An exploratory randomized controlled trial evaluating text prompts in Lebanon to encourage health-seeking behavior for hypertension

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Abstract

Aims of the study. The current study evaluates the effectiveness of an opportunistic mobile screening on the percentage of people who are aware of whether they may be hypertensive (in an observational study) and the effectiveness of reminder prompts on the percentage of people who seek further medical attention (in a randomized controlled trial).

Methods used to conduct the study. The screening of 1227 participants (529 female) was conducted during the registration period of the 2018 Beirut International Marathon in Lebanon. Next, 266 participants whose screening indicated hypertension (64 Female) were randomly allocated to a treatment group or a control group in a 1:1 fashion. The treatment group received a reminder prompt to seek further medical attention for their potential hypertension and the control group did not. The overt nature of the text message meant that participants in the treatment group could not be blinded to their group allocation. The primary outcome is participants' self-reports of whether they sought further medical attention.

Results of the study. For the opportunistic screening, a 25% prevalence rate and a 24% awareness rate of hypertension was indicated. A McNemar analysis suggested that the screening increased participant awareness ($X^2(N=1227)=72.16$, $p<0.001$). For the randomized controlled trial, 219 participants provided follow-up data via a phone call (82% retention). A Chi-squared analysis suggested that the reminder prompt successfully encouraged more participants to seek further medical attention, 45.5% treatment group vs. 28.0% control group ($X^2(1, N=219)=7.19$, $p=0.007$, $\varphi=0.18$).

Conclusions drawn and clinical implications. Extra support in the form of a brief reminder message can increase the percentage of people who seek further medical attention after attending an opportunistic screening at a marathon event. The discussion reviews how the results align with previous research, strengths and limitations of the current study, and implications for future research and practice.

Trial registration. Clinical.Trials.gov, NCT04324723. Registered 25 March 2020 - Retrospectively registered, https://clinicaltrials.gov/ct2/show/NCT04324723.

Keywords: Hypertension, Awareness, Intention-behavior gap, Reminder prompts, Text message, Randomized controlled trial

What is already known about this subject?

Simply providing more health screenings will not increase public health if people informed of their poor health fail to take appropriate action. Many people fail to take action to improve their poor cardiovascular condition, even when they express intentions to do so. The gap between people's intentions to eat more healthfully or exercise more and their actual behavior is particularly disheartening given the wide range of disorders these behaviors affect.

What does this article contribute to the literature?

The current study contributes to an expanding literature on what 'nudge' type interventions can be used to enhance people's health-related behaviors. Specifically, the current randomized controlled trial evaluates whether reminder prompts increase the percentage of people who seek further medical attention after attending an opportunistic health screening at a sporting event.

Background

Health screenings are a widely used preventative strategy to improve public health [1]. In part due to expanded health screenings, people's awareness of their hypertensive condition has increased since 1976 in high income countries [2]. Mobile health screenings are an important part of this expansion [3]. Even when mobile screenings are not operated by trained health professionals, they may still decrease health inequalities when they help people understand how to access appropriate care after learning about their poor health [4,5]. Mobile screenings can be successfully marketed to increase attendance by making such screenings more convenient. For example, a positioning screening at a sporting event is one way to make screenings more convenient and can increase awareness of poor health conditions [6,7,8]. At the 2014 Beirut International Marathon it was found that almost one third of runners were not aware that they had elevated blood pressure and the mobile screening made them aware [9].

Behavioral techniques, sometimes referred to as nudges, can be used to increase people's attendance at scheduled health screenings, e.g. by sending letters or text messages with tailored messages [10,11]. Yet, simply increasing people's awareness of their health and access to care cannot increase public health if people informed of their poor health fail to take appropriate action [12,13]. Particularly relevant to the current study, many people fail to take action to improve their poor cardiovascular condition [14,15], even when they express intentions to do so [16,17]. The gap between people's intentions to eat more healthfully or exercise more and their actual behavior is particularly concerning given the wide range of disorders these behaviors affect [18,19]. Indeed, similar to how nudges have been used to help people attend scheduled screenings, the current trial tests if nudges could also be used to help people take action after learning about their poor health condition [20,21,22].

The current study addresses two aims across two phases. In Phase 1, we aimed to evaluate whether an opportunistic mobile health screening increased people's awareness of their hypertensive condition at the 2018 Beirut International Marathon. The research team hypothesized that the screening would increase awareness. In Phase 2, we aimed to evaluate one behavior change technique's, i.e. reminder prompts, ability to nudge people to seek further medical attention. The research team hypothesized that reminder prompts would increase health seeking behavior.

