# Impact of a Smartphone-Based Health Education Intervention in Reducing the Incidence of influenza-like illnesses (ILI) During Hajj

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# Abstract

### Background

This study was aimed at demonstrating the impact of a health education intervention on reducing the incidence of influenza-like illnesses symptoms among Malaysian's Hajj pilgrims.

### Methods

This study utilizes a quasi-experimental study in the evaluation of the impact of the intervention. Participants were recruited during Hajj orientation courses organized by private Hajj companies. Participants from two separate companies were recruited into an intervention group and control group respectively. The intervention group received a Health Belief Model (HBM) based smartphone health education intervention application while the control group received a normal Hajj guide intervention smartphone application before departure to Hajj. Data on the incidence of influenza-like illnesses (ILI) were collected from participants from two Hajj companies before and after returning from Hajj. Data analysis was conducted using SPSS with descriptive analysis, and analytical tests were conducted at 5% significance level.

### Results

A total of 102 pilgrims completed the study in both intervention and control groups. The incidence of the symptoms of influenza-like illnesses (ILI) was statistically significant between the intervention and control groups ($p = 0.049$). The change in the level of knowledge and attitude among the intervention was statistically significant ($p= 0.001$, $p = 0.029$).

### Conclusion

In conclusion, the health education intervention has an impact on reducing the incidence of symptoms among Hajj pilgrims.


# Background

Annually, the Hajj pilgrimage to Makkah in Saudi Arabia attracts an estimated 10 million Muslim faithful from across the world. This pilgrimage is usually associated with a regular occurrence of influenza and influenza-like illnesses (ILI) among pilgrims. Hajj can equally pose a risk for many respiratory tract infections (RTIs) as well as the outbreaks communicable diseases [1]. A possible high rate of morbidity and mortality due to ILI are commonly associated with pilgrims during Hajj that are challenged by presence of comorbidities as well as other high-risk individuals [2]. Over 90% of pilgrims suffered from at least a specified respiratory symptom and the risk of respiratory infections due to mainly viruses increases several folds during Hajj[3]. However, more severe respiratory illnesses such as pneumonia are the major cause of hospitalization during the Hajj [4, 5].

The transmission and dissemination of respiratory viruses during the Hajj period could result in the worldwide spread, which has already been reported among the US pilgrims [6]. High occurrence of respiratory illnesses was reported among returning Malaysian Hajj pilgrims even though they practice some preventive measures [7]. Also, a study among South African pilgrims reported the occurrence of circulating influenza strains in 9.4% of their returning pilgrims [8].

The Saudi Health ministry usually undertakes the planning and design of programs to educate the pilgrims such as infection control practices (e.g., use of face mask, cough etiquette, vaccination, hand hygiene) to reduce the incidence of severe Hajj-related illness [9, 10]. All these preventive strategies must be done concurrently to decrease the influenza and ILI effectively [7]. This scheme of the seasonal layout plan is coordinated with numerous international organizations such as the European Centre for Disease Prevention and Control (ECDC), World Health Organization (WHO) and the United States Centre for Disease Control and Prevention (CDC), who issued guidelines for control of respiratory diseases during Hajj [10]. However, participating countries should ensure proper and adequate preparation of pilgrims before embarking on Hajj pilgrimage.

Smartphone and cyber-based technologies have been regarded as a suitable and feasible means to deliver intervention modules in several studies. Smartphone phone-based application delivery has been used broadly and successfully to sustain portable and widespread interventions [11]. The capacity to digitally distribute material grants multiple benefits to health care researchers and end-users alike; prominently, personalization of resources, enhanced scalability, and affordable costs. Hence it is hypothesized that a health educational module that proffers evidence-based data concerning risk factors associated with respiratory infections prevention strategies may have the added advantage of decreasing the uncertainty for other health situations with a distinct improvement in general well-being [12].

Some studies have been conducted on educational interventions on respiratory tract infection prevention among Hajj pilgrims from different countries [13-16]. However, none of the health educational intervention was based on any health behaviour theory to boost compliance with these preventive practices and increase their levels of knowledge towards respiratory tract infection, preventive attitudes and practices towards prevention strategies. Similarly, there is also low compliance with the preventive measures among Malaysian pilgrims [7, 17]. Therefore, the objective of this study is to develop and evaluate the impact of health education intervention in reducing the incidence of ILI among Hajj pilgrims from Malaysia.

# Methods

### Study design and sampling

A quasi-experimental study design was employed to assess the impact of the smartphone-based health education intervention on the reduction of the incidence of ILI. The incidence, duration of symptoms and the episodes of ILI were assessed using a validated self-administrated questionnaire [18] administered in July 2019 and September 2019 as a preintervention survey and a postintervention survey respectively.

Out of the eight Hajj and Umrah companies approached for enrollment in the study, only two companies agreed to participate in the study. Therefore, one company was purposively selected for implementing the intervention and the other one was selected as control group. The Hajj companies selected for intervention and control are located in two separate states of Kelantan and Kuala Lumpur respectively. A sample size of 60 participants per group would achieve a significant difference in studied outcome between intervention and control group using a two-sided test with $\alpha = 0.05$ and power = 0.8. Participants who met the inclusion and exclusion criteria from the Hajj companies were enrolled for the study (Fig. 1). The intervention phase was guided by the Transparent Reporting of Evaluations with Non-randomized Designs (TREND) statement.

### Study participants and location

The study participants are pilgrims who attended the Hajj orientation course organized by private Hajj companies in Kelantan state Malaysia during the recruitment period. Kelantan state is predominantly a Muslims state with about 96.8% of its population being Muslims and belongs to the Malay ethnic group. Pilgrims were selected to participate in the study based on pre-defined inclusion and exclusion criteria. Hajj pilgrims from Malaysia attending the Hajj orientation course, 18 years old and above, ability to read and write and willing participate were included in the study. Exclusion criteria included pilgrims participating in lesser Hajj, health-care workers and those that cannot read and write.

Pilgrims were categorized into ‘at increased risk' as those in which influenza vaccine and pneumococcal vaccine are strongly recommended i.e pilgrims aged 50 years and above and/or had pre-existing health conditions such as asthma, diabetics, lung or kidney diseases based Malaysian Clinical Practical Guidelines (19). Aside these, other pilgrims and those less than the age of 50 years were classified as ‘non-risk pilgrims'. During the enrolment stage, if participants met the selection criteria, informed consent were then taken.

