. Participants emphasized that growing and consuming the microgreens provided a fast, cost-effective, and healthy addition to their diets.

**DISCUSSION**

Medical students participated in the first outreach event to pilot-test the microgreens kit method. Data was collected using pre- and post-surveys. Here, we were able to successfully employ a novel method to utilize microgreens as a teaching tool and address any complications that arose. Analysis of data collected from the surveys provided insight into partic-
Figure 1: Demographics, Survey Question Examples, and Cost Analysis.

A. Gender ratio of participants.
B. Gender ratio of post-planting survey respondents.
C. Age distribution of pre- and post-planting survey respondents.
D. Example question from pre- and post-planting survey with statistical analysis.
E. Total cost of microgreens Growing Kit from various sources online compared to the event.

Likert Scale value for the survey question utilized the following answer options:
1 = Strongly Disagree, 2 = Disagree, 3 = Neither disagree nor agree, 4 = Agree, 5 = Strongly Agree.
Statistical analysis was completed with Student’s T-test, *P<0.05.
Figure 2: Diagram of Growth and Photos from Participants

A. Overview of the planting and growing process.

B. Collage of submitted photos from participants over the week of growing.

Figure 3: Testimonials from Post-Planting Survey

"Super easy! Would love to try different greens!"

"They grew SO fast! almost look like they are out-growing their container!"

"This event was excellent, I'd like you to do the same type of event so I can get some more micro-greens!"

"Ended up sprouting mold. I did not feel comfortable eating them at this point as the mold was pretty bad."

"Picking [seed husks] takes a very long time but they were soooo yummy and I literally felt so healthy and energized eating them"

"I'd love to get education about preventing mold (while at the event)"
Participants’ nutritional awareness as well as highlighted the ease of use of microgreens as a teaching tool. Additionally, we analyzed participant demographics and microgreens kit cost-effectiveness. This data showed no significant differences between pre- and post-planting survey demographics. Data collected on the self-reported gender of participants showed that there were significantly more female participants than males. Cost analysis revealed our microgreen growing kit was significantly less than any available on online or the cost of purchasing all the components to grow microgreens by oneself. Within the post-planting survey, there was a section to provide written feedback, and many students reported positive experiences. The main negative experience reported in a subset of participants was the presence of mold on the microgreen seeds. In many cases, the mold was reported to occur on day two of the growing process. This is unlikely as mold may be detected on days 4-8 if the soil is overwatered but rarely seen earlier. We believe that many of the reported cases of mold were participants mistaking the root hairs of the sprouting sunflower as mold. See Supplemental Figure S2 for an example of root hairs compared to actual mold. To prevent confusion, we will emphasize the difference between these two more clearly during future events. This important feedback coupled with the data collected from both surveys will help us optimize microgreens growing kits as teaching tools for nutritional awareness in local communities. In addition, we will conduct similar pre- and post-surveys to hopefully show significant increases in awareness toward fresh vegetables.

Since this pilot event derived participants from first- and second-year medical students, we found that participant survey responses reflected an initial high level of nutritional and health awareness. Importantly, this pilot event with medical students provides future doctors with a novel experience to draw upon while speaking with patients about healthy eating. The healthcare community needs new methods to connect the risks associated with an unhealthy diet and long-term effects on health outcomes.27 Previous garden-based interventions have demonstrated significant improvements in health outcomes in older children and adults.28 Therefore, we believe we can translate the success of garden-based interventions into an accessible and low-cost experience by teaching participants to grow microgreens at home. In particular, sunflower microgreens have exceptional nutritional value with macronutrients known to promote anti-oxidant, anti-diabetic, and anti-cholesteric activity.19,22 By observing the growth progress, participants are reminded of the power of fresh produce and rewarded by the feeling of growing one’s own food.