Methods

Phase 1 is an observational study, and Phase 2 is a randomized controlled trial. Ethical approval for the study was received from Rafic Hariri University Hospital. The study was retrospectively registered before seeking publication at Clinical.Trials.Gov (NCT04324723), and therefore the results should be interpreted in an exploratory fashion. This limitation is further addressed in the discussion section.

In Phase 1, spectators and runners attending the 2018 Beirut International Marathon were invited to take part in an opportunistic health screening from the 7th to the 11th of November 2018. The research team aimed to screen as many people as possible without a pre-calculated sample-size for Phase 2. One week before the event, all volunteers were trained how to measure blood pressure using an Omron (n.d.) 5 Series BP742N blood pressure monitor by a cardiologist (co-author SK) [23].

After giving their informed consent in writing, participants were asked to independently complete a paper survey about their health, though volunteers made themselves available to help if requested. The items in the survey were informed by common items patients respond to when registering at a general practice, i.e. date of birth, gender, weight in Kg, and height in cm. The survey also asked participants whether they were aware that they were suffering from hypertension, diabetes, or high cholesterol; whether they had a family history of hypertension; whether they knew that high blood pressure could cause health problems; and whether they knew that systolic blood pressure (SBP) measures over 140 mmHg and diastolic blood pressure (DBP) measures over 90mmHg were the diagnostic thresholds for stage II hypertension that may require treatment. This diagnostic threshold reflects guidelines in the United States [24] and extends to the diagnostic thresholds applied in Europe for grades 1, 2, and 3 hypertension [25]. Participants also answered questions about their health habits including whether they checked their blood pressure, cholesterol, and diabetes status; whether they had regular physical check-ups; and whether they used alcohol or smoked. Lastly, participants were asked if they were happy for the research team to contact them about their results via WhatsApp Messenger. Those that said yes were asked to provide their mobile phone number and first name.

After completing the survey, participants were asked to sit calmly for five minutes before trained volunteers measured their SBP, DBP, and heart rate. Volunteers informed participants of their measurements. If the measurements were over the aforementioned

diagnostic thresholds for stage II hypertension, participants were advised to seek further medical attention to manage their health.

In Phase 2, participants eligible for the randomized controlled trial were those whose measurements indicated possible stage II hypertension who consented to receive further contact and who gave the research team a valid Lebanese mobile phone number. A statistician (AS) randomly allocated these participants into either a control or treatment group in a 1:1 fashion using Stata version 15. Participants were not explicitly told which group they were allocated to, but the overt nature of the text message rendered participants in the treatment group aware of the intervention. Participants allocated to the control group did not receive any reminder prompts. Participants allocated to the treatment group received one reminder prompt, a WhatsApp message, 25 days following the marathon. While 14 days would have better aligned with a rule of thumb to increase response rates in mailed survey studies [26], the choice of 25 days was made based on our research team members' experiences working with people in Lebanon where longer delays may be preferred. The message included each participant's first name, blood pressure measurements, and a statement directing them to seek medical attention for their elevated blood pressure. The message translated from Arabic to English appears below.

"Dear [First name],

Your BP reading during Beirut Marathon was [reading].

This indicates that you have elevated blood pressure.

You should seek medical attention at your earliest convenience.

Your wellbeing matters to us.

Nudge Lebanon team"

One month after the WhatsApp message was disseminated, a researcher contacted participants via a phone call to ask whether they had sought further medical attention for their potential hypertensive condition since the opportunistic screening. The one-month delay struck a balance between giving participants enough time to seek further medical attention and ensuring participants could accurately recall and report whether they did; future studies may investigate other delays. The researchers were not made aware of which group participants were allocated to before calling.

Outcome Measures

The dataset included 21 outcomes. Three outcomes were taken by the volunteer, including DBP, SBP and heart rate. Sixteen outcomes were participants' self-reported survey responses, which are stated in the above section. These items were not validated tools and our interpretations rely on the items' face validity. The item measuring participants' awareness of their hypertensive condition (before the screening) stated "Do you currently suffer from hypertension?" (Yes/No). The 20th outcome was generated using participants' indicated hypertensive condition, based on the aforementioned threshold for stage II hypertension. The 21st outcome was whether participants indicated seeking further medical attention during the follow-up phone call.