### Health education intervention module

The intervention module used in this study is the smartphone application known as the Hajj health educational modules (Hajj-HEM) developed in Malay language [20]. This application was developed to guide Hajj pilgrims from Malaysia towards the prevention of ILI as well as increasing their level of knowledge, attitude and practice towards the prevention of respiratory diseases**.** The participants were notified that the application is used only for research purpose and is only available to the participants that consented to participate. The Hajj-HEM was developed through a process of consultations with a panel of experts consisting of epidemiologist, microbiologist, health educationist, computer scientist and medical statistician. The module was developed based on the theory of the health belief model (HBM). This theory has a broad spectrum of applicability in intervention studies and a guide in dealing with many health-related issues and adherence to treatment regimens. Applying the model to developing persuasive educational messages for healthy behaviour is widely supported. The module consisted of five main activities applied from the HBM [21] divided into four sections (before Hajj, during Hajj, after

Hajj and formative assessment). The HBM was utilized to enhance the pilgrims' motivation to make lifestyle changes during Hajj.

The Health education intervention application (Hajj HEM) has two major components, including (1) pages for registering the users and collecting the individual's personal health data, which is the information users wants to protect in the app; (2) pages demonstrating the overview of respiratory tract infection and prevention steps for contracting the infections. First of all, the user registers an account and key in some personal health information. Users can go to the application based on the menu options. Users can also go to the formative assessment section and use the interactive questions and answers to assess their understanding of the health education module. To overcome the challenges of lost in internet connection, the application was designed to function even without internet connection once it is installed in the smartphone.

### Module validation and pre-testing

The content validity of the Respiratory tract infection prevention Hajj health education module was assessed in collaboration with experts in respiratory diseases and public health and epidemiology; include researcher's supervisors and other lecturers in the department of microbiology, community medicine; as well as those in the area of educational studies, for proper scrutiny. Information technology (IT) experts also validated the application. In addition, the educational module was tested among 20 pilgrims who did not participate in the study for clarity of meaning, language and the flow of contents.

### Intervention group

The intervention delivery of the health education module was done in with the aid of research assistants. The intervention on respiratory tract infection prevention was delivered to the participants for a period of one to two weeks before departure to Hajj pilgrimage. The delivery of the intervention was through self-download of the newly developed application known as the "Hajj HEM" through the google play store with the help of the research assistant for the study. The delivery of the module was closely monitored and supervised by the researcher, while giving necessary feed-back to the research assistants to ensure that the module was properly downloaded. The privacy of the users were respected in line with Malaysia's Personal Data Protection Act (PDPA).

### Control group

The control group received the normal Hajj guide application (M-Hajj DSS and M-Umrah application) developed by Mohamed et al [22]. Similarly, research assistants were involved in the implementation of intervention in the control group.

### Compliance of health education module by participants

Participants were encouraged to be compliant regarding the usage of the smartphone application before, during and after Hajj. The formative assessment section was included in the module for the evaluations

of participants comprehension, learning needs and progress throughout the intervention. Formative assessments also help the researcher identify concepts that participants are struggling to understand. how participant and compliance of the app. Similarly, sections were provided regarding “Feedback from users about the content” and “Feedback from users about the app”.

### Data collection

Data collection was conducted using a validated self-administrated questionnaire administered in July 2018 and September 2019 as a preintervention survey and a postintervention survey, respectively [23]. The questionnaire consist of four sections named A, B, C and D for socio-demographic variables, knowledge, attitude and practices related to ILI respectively. Section A consists of statements relating to socio-demographic characteristics such as age, gender, race and marital status, occupational status, level of education, previous Hajj or Umrah experience in the last 5 years, vaccinations history, and presence of comorbidities and presence of RTI prior to departure to Hajj. Section B consist of items with ‘Yes’, ’No’ and ‘I don’t know’ options relating to knowledge of ILI. Section C includes questions on attitudes regarding ILI with strongly agree, agree, not sure, disagree and strongly disagree options. Section D consists of items related to practices towards ILI with ‘Always’, 'Occasional' and 'Never' options. Results of the reliability test carried out showed Cronbach’s coefficient alpha for knowledge, attitude and practice was 0.777, 0.709 and 0.729 respectively.

### Statistical analyses

The data were examined and cleaned before the final analysis to ensure all values are entered appropriately and within the correct range. The data were all initially entered in SPSS 24.0. data analyses were performed with IBM Statistical Package for Social Sciences (SPSS) version 24. All data checked for missing values. Frequency and percentage were used to summarize categorical variables such as race, occupation, educational qualification, history of previous vaccination, previous Hajj and Umrah experience, presence of comorbidities. Mean and standard deviation was used as the measures of central tendency and dispersion, to summarize continuous variables such as age. Pearson Chi-square test was done to get a baseline comparison of the groups by their socio-demographic characteristics, history of vaccination, presence of respiratory tract infection symptoms before departure and the presence of influenza-like illnesses signs and symptoms. Fisher’s Exact test was conducted for variables which equal or more than 20% of the cells had expected frequency less than five observations. Independent t-test was performed to determine the between-group differences in the total knowledge scores, attitude scores, and practice scores at baseline.

## Results

### Baseline sociodemographic characterization

Table 1 shows the baseline sociodemographic characteristics of participants. The two groups shows a similar characteristics during the recruitment. All of the comparisons between the intervention and control

groups showed no statistical difference. Baseline characterization of the participants ensured that participants were drawn from similar baseline socio-demographic characteristics or same propensity score. Assigning one participant to the intervention and another one to control is not accidental, hence comparing the two participants' outcomes is a logical strategy. This proffer the possibility that either one would participate in the intervention or control. Without this assumption, it is impossible to infer all the selection bias has been removed from the estimated treatment effect.

The response rate during the post-intervention were 83.87% and 76.92% for the intervention and control groups respectively as some participants were lost during follow up. The age of the respondents ranged from 20 to 73 years, with a mean (SD) age of 46.90 (12.78) years. Majority of the respondents are females in both intervention and control groups. Most of the respondents (76.5%) were married, while half of them (50.0%) are civil servants. In terms of the level of education, bachelor's degree and secondary holders are the majority, and they account for 36.3% each.

### Comparison of socio-demographic characteristics and the incidence of ILI between intervention and control groups

This section shows the association of the sociodemographic characteristics with the incidence of respiratory tract infection symptoms in both intervention and control groups. The result of the Chi square analysis shows no significant difference among the variables as shown in Table 2.