It is difficult to influence diet and nutritional habits without overcoming the barrier to equitable health due to living in a food desert.12 For example, doctors may recommend vegetables and other healthy foods, but if patients live in food deserts, they often face insurmountable barriers to access such foods.29 A long-term goal to improve patients’ diet-awareness could be for physicians to host once-monthly meetings of patients and their multigenerational families to learn more about how to grow food at home and prepare meals that implement healthy cooking. These community events aimed at preventing obesity could be important tools to help turn the tide of the obesity epidemic in the US.30 Over time, educating communities could begin to demand solutions from their elected leaders for farmers’ markets, more fresh produce offered by corner stores, and government support through the Supplemental Nutrition Assistance Program (SNAP) to incentivize purchasing fresh vegetables over high-calorie foodstuffs.31

Low-income minority neighborhoods have disproportionately increased rates of obesity across the US in predominantly urban settings. According to World Population Review, approximately 42% of Philadelphia’s population is Black or African American.32 Furthermore, in Philadelphia, roughly 71% of African Americans are either overweight or obese. This could be due to a lack of access to healthy foods, the need to travel further to obtain such food options, or an overrepresentation among those below the poverty line.33 In addition, African Americans are four times more likely than whites to live in a neighborhood that lacks a full-service supermarket. Instead, small chain grocery stores exist and rarely provide shoppers with consistent access to fresh produce. This finding serves as a potential explanation for why African Americans are 1.5 times more likely than their white counterparts to be obese.34

It is important to consider the full spectrum of factors influencing food choices within racial and ethnic minority communities. Culture and food traditions have created a sense of familiarity and identity. For example, African Americans associate “soul food” with cultural pride.22 As highlighted in the recent book Black Food Matters, it is vital to consider access, privilege, equity, and justice when designing community education tools discussing healthy eating practices.36
Our next phase of outreach will target students between ten to seventeen years old from low-income zip codes in Philadelphia who may not have the privilege of growing edible plants previously. The goal of our outreach will be to increase awareness of healthy eating and prevent young adults from developing maladaptive eating habits.37

**CONCLUSION**

The obesity epidemic increasingly impacts millions of people, disproportionately affects low-income communities, and strains our healthcare system. More than ever, it is crucial to find new methods to combat this deadly disease. One way is to increase nutritional awareness and change eating behaviors. Previously, utilizing community gardens has been shown to make a positive impact, however, widespread use of these gardens is unrealistic for three reasons: 1) the time, cost, and space requirements are a major hindrance for low-income districts 2) the process of planting, growing, tending, and harvesting traditional vegetables is seasonal and takes months 3) outdoor temperatures during the school year are not amenable for a community garden. Microgreens outreach events offer a novel method to engage with underserved communities in a fun, easy, and low-cost manner as exemplified during our pilot event on a medical school campus. We hope to continue to innovate methods to further reduce the cost per participant. We aim to apply this method to local communities as an interactive educational tool to prevent obesity and educate participants about health-conscious eating.

**LIMITATIONS**

Although participant feedback was largely positive, mold was reported within the feedback of some participants. However, in many cases, participants most likely confused root hairs as the seeds began to sprout for mold. Further care should be taken to demonstrate the difference between mold and rootlet spouting. Future questions within surveys should determine levels of awareness about food deserts and the barriers for community members to access affordable fresh food. In addition, future studies should analyze correlations between participant demographics and responses to survey questions. Cooking methods were not discussed during the event due to time limitations. In the future, a longer discussion should be implemented to educate participants about the nutritive potential of microgreens. Lastly, the plastic growing containers could be returned, cleaned, and reused to reduce waste.

**REFERENCES**


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Supplemental Figure S1: Participant pre- and post-planting survey responses are listed above. Statistical analysis was completed with Student’s T-test, with significant differences denotes with *P<0.05.
Supplemental Figure S2: Take home instructions detailing the steps for microgreens growth.

**DUCOM MICROGREENS CHEAT SHEET:**

**Day 1-2** – Keep soil moist by sprinkling tap water over seeds to help germination. Make sure to have weight on top of the inverted lid to keep roots growing in the correct direction, and store the microgreens in a dark closet

(20 min video if you want to be a microgreens pro ®)

**Day 2-3** – Roots are now secured into the soil, add a little more water if the soil feels dry (lots of factors influence water needs), remove the lid/weight, and place next to a window or under a lamp

**Day 4-5** – Sprouts should start to become green and extend. Add water to keep soil moist, but not too much to avoid mold growth

(If you get mold at this point, all is not lost. You can mist a 1:3 dilution of Hydrogen peroxide over the microgreens to remove it – and then water less often to avoid a recurrence)

**Day 6-7** – Microgreens are almost ready for harvest, they should be an even height and most will still have the seed husks on

**Day 6/7/8** – Once ready to harvest, lightly spray the tops of the husks with water and then remove the husks by hand/brushing the husks off. If you elect to eat your microgreens, please wash them well before consumption.

Please DM our Instagram @ducomicrogreens if you have any questions at any time and Happy Growing!