Analyses

As the study was retrospectively registered, the analyses are interpreted in an exploratory fashion. To remove the influence of errors in self-reported data (e.g. a "1975 cm" height), outliers greater than three times each variable's interquartile range and missing data were replaced using the expectation-maximization method. For Phase 1, 6 instances of age data, 5 weight, and 16 height were replaced; and for Phase 2, 3 instances of weight data and 4 height were replaced. All categorical variables were coded as binary for the analyses, e.g. gender was coded as 1 = female and 0 = not female, and hypertension was coded as 1 = yes and 0 = no.

Baseline characteristics were calculated for participants who attended the screening and for participants in the control and treatment groups. The characteristics of participants in the control and treatment groups were compared using Pearson's Chi-square tests and independent samples t-tests. Data from Phase 1 were used to assess whether the screenings changed people's awareness of their potential hypertensive condition using a McNemar's test. Data from Phase 2 were used to assess the effectiveness of the reminder prompt intervention using a Pearson's Chi-square test. All statistical analyses were performed using SPSS version 25. The statistical significance for all analyses were interpreted using a 0.05 alpha level.

<p align="center">**Results**</p>

The flow of participants through the study is presented in Figure 1. At the marathon, 1227 participants were screened. From the screened participants, 1129 (90.01%) consented to receive further communications. Of these 1129 participants, 839 participants' measurements did not indicate possible hypertension, and a further 24 did not provide a valid phone number.

The remaining 266 participants were randomly allocated to the control group ($N = 133$) or to the treatment group ($N = 133$).

The baseline characteristics of participants are provided in Table 1, first for all screened participants and then for participants in the control and treatment groups. Summaries of categorical variables are expressed as numbers and percentages, and summaries of continuous variables are expressed as means and standard deviations. The only baseline characteristic that differed between the groups was the percentage of participants who indicated having a family history of hypertension. This percentage was smaller in the control than in the treatment group, 45.79% vs 66.07% respectively, $X^2(1, N = 219) = 9.14$, $p = 0.003$. At follow-up, data were obtained from 107 (80.45%) participants in the control group and 112 (84.21%) in the treatment group; the remaining participants could not be reached by phone.

Phase 1: Screening results

The McNemar test indicated a significant change in participants' awareness of their potential hypertensive condition from before to after screening, $X^2(N = 1227) = 72.16$, $p < 0.001$. The prevalence of hypertension in the current sample was 25.18% ($N = 309$) of which only 24.27% ($N = 75$) indicated being aware of their hypertensive condition before the screening. Conversely, the prevalence of non-hypertension was 74.82% ($N = 918$), of which a smaller percentage, 8.93% ($N = 82$), perhaps mistakenly, indicated being aware of a hypertensive condition before the screening.

Phase 2: Trial results

The Chi-squared test indicated that a greater percentage of participants in the treatment group reported seeking medical attention ($N = 51$, 45.5%) than in the control group ($N = 30$, 28.0%), $X^2(1, N = 219) = 7.19$, $p = 0.007$, $\varphi = 0.18$. In absolute terms, this is a 17.5% increase. In relative terms, this is a 62.5% increase. The participants were not explicitly asked if they had experienced any harms from the intervention or trial, and no complaints were received. The results are displayed in Figure 2.

Discussion

The current study evaluates the effectiveness of an opportunistic mobile screening on the percentage of people aware of their potential hypertensive condition and the effectiveness of reminder prompts on whether people seek further medical attention. The results of Phase 1

suggest that the screening positively influenced people's awareness. The results of Phase 2 suggest that the reminder prompts positively influenced whether people sought further medical attention. Below we discuss how the results align with previous research, strengths and limitations of the current study, and implications for future research and practice.

Alignment with previous research

Regarding Phase 1, the current study found a 25% prevalence rate of indicated hypertension, which largely aligns with previous research. A 2013 systematic review found a marginally higher prevalence rate (29.5%) across Arab countries, but this review did not include any studies in Lebanon [27]. More recent studies conducted in Lebanon have found marginally higher rates. For example, in 2015 Mater et al. found a prevalence rate of 27% [28], and in 2018 Mouhtadi et al. found 29% [29], and Noubani et al. found 36% [30]. The fact that the current study found a slightly lower rate may be due to the unique nature of its sample: people who attend a marathon event. As is the case in the current study, all of these Lebanon studies' prevalence rates are based on measurements taken by trained people using calibrated equipment.