### Effect of intervention on the incidence of ILI among the intervention and control groups

A chi square test was conducted to determine the overall effect of health education intervention in preventing the incidence of respiratory tract infections symptoms among the intervention and control group before and after Hajj. No statistical difference ($p = 0.515$) was found at the pre intervention stage, where only 1 participant (2.0%) reported symptoms of respiratory traction infections in the control group and 2 participants (3.8%) reported the symptoms in the intervention group. However, after returning from Hajj, there was a significance difference in the occurrence of RTI symptoms where 13 participants (26.0%) in the control group and 5 participants (9.6%) in the intervention group ($p = 0.038$) as shown in Table 3.

### Effect of intervention on compliance with face mask use in reducing the incidence of ILI symptoms

The compliance of facemask usage based on the recommendation in the health education module using chi square test as shown in Table 4. Acceptable practices such as use of N95 surgical mask, use of disposal mask, disposal of mask after each use and the use of face mask in crowded area showed a statistically significant result between the intervention and control groups. Only the use of mask in crowded area among the control group showed a significant difference among all the variables analysed.

## Discussion

Currently, there is no any study done in Malaysia to evaluate the effectiveness of a smartphone application for health education module in reducing the incidence of ILI during Hajj. Therefore, this study demonstrates the impact of a smartphone application for health education intervention in the prevention of influenza-like illnesses among Malaysian Hajj pilgrims. The Hajj-HEM was developed with the main aim to be a health education intervention for Hajj pilgrims for the prevention of influenza-like illnesses during Hajj. The intervention will enhance ILI prevention knowledge related to control and prevention of infections and as a component of an effective strategy aimed at reducing ILI during Hajj and increasing KAP levels using the novel and interactive smartphone application.

Smartphone app as the medium of delivery was considered for the intervention due to the wide acceptance spanning over 75.9% adopting its usage since 2017 across all age groups in Malaysia. Similarly, access to internet covered about 24.5 million users in Malaysia with over 89.4% accessed through smartphones [27]. The remarkable proliferation and potential application of smartphones technologies in health promotion studies have unfolded modern frontiers mHealth intervention approach to advance individual healthcare commitment as well as optimized prevention and control of diseases. mHealth have been shown to be of great benefit in the impact health promotion behaviours [28, 29]. The choice of smartphone demonstrate a vital opportunity to change health behaviours worldwide, especially in emerging economies [30]. The smartphone intervention guided by the Health Belief Model (HMB) utilized in the development of the smartphone application displayed remarkable achievement in the reduction of the incidence of influenza-like illnesses as well as enhancing the levels preventive knowledge, attitude and health behaviour. The impact of the health education module was statistically significant in the intervention group compared with the control subjects from pre-test to post-test.

In this study, the incidence of respiratory illness symptoms of 9.6% and 26.0% was statistically significant ($p = 0.038$) among the pilgrims in the intervention and control groups respectively. Out of this figures, 4 and 2 pilgrims fulfil the criteria for ILI in the intervention and control groups respectively. For non-ILI symptoms, only 1 pilgrim from the intervention group and 7 pilgrims from the control group reported other non-ILI symptoms. However, 2 participants reported both ILI and non-ILI symptoms in the control group and none reported both symptoms in the intervention group. These results revealed a lower incidence rate when compared with previous studies conducted among Malaysian pilgrims. A study conducted by Hashim et al [7] reported the incidence of respiratory illness symptoms among Malaysian hajj pilgrims for the 2013 season was 93.4%, with a subset of 78.2% fulfilling the criteria for ILI. The lower acquisition of the symptoms may be due to the increase in the knowledge of the prevention of RTI which was recorded in both the intervention and control groups. However, the uptake of influenza and pneumococcal vaccines which could provide the protection against the infection. The use of other preventive measures also showed improvement during the pre and post-test across both groups. However, in this study, it was shown that respiratory symptoms started after one week of stay in the Holy land and continued after that. This is possible due to the incubation period of most generally circulating respiratory aetiological agents is within one week [31].

The symptoms of RTI during Hajj was challenging because the information was collected retrospectively from pilgrims on arrival from Hajj. Information about having a headache, experiencing fatigue or myalgia during hajj season whereby the hajj pilgrims needed to complete hajj ritual in a very close and dense environment is almost inevitable. Therefore, the definition of ILI by the CDC is not a suitable criterion for Hajj. Due to the variation in conceptualizing the definition respiratory tract symptoms among hajj pilgrims particularly in the era of pandemic influenza, the recommendation by Rashid, Shafi (32) is convenient for hajj pilgrims or any mass gathering and therefore it was adopted in this study. For the pilgrims to be considered as having an "acute respiratory infection", the aetiological agent most be identified or when the pilgrim is admitted to a health centre during Hajj. While a pilgrim with the triad of ‘cough, sore throat and subjective fever’ can be considered as having ILI. Other respiratory symptoms aside the ILI symptoms are termed as the non-ILI symptoms.

The massive crowd during the Muslim's pilgrimage is the crucial determinant towards the development of risk of respiratory symptoms. Pilgrims generally are subjected to spread or acquire respiratory infections as a based on the epidemiological pattern of the circulating pathogens. Based on the symptoms of respiratory tract infection, a pilgrim with the presence of at least one vital symptom of either fever, headache or myalgia in addition to at least one of the local symptoms was considered symptomatic for respiratory tract infection [33]. The symptoms of the infection before the intervention was not statistically significant among the intervention and control groups. The present study revealed a positive effect of the intervention on the incidence of RTI symptoms among the participants. A significant reduction in the proportion of respondents in intervention group compared to the control group is clear indication of the effectiveness of the health education module towards the reduction of the incidence of RTI symptoms.

The intervention group showed high compliance with the use of face mask. The correct and regular use of the face mask is essential in reducing the incidence of RTIs. Adherence to use in all place during the pilgrimage is also essential. This finding is supported in a systematic review by [34] which found that masks were conceivably effective at restricting respiratory virus infection by close contact with infected individuals when used by healthy individuals. Overall the general compliance was reflected in the change in practice score among the intervention group, although not significant with those of the control group.

Despite the impact of the intervention, this study has some limitations. The comparatively short period of enrolment of participants (3-4 weeks) might have possible small effects on the findings of this study [35]. The control group may have been exposed to other sources of information during the study period and this could not be controlled by the researcher. However, this study was based on participants use of self-reported information which may lead to recall and information bias. The chance of recall bias is also a factor to consider in this study because the respondents were asked to fill the questionnaires retrospectively during post intervention. Therefore, based on the experiences being described, there may be a risk of recall bias.

# Conclusions

In conclusion, the present study revealed the positive impact of a smartphone-based health intervention on the incidence of influenza and influenza-like illnesses symptoms, including the advancement in the levels of KAP among the selected Hajj companies. This module will also be important particularly with the present COVID-19 pandemic in which the module addressed the prevention practices that are applicable COVID-19 prevention guidelines.

# Abbreviations

**ILI**: Influenza-like illness

**IRT**: Item response theory

**CFA**: Confirmatory factor analysis

**KAP**: Knowledge, attitude, and practice

# Declarations

### Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

### Ethics approval and consent to participate

Ethical approvals were obtained from the Human Research Ethics Committee of Universiti Sains Malaysia [ref no: USM/JEPeM/17020146]. The trial was registered with Australian New Zealand Clinical Trials Registry (ANZCTR) with registration number ACTRN12619000217101 on the 14/02/2019. The questionnaire was designed to be anonymous, and informed written consent was obtained from every respondent. The data were kept confidential and the results would not identify the respondents personally.

### Consent for publication

Not applicable

### Competing interests

The authors declare that they have no competing interest.

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### Authors' contributions

MDG, NNN and HH designed the research, developed the questionnaire, collected the data, and performed the statistical analysis; NNN, HH, WNA, BMA and AAB participated in the design, the development of the questionnaire, and the data collection and data analysis and critically reviewed the work and this report; and NWA, ZZD, and SN participated in the design and critically reviewed the statistical analysis and the work of this report. All authors read and approved the final manuscript.

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## References

1. ECDC. Public health risks related to communicable diseases during the Hajj 2017, Saudi Arabia 30 August – 4 September 2017: European Centre for Disease Prevention and Control; 2017 [Available from: https://ecdc.europa.eu/sites/portal/files/documents/RRA-Mass-gathering-Saudi-Arabia-Hajj-10-Aug-2017.pdf.
2. Farrag MA, Hamed ME, Amer HM, Almajhdi FN. Epidemiology of respiratory viruses in Saudi Arabia: toward a complete picture. Archives of virology. 2019:1-16.
3. Benkouiten S, Charrel R, Belhouchat K, Drali T, Nougairede A, Salez N, et al. Respiratory viruses and bacteria among pilgrims during the 2013 Hajj. Emerging infectious diseases. 2014;20(11):1821.
4. Hoang VT, Gautret P. Infectious Diseases and Mass Gatherings. Current infectious disease reports. 2018;20(11):44.
5. Madani TA, Ghabrah TM, Al-Hedaithy MA, Alhazmi MA, Alazraqi TA, Albarrak AM, et al. Causes of hospitalization of pilgrims during the Hajj period of the Islamic year 1423 (2003). Annals of Saudi medicine. 2006;26(5):346-51.
6. Barasheed O, Rashid H, Alfelali M, Tashani M, Azeem M, Bokhary H, et al. Viral respiratory infections among Hajj pilgrims in 2013. Virologica Sinica. 2014;29(6):364-71.
7. Hashim S, Ayub ZN, Mohamed Z, Hasan H, Harun A, Ismail N, et al. The prevalence and preventive measures of the respiratory illness among Malaysian pilgrims in 2013 Hajj season. J Travel Med. 2016;23(2):tav019.
8. Parker S, Hoosen AA, Feldman C, Gamil A, Naidoo J, Khan S. Respiratory infections due to Streptococcus pneumoniae and the influenza virus in South Africans undertaking the Hajj. Southern

African Journal of Infectious Diseases. 2018:1-5.

9. Memish ZA. Infection control in Saudi Arabia: meeting the challenge. American journal of infection control. 2002;30(1):57-65.
10. Almutairi MM, Alsalem WS, Hassanain M, Hotez PJ. Hajj, Umrah, and the neglected tropical diseases. PLoS neglected tropical diseases. 2018;12(8):e0006539.
11. Buhi ER, Trudnak TE, Martinasek MP, Oberne AB, Fuhrmann HJ, McDermott RJ. Mobile phone-based behavioural interventions for health: A systematic review. Health Education Journal. 2013;72(5):564-83.
12. Hartin PJ, Nugent CD, McClean SI, Cleland I, Tschanz JT, Clark CJ, et al. The empowering role of mobile apps in behavior change interventions: The Gray Matters randomized controlled trial. JMIR mHealth and uHealth. 2016;4(3).
13. Turkestani A, Balahmar M, Ibrahem A, Moqbel E, Memish Z. Using health educators to improve knowledge of healthy behaviour among Hajj 1432 (2011) pilgrims. East Mediterr Health J. 2013;19(Suppl 2):S9-12.
14. Aelami M, Khajehdalouee M, Yagoubian H, Jamahdar SA, Pittet D. Implementation of an educational intervention among Iranian hajj pilgrims for the prevention of influenza-like illness. Antimicrobial Resistance and Infection Control. 2015;4(1):O48.
15. Alamri FA, Amer SA, Alhraiwil NJ. Knowledge and Practice after Health Education Program among Hajj 1438 H (2017) Pilgrims, in Saudi Arabia. Journal of Epidemiology & Health Care. 2018;1(1):7.
16. Goni MD, Hasan H, Wan-Arfah N, Naing NN, Deris ZZ, Arifin WN, et al. Health Education Intervention as an Effective Means for Prevention of Respiratory Infections among Hajj Pilgrims: A Review. Frontiers in Public Health. 2020;8:449.
17. Goni MD, Naing NN, Hasan H, Arfah NW, Arifin WN, Baaba AA. Uptake of recommended vaccines and its associated factors among Malaysian pilgrims during Hajj and Umrah 2018. Frontiers in Public Health. 2019;7:268.
18. Goni MD, Naing NN, Hasan H, Wan-Arfah N, Deris ZZ, Arifin WN, et al. A Confirmatory Factor Analysis of the knowledge, attitude and practice questionnaire towards prevention of Respiratory tract infections during Hajj and Umrah. 2020.
19. Malaysian Clinical Practical Guidelines. Academy of Medicine of Malaysia, Clinical Practice Guidelines, Adult Vaccination. In: Vaccination A, editor. Malaysia: Academy of Medicine of Malaysia; 2019.
20. Mohammed D, Habsah H, Naing N, Rafie M, Nadiah W, Arifin W, et al. Development and validation of Smartphone based Health Education Module towards the prevention of respiratory tract infection in Malaysian Hajj pilgrims. International Journal of Human and Health Sciences (IJHHS). 2019:30.
21. Orji R, Vassileva J, Mandryk R. Towards an effective health interventions design: an extension of the health belief model. Online journal of public health informatics. 2012;4(3).
22. Mohamed HH, Arshad MRHM, Rashid NA, Zainol Z, Husain W, Majid OA, et al., editors. M-Umrah: An Android-based application to help pilgrims in performing Umrah. 2013 International Conference on

Advanced Computer Science Applications and Technologies; 2013: IEEE.