In addition to prevalence rates, the mentioned three studies in Lebanon also captured the percentage of participants aware of their hypertensive condition before being screened by asking participants if they had ever been diagnosed with a hypertensive condition in a pre-screening survey. The awareness rates found by Mater et al. (54%) and Noubani et al. (65%) are higher than the rates found by Mouhtadi et al. (26.5%) and the current study (24%). Plausibly, Mater et al. and Nouani et al.'s awareness rates are higher because their participants were all recruited from urban areas where people tend to have higher levels of education and better access to medical resources. This inference aligns with the results of Yusufali et al.'s 2017 study [31], which found higher hypertension awareness rates in urban than rural areas in four Middle Eastern countries: Iran, Palestinian, Saudi Arabia, and the United Arab Emirates.

Regarding Phase 2, the benefits found for the reminder prompts in the current study also align with previous research. For example, a 2019 study found that text reminders increased people's attendance at scheduled health screenings [11]. A 2018 systematic literature review of text reminders' effects on health related-behaviors found there to be positive effects in 86% (83/97 studies) of medical compliance studies (i.e. medication, treatment, and vaccination adherence) and in 85% (48/56) of appointment attendance studies [32]. The literature review also found evidence supporting the effectiveness of text reminders

in other health-areas, such as exercise (6 studies), substance use (1 study), and smoking cessation (1 study).

Strengths and limitations

The present study has many strengths. First, we were able to screen a large number of people for hypertension at a public event who may not have otherwise had the opportunity to take part in a screening. Second, our participant retention was high. Over 90% of participants whose measurements indicated hypertension were willing to take part in the randomized controlled trial thereafter, and we were able to contact over 80% of participants who took part in that trial to learn whether they sought further medical attention. Third, we were able to use a no-cost messaging system, WhatsApp, to deliver the same sorts of behaviorally-informed text-message interventions previously found to be effective but which typically entail some cost.

One limitation of the study is that it was not pre-registered. Prospective registration of clinical trials evaluating pharmaceutical and behavioral interventions increases research transparency and restricts selective outcome reporting [33]. We have reported the planned primary outcome, i.e. whether participants sought further medical attention, which is the most straightforward outcome relevant to the current trial's methods. However, having not pre-registered the trial entails that there is nothing in the public domain to confirm that the analyses reported include the planned primary outcome.[34] We understand that this should temper confidence in our findings and some may prefer to interpret our findings in an exploratory manner.

A second limitation of the study is that participants' blood pressure measurements were only taken once. While one measurement is insufficient for a proper diagnosis of hypertension, for the purpose of an opportunistic screening, a single measurement is an instructive signal that can trigger people to seek further medical attention where a proper diagnosis may be obtained. A third limitation of the current study is that our findings rely on the accuracy of self-reports. The fact that participants were randomly allocated into control or treatment groups in Phase 2 decreases but does not eliminate concerns about social desirability influencing their responses, i.e. both groups' responses may be inflated [35]. We also did not ask when participants sought further medical attention, before or after receiving the reminder prompt, and so cannot comment on how many participants in the treatment group sought further medical attention before receiving the reminder prompt. Lastly, note that the current study's sample is composed of a particular subset of the population, spectators

and runners at a marathon event, and the beneficial results of the reminder prompt intervention may not generalize to the larger population.

Implications for future research and practice

The implications of the present study for practice are quite clear: reminder prompts can nudge more people to take action after learning about a poor health condition at a health screening. However, when the reminder prompts should be sent and what the reminder prompts should say is debated. Other studies suggest that reminder prompts that prime positive social norms [36] or that increase people's knowledge of supportive information [37] may encourage health behavior better than text messages without such behaviorally-informed content. What the reminder prompt should say in each study could be decided after considering the specific barriers of and facilitators to the desired behavior using a diagnostic tool, like the COM-B model [38].

The COM-B model is the diagnostic center of the Behavior Change Wheel methodology [39]. To diagnose the reason(s) a target behavior is not occurring, the COM-B model asks interventionists to consider people's existing Capabilities (knowledge and ability), Opportunities (physical and social resources), and Motivations (contemplative and habitual). If people are lacking in one or more of the components, then they will be less likely to perform the desired behavior. The Behavior Change Wheel helps interventionists select behavior change techniques linked to those diagnosed reason(s) from a list of 93 empirically validated techniques, including prompts/cues [40]. The current study's Phase 1 screening results suggest that people may be unaware of their potential hypertensive condition before screening: a Capability-knowledge component of whether they seek further medical attention. The current study's Phase 2 trial results suggest that reminder prompts sent to people's mobile phones may help: an Opportunity-physical component. Future studies should undertake formative research to understand the other components the reminder prompts could address to enhance their effectiveness.