23. Goni MD, Hasan H, Naing NN, Wan-Arfah N, Deris ZZ, Arifin WN, et al. Assessment of Knowledge, Attitude and Practice towards Prevention of Respiratory Tract Infections among Hajj and Umrah Pilgrims from Malaysia in 2018. International Journal of Environmental Research and Public Health. 2019;16(22):4569.
24. Yusof AMM, Rahman NA, Haque M. Knowledge, attitude, and practice toward food poisoning among food handlers and dietetic students in a public university in Malaysia. Journal of Pharmacy & Bioallied Sciences. 2018;10(4):232.
25. Shafei MN, Sulong MR, Yaacob NA, Hassan H, Mohamad WMZW, Daud A, et al. Seroprevalence of leptospirosis among town service workers in northeastern state of Malaysia. International Journal of Collaborative Research on Internal Medicine & Public Health. 2012;4(4):395.
26. Arbiol J, Orencio PM, Nomura H, Takahashi Y, Yabe M. Knowledge, attitude and practices towards leptospirosis among lakeshore communities of Calamba and Los Baños, Laguna, Philippines. Agriculture. 2016;6(2):18.
27. MCMC. Hand Phone Users Survey 2017. In: Commission MCAM, editor. mcmc.go.my: Malaysian Communications And Multimedia Commission 2017.
28. Free C, Phillips G, Galli L, Watson L, Felix L, Edwards P, et al. The effectiveness of mobile-health technology-based health behaviour change or disease management interventions for health care consumers: a systematic review. PLoS Med. 2013;10(1):e1001362.
29. Overdijkink SB, Velu AV, Rosman AN, Van Beukering MD, Kok M, Steegers-Theunissen RP. The usability and effectiveness of mobile health technology–based lifestyle and medical intervention apps supporting health care during pregnancy: systematic review. JMIR mHealth and uHealth. 2018;6(4):e109.
30. Zhao J, Freeman B, Li M. Can mobile phone apps influence people's health behavior change? An evidence review. Journal of medical Internet research. 2016;18(11):e287.
31. Lessler J, Reich NG, Brookmeyer R, Perl TM, Nelson KE, Cummings DA. Incubation periods of acute respiratory viral infections: a systematic review. The Lancet infectious diseases. 2009;9(5):291-300.
32. Rashid H, Shafi S, El Bashir H, Haworth E, Memish ZA, Ali KA, et al. Influenza and the Hajj: defining influenza-like illness clinically. International Journal of Infectious Diseases. 2008;12(1):102-3.
33. Choudhry A, Al Mudaimegh K, Turkistani A, Al Hamdan N. Hajj-associated acute respiratory infection among hajjis from Riyadh. Eastern Mediterranean Health Journal. 2006;12(3-4):300.
34. Benkouiten S, Brouqui P, Gautret P. Non-pharmaceutical interventions for the prevention of respiratory tract infections during Hajj pilgrimage. Travel medicine and infectious disease. 2014;12(5):429-42.
35. Egbewale BE. Statistical issues in randomised controlled trials: a narrative synthesis. Asian Pacific Journal of Tropical Biomedicine. 2015;5(5):354-9.

# Tables

**Table 1:** Comparison of baseline socio-demographic characteristics between intervention and control groups

| Socio-demographic factor | Intervention | Control | p value |
|---|---|---|---|
| | Frequency (%) (n = 52) | Frequency (%) (n =50) | |
| Age (years) | | | |
| Mean (SD) | 48.88 (11.75) | 44.84 (13.57) | 0.110[a] |
| Gender | | | |
| Male | 16 (30.8) | 14 (28.0) | 0.465[b] |
| Female | 36 (69.2) | 36 (72.0) | |
| Marital status | | | |
| Married | 46 (82.7) | 35 (70.0) | 0.083[c] |
| Single | 6 (11.5) | 14 (28.0) | |
| Divorced/widowed | 3 (5.8) | 1 (2.0) | |
| Occupation | | | |
| Civil servant | 24 (46.2) | 27 (54.0) | 0.692[c] |
| Self employed | 5 (9.6) | 4 (8.0) | |
| Private | 5 (9.6) | 5 (10.0) | |
| Pensioner | 13 (25.0) | 7 (14.0) | |
| Housewife | 4 (7.7) | 4 (8.0) | |
| Student | 1 (1.9) | 3 (6.0) | |
| Highest level of education | | | |
| PhD | 4 (7.7) | 0 (0) | |
| Master’s degree | 3 (5.8) | 4 (8.0) | |
| Bachelor’s degree | 16 (30.8) | 21 (42.0) | |
| Diploma | 11 (21.2) | 6 (12.0) | |
| Secondary school | 18 (34.6) | 19 (38.0) | |
| Previous Hajj experience | | | |
| Yes | 16 (30.8) | 9 (18.0) | 0.102[b] |
| No | 36 (69.2) | 41 (82.0) | |
| Previous Umrah experience | | | |

| | | | |
|---|---|---|---|
| Yes | 16 (30.8) | 11 (22.0) | |
| No | 36 (69.2) | 39 (78.0) | |
| Influenza vaccination history | | | |
| Yes | 15 (28.8) | 13 (26.0) | 0.460[b] |
| No | 37 (71.2) | 37 (74.0) | |
| Pneumococcal vaccination history | | | |
| Yes | 12 (23.1) | 13 (26.0) | 0.455[b] |
| No | 40 (76.9) | 37 (74.0) | |
| Presence of influenza-like illnesses symptoms before departure | | | |
| Yes | 2 (3.8) | 1 (2.0) | 1.000[a] |
| No | 50 (96.2) | 49 (98.0) | |
| Presence of common cold symptoms before departure | | | |
| Yes | 2 (3.8) | 1 (2.0) | 1.000[a] |
| No | 50 (96.2) | 49 (98.0) | |