<div align="center">

Conclusions

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Opportunistic screenings conducted at public sporting events can increase people's awareness of their potential hypertensive condition. Nevertheless, increasing people's awareness may not be sufficient to trigger them to take appropriate action to improve their health. The current study's findings suggest that screenings can increase people's awareness of their potential hypertensive condition and a reminder prompt can trigger more people to seek recommended medical attention. Future research is needed to determine precisely what such reminder prompts should say.

List of Abbreviations

COM-B model - Capability-Opportunity-Motivation model

SBP - systolic blood pressure

DBP - diastolic blood pressure

Declarations

Table 1.

Baseline demographic characteristics of all participants and between participants allocated to the Control and Treatment groups.

Characteristic	Screened	Control	Treatment
Total Number	1227	133	133
Number Retained	n/a	107 (80.45%)	112 (84.21%)
1. Systolic blood pressure (M, SD)	121.43 (17.08)	138.27 (13.87)	140.60 (16.69)
2. Diastolic blood pressure (M, SD)	82.69 (10.75)	94.27 (7.76)	95.68 (8.80)
3. Heart rate (M, SD)	82.00 (14.45)	84.92 (15.85)	86.44 (13.00)
4. Gender-Female	529 (43.11%)	30 (28.04%)	34 (30.36%)
5. Age in years (M, SD)	40.76 (14.26)	42.10 (13.71)	42.13 (13.54)
6. Weight in Kg (M, SD)	74.24 (15.28)	80.22 (16.60)	80.17 (14.53)
7. Height in cm (M, SD)	170.49 (9.55)	173.69 (10.92)	171.10 (8.79)
Awareness of health condition			
8. Hypertension	157 (12.80%)	19 (17.76%)	31 (27.68%)
9. Diabetes positive	82 (6.68%)	9 (8.41%	10 (8.93%)
10. High cholesterol	176 (14.34%)	17 (15.89%)	20 (17.86%)
Hypertension			
11. Family history	608 (49.55%)	49 (45.79%)	74 (66.07%)**
12. Knowledge about consequences	1107 (90.22%)	97 (90.65%)	106 (94.64%)
13. Knowledge about thresholds	753 (61.37%)	70 (65.42%)	68 (60.71%)
Habits			
14. Monitoring Blood pressure	530 (43.19%)	56 (52.34%)	64 (57.14%)
15. Monitoring Cholesterol	582 (47.43%)	50 (46.73%)	63 (56.25%)
16. Monitoring Diabetes	603 (49.14%)	52 (48.60%)	62 (55.36%)
17. Monitoring Check-ups	759 (61.86%)	66 (61.68%)	73 (65.18%)
18. Alcohol use	542 (44.17%)	38 (35.51%)	46 (41.07%)
19. Smoking	389 (31.70%)	33 (30.84%)	44 (39.29%)
20. Indicated potential hypertension	309 (25.18%)	107 (100%)	112 (100%)

** A chi-squared test revealed that more participants in the control group indicated having a family history with hypertension than participants in the Treatment group $X^2(1, N = 219) = 9.14, p = 0.003$.

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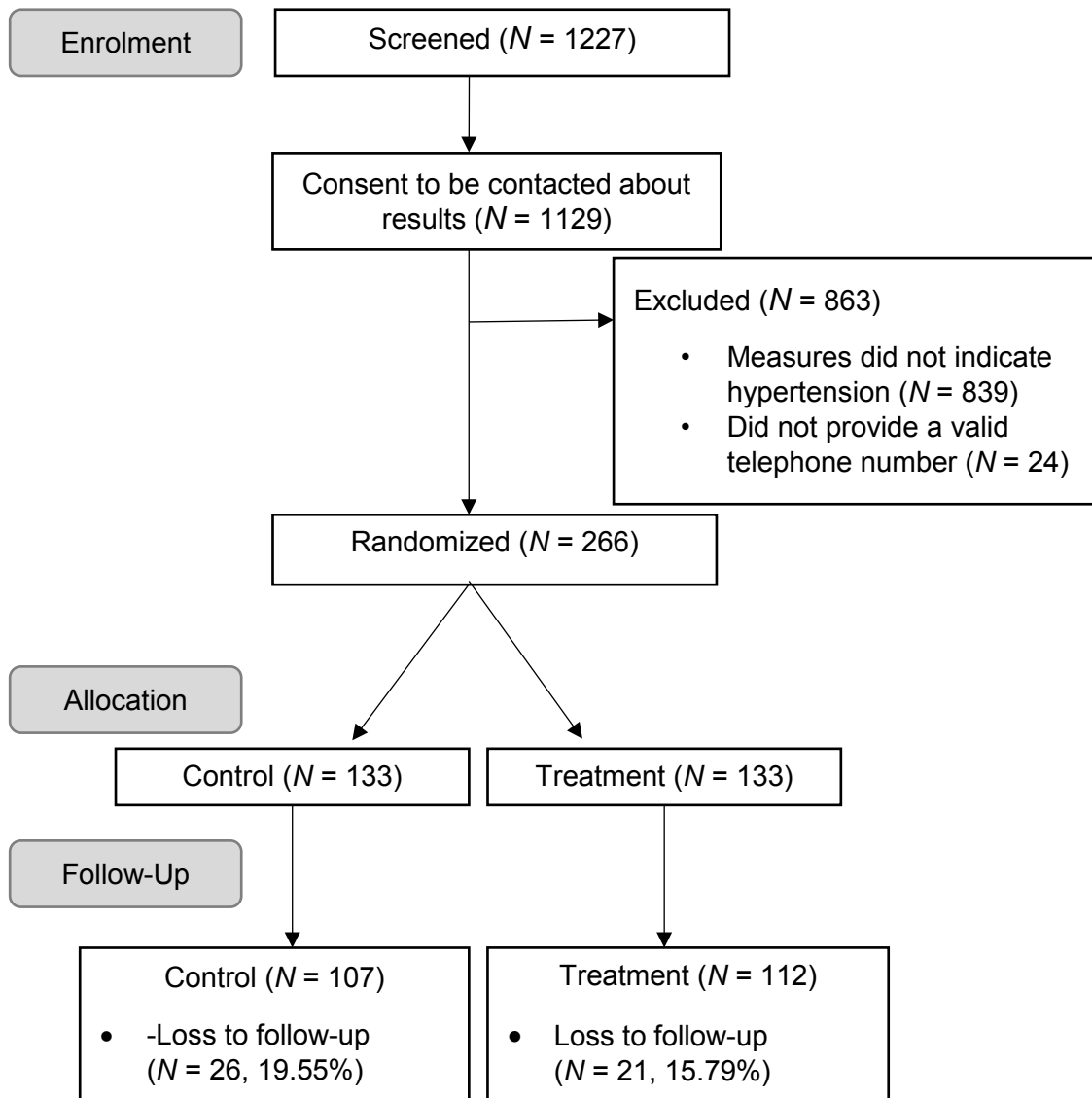
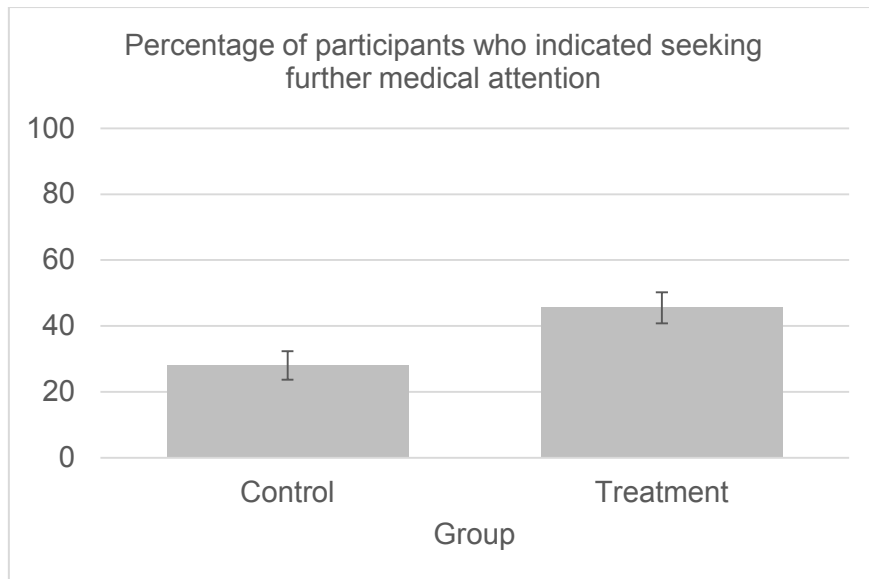*Figure 1*. Flow of participants through the study

Figure 2. Percentage of Participants who indicated seeking further medical attention