[a] t-test

[b] Fisher's exact test

[c] Pearson Chi-square

**Table 2:** Comparison of sociodemographic characteristics and incidence of ILI symptoms during Hajj among the intervention and control groups

| | Intervention (n=52) | | | | Control (n=50) | | | |
|---|---|---|---|---|---|---|---|---|
| | Yes, n (%) | No, n (%) | $\chi^2$ | p value | Yes, n (%) | No, n (%) | $\chi^2$ | p value |
| Age group | | | | | | | | |
| At risk | 3 (60.0) | 22 (46.8) | 0.315 | 0.662[a] | 8 (66.7) | 15 (39.5) | 2.715 | 0.183[a] |
| Not at risk | 2 (40.0) | 25 (53.2) | | | 4 (33.3) | 23 (60.5) | | |
| Gender | | | | | | | | |
| Male | 3 (60.0) | 13 (27.7) | 2.219 | 0.163[a] | 6 (50.0) | 8 (21.1) | 3.791 | 0.071[a] |
| Female | 2 (40.0) | 34 (72.3) | | | 6 (50.0) | 30 (78.9) | | |
| Marital status | | | | | | | | |
| Married | 38 (80.9) | 5 (100) | 1.158 | 0.561[b] | 10 (83.3) | 25 (65.8) | 1.441 | 0.486[b] |
| Single | 6 (12.8) | 0 (0) | | | 2 (16.7) | 12 (31.6) | | |
| Divorced/widowed | 3 (6.4) | 0 (0) | | | 0 (0) | 1 (2.6) | | |
| Occupation | | | | | | | | |
| Civil servant | 2 (40.0) | 22 (46.8) | 2.228 | 0.817[b] | 7 (58.3) | 20 (52.6) | 1.588 | 0.903[b] |
| Self employed | 1 (20.0) | 4 (8.5) | | | 1 (8.3) | 3 (7.9) | | |
| Private | 0 (0) | 5 (10.6) | | | 1 (8.3) | 4 (10.5) | | |
| Pensioner | 2 (40.0) | 11 (23.4) | | | 2 (16.7) | 5 (13.2) | | |
| Housewife | 0 (0) | 4 (8.5) | | | 0 (0) | 4 (20.5) | | |
| Student | 0 (0) | 1 (2.1) | | | 1 (8.3) | 2 (5.3) | | |
| Highest level of education | | | | | | | | |
| PhD | 0 (0) | 4 (8.5) | 5.241 | 0.263[b] | | | 1.881 | 0.598[b] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Master's degree | 0 (0) | 3 (6.4) | | | 0 (0) | 4 (10.5) | | |
| Bachelor's degree | 1 (20.0) | 15 (31.9) | | | 6 (50.0) | 15 (39.5) | | |
| Diploma | 3 (60.0) | 8 (17.0) | | | 2 (16.7) | 4 (10.5) | | |
| Secondary school | 1 (20.0) | 17 (36.2) | | | 4 (33.3) | 15 (39.5) | | |
| Previous Hajj experience | | | | | | | | |
| Yes | 1 (20.0) | 15 (31.9) | 0.301 | 1.000[a] | 2 (16.7) | 7 (18.4) | | |
| No | 4 (80.0) | 32 (68.1) | | | 10 (83.3) | 31 (81.6) | 0.019 | 1.000[a] |
| Previous Umrah experience | | | | | | | | |
| Yes | 0 (0) | 16 (34.0) | 2.459 | 0.308[a] | 1 (8.3) | 10 (26.3) | 1.719 | 0.257[a] |
| No | 5 (100) | 31 (66.0) | | | 11 (91.7) | 28 (73.7) | | |
| Influenza vaccination history | | | | | | | | |
| Yes | 2 (40.0) | 13 (27.7) | 0.335 | 0.619[a] | 5 (41.7) | 8 (21.1) | 2.014 | 0.256[a] |
| No | 3 (60.0) | 34 (72.3) | | | 7 (58.3) | 30 (78.9) | | |
| Pneumococcal vaccination history | | | | | | | | |
| Yes | 2 (40.0) | 10 (21.3) | 0.892 | 0.325[a] | 5 (41.7) | 8 (21.1) | 0.156 | 0.256[a] |
| No | 3 (60.0) | 37 (78.7) | | | 7 (58.3) | 30 (78.9) | | |
| Chronic lung disease | | | | | | | | |
| Yes | 0 (0) | 1 (2.1) | 0.108 | 1.000 | 1 (8.3) | 0 (0) | 3.231 | 0.240[a] |
| No | 5 (100) | 46 (97.9) | | | 11 (91.7) | 38 (100) | | |
| Neuromuscular disease | | | | | | | | |
| Yes | 0 (0) | 1 (2.1) | 0.108 | 1.000[a] | 2 (16.7) | 3 (7.9) | 0.780 | 0.582[a] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No | 5 (100) | 46 (97.9) | | | 10 (83.3) | 35 (92.1) | | |
| Allergic rhinitis | | | | | | | | |
| Yes | 1 (20.0) | 4 (8.5) | 0.686 | 0.410[a] | 2 (16.7) | 0 (0) | 6.597 | 0.054[a] |
| No | 4 (80.0) | 43 (91.5) | | | 10 (83.3) | 38 (100) | | |
| Diabetes | | | | | | | | |
| Yes | 1 (20.0) | 6 (12.8) | 0.203 | 0.530[a] | 2 (16.7) | 2 (5.3) | 1.611 | 0.240[a] |
| No | 4 (80.0) | 41 (87.2) | | | 10 (83.3) | 36 (94.7) | | |
| Hypertension | | | | | | | | |
| Yes | 0 (0) | 10 (21.3) | 1.317 | 0.569[a] | 3 (25.0) | 11 (28.9) | 0.070 | 1.000[a] |
| No | 5 (100) | 37 (78.7) | | | 9 (75.0) | 27 (71.1) | | |
| Heart disease | | | | | | | | |
| Yes | 0 (0) | 1 (0) | 0.108 | 1.000[a] | - | - | - | - |
| No | 5 (100) | 46 (97.9) | | | 12 (100) | 38 (100) | | |
| Presence of influenza-like illnesses symptoms before departure | | | | | | | | |
| Yes | - | - | - | - | - | - | - | - |
| No | 5 (100) | 47 (100) | | | 12 (100) | 38 (100) | | |
| Presence of common cold symptoms before departure | | | | | | | | |
| Yes | 0 (0) | 1 (2.6) | 0.322 | 1.000[a] | 0 (0) | 1 (2.6) | 0.322 | 1.000[a] |
| No | 12 (100) | 37 (97.4) | | | 12 (100) | 37 (97.4) | | |

[a] Fisher's exact test

[b] Pearson Chi-square

**Table 3:** Comparison of ILI incidence among the intervention and control group after Hajj/Umrah

| Variables | Intervention (n=52) | Control (n=50) | p value |
|---|---|---|---|
| Presence of RTI symptoms after Hajj | | | |
| Yes | 5 (9.6) | 13 (26.0) | 0.038[a] |
| No | 47 (90.4) | 37 (74.0 | |
| Symptoms of: | | | |
| ILI | 4 (7.7) | 2 (4.0) | 0.049[b] |
| Non-ILI | 1 (1.9) | 7 (14.0) | |
| Both ILI and Non-ILI | 0 (0) | 2 (4.0) | |
| ILI occurred after how many days: | | | 0.190[b] |
| None | 47 (90.0) | 39 (78.0) | |
| 1 – 7 days | 1 (1.9) | 4 (8.0) | |
| > 1 week | 4 (7.7) | 7 (14.0) | |
| Episodes of ILI | | | 0.385[a] |
| Yes | 5 (9.6) | 8 (16.0) | |
| No | 47 (90.4) | 42 (84.0) | |
| Duration of ILI | | | |
| 1 day | 1 (1.9) | 1 (2.0) | 0.793[a] |
| 2 - 3 days | 1 (1.9) | 2 (4.0) | |
| 4 – 5 days | 1 (1.9) | 0 (0) | |
| 6 – 7 days | 1 (1.9) | 1 (2.0) | |
| > 1 week | 0 (0) | 1 (2.0) | |
| Non-ILI symptoms occurred after how many days | | | |
| <2 days | 0 (0) | (0) | 0.103[a] |
| 3 – 5 days | 1 (1.9) | 2 (4.0) | |
| 6 – 7 days | 0 (0) | 4 (8.0) | |
| > 1 week | 1 (1.9) | 3 (6.0) | |
| Duration of Non-ILI symptoms | | | |
| 1 day | | | |

| | | | |
|---|---|---|---|
| 2 - 3 days | 0 | 2 (4.0) | 0.306[a] |
| 4 – 5 days | 0 | 2 (4.0) | |
| 6 – 7 days | 1 (1.9) | 2 (4.0) | |
| > 1 week | 1 (1.9) | 1 (2.0) | |
| Admitted in hospital for RTI infection | | | |
| Yes | 0 | 0 | |
| No | 52 | 50 | |

[a] Fisher's exact test

[b] Pearson Chi-square

**Table 4:** Compliance of face mask use among the intervention and control group during Hajj

| Variables | RTI incidence | | p value |
|---|---|---|---|
| | Intervention (n=52) | Control (n=50) | |
| Use of 1 ply face mask | | | <0.001[a] |
| Always | 13 (25.0) | 1 (2.0) | |
| Occasional | 35 (67.3) | 31 (62.0) | |
| Never | 4 (7.7) | 18 (36.0) | |
| Use N95 surgical mask | | | 0.005[a] |
| Always | 11 (21.2) | 1 (2.0) | |
| Occasional | 22 (42.3) | 20 (40.0) | |
| Never | 19 (36.5) | 29 (58.0) | |
| The use of niqab | | | 0.235[a] |
| Always | 7 (13.5) | 2 (4.0) | |
| Occasional | 13 (25.0) | 15 (30.0) | |
| Never | 32 (61.5) | 33 (66.0) | |
| The use of disposable mask | | | 0.024[a] |
| Always | 18 (34.6) | 6 (12.0) | |
| Occasional | 18 (34.6) | 21 (42.0) | |
| Never | 16 (30.8) | 23 (46.0) | |
| Use of non-disposable face mask | | | 0.096[a] |
| Always | 17 (32.7) | 8 (16.0) | |
| Occasional | 17 (32.7) | 16 (32.0) | |
| Never | 18 (34.6) | 26 (52.0) | |
| Dispose mask after each use | | | 0.004[a] |
| Always | 23 (44.2) | 8 (16.0) | |
| Occasional | 5 (9.6) | 13 (26.0) | |
| Never | 24 (46.2) | 29 (58.0) | |
| Mask use in Masjid | | | 0.051[a] |
| Always | 23 (44.2) | 11 (22.0) | |

| | | | |
|---|---|---|---|
| Occasional | 19 (36.5) | 28 (56.0) | |
| Never | 10 (19.2) | 11 (22.0) | |
| Mask use when outside the hotel | | | 0.066[a] |
| Always | 19 (36.5) | 10 (20.0) | |
| Occasional | 25 (48.1) | 24 (48.0) | |
| Never | 8 (15.4) | 16 (32.0) | |
| Use of mask in crowded areas | | | 0.026[a] |
| Always | 17 (32.7) | 7 (14.0) | |
| Occasional | 15 (28.8) | 26 (52.0) | |
| Never | 20 (38.5) | 17 (34.0) | |

[a] [a]Pearson Chi-square

# Figures

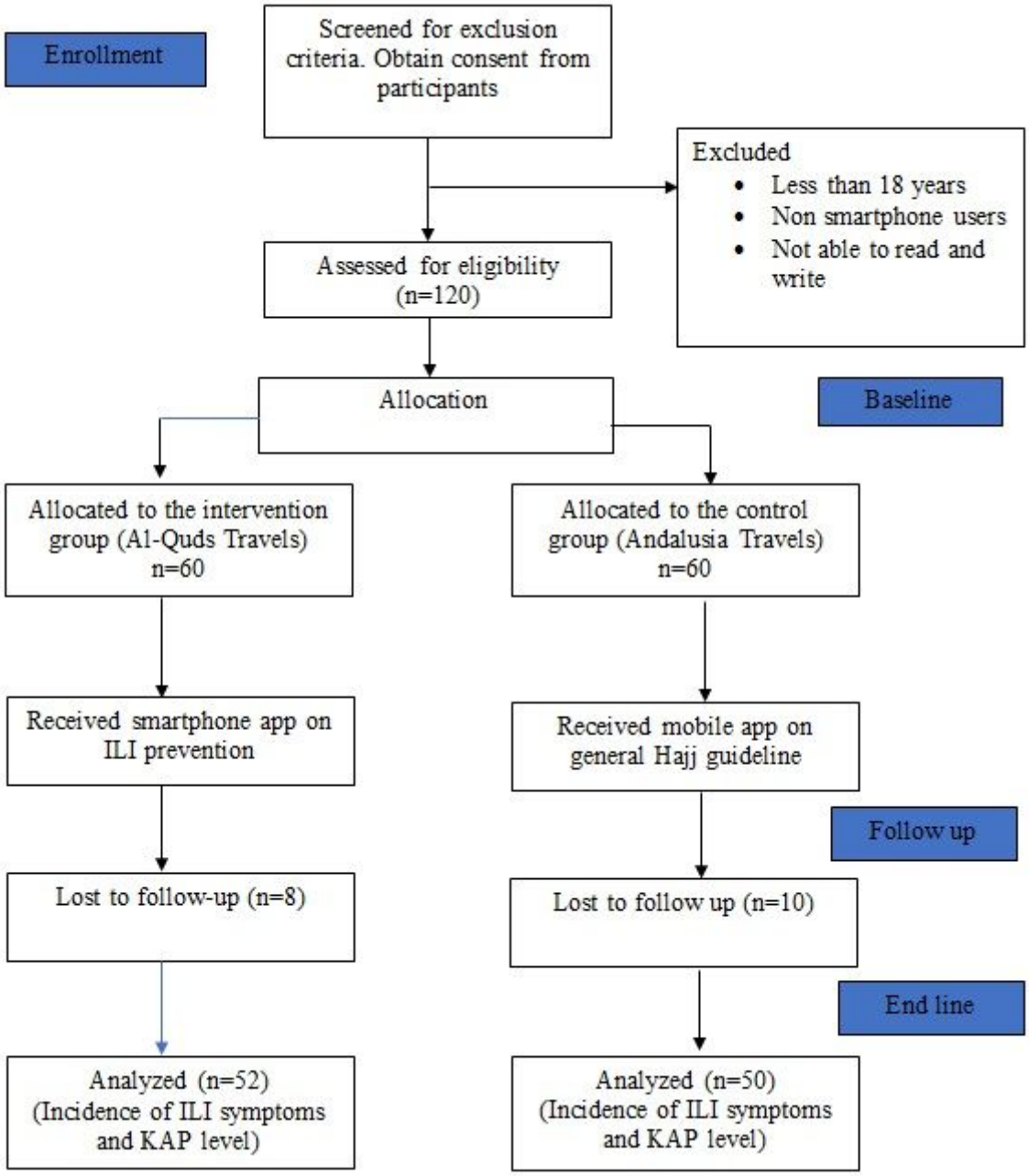


**Figure 1**

Flow diagram of the study.

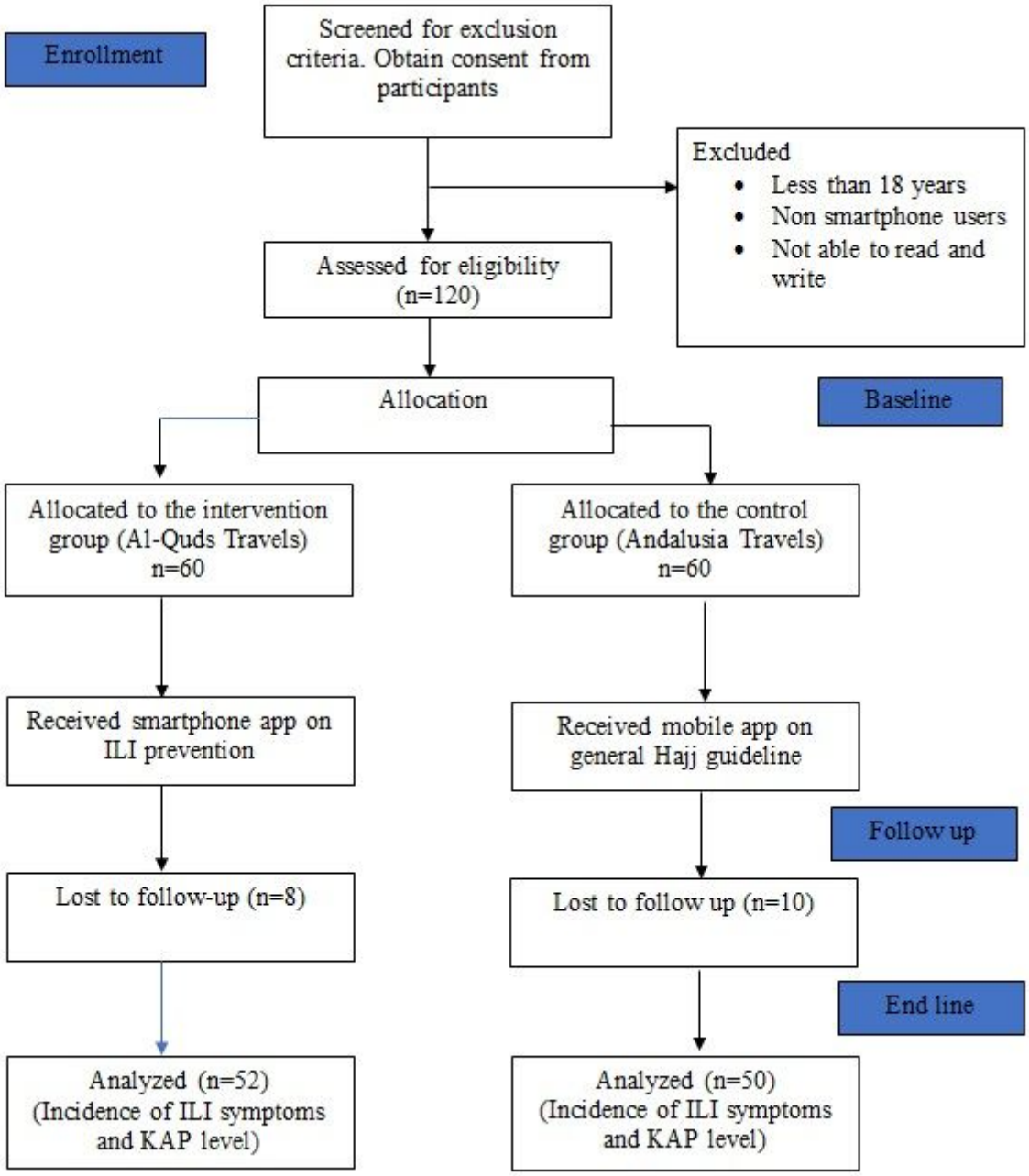


**Figure 1**

Flow diagram of the study.