Survey of airflow obstruction in two African countries: paper questionnaire versus mobile phone technology

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Abstract

The objective of this study was to determine the prevalence of airflow obstruction and associated risk factors among study participants. Data were collected and compared using a paper questionnaire and mobile phone technology. The pilot study was carried out among adult residents of two communities in Nigeria and Benin Republic. A paper questionnaire and a mobile phone containing the same information were used to interview the respondents with spirometry testing between the two interviews. Data collected were analysed using SPSS version 16. Kappa statistics was used to test the agreement between the data collected using the paper questionnaire and the mobile phone. One hundred respondents comprising of 56 males and 44 females, with a mean age of 45.4±16.8 years participated in the study. Fifteen selected variables showed varying levels of agreement ranging from slight to perfect agreement between data collected using the two methods. The respiratory symptoms identified were cough (18%), phlegm (18%), wheeze (8%), and shortness of breath (30%). Wood was the major type of fuel used for cooking by the respondents (59.0%). Only 42 spirograms passed quality control and only 2 (4.8%) showed features of airflow obstruction. The study revealed that there was an agreement between data collected using mobile phones and the traditional paper questionnaire. The prevalence of risk factors for airflow obstruction was high among the respondents. We recommend that the use of mobile phones in data collection should be promoted and employed in large-scale surveys in all developing countries of the world.

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Introduction

The use of electronic devices as a method of data collection instead of the traditional paper and pencil method has recently been on the increase.[1] There are a plethora of devices suitable for electronic data capture (EDC), ranging from a personal tablet computer, portable digital assistant (PDA), net book, and more recently mobile phones.[2] A major advantage of these methods is that data become readily available after collection in the field, and evaluation of the study status, review, and analysis of data can be done in real-time; it has been found to be an inexpensive and easy means of collecting information.[3]

For decades, clinical research studies have been conducted by collecting data with paper questionnaires, which are subsequently entered into a database to create electronic records.[4] Although well established, this method is time-consuming and errors are frequent, storage costs are prohibitive, and the costs of double data entry are high. Methods of EDC have been developed in order to merge the process of data collection and data entry.[4] Compared with the traditional process that relies on paper forms with subsequent transcription to a computer system, electronic devices are used to collect data in a digital format at the point of survey. This allows for fast and automated data aggregation. There are numerous devices suitable for EDC. Handheld devices such as PDAs, and recently mobile phones, are increasingly being used instead of paper and pencil methods of data collection,[4,5] improving the efficiency and effectiveness of data collection in resource-poor environments.[5]

Sixty-four per cent of mobile phones are being used in the developing world where there are more mobile than fixed lines. According to the International Telecommunications Union, the continent of Africa has about 280 million telephone subscribers, of which some 260 million (over 85%) are mobile cellular subscribers. This means that in Africa, mobile users account for 83–85% of telephone subscribers, a higher proportion than any other region in the world.[6] In South Africa for example, there are approximately 36.4 mobile phones per 100 population,[7] even in remote rural areas.[8]

The use of mobile technology as a research instrument is in its infancy in developing countries, and only a few studies have investigated the use of mobile phones as a data collection tool,[9] compared with some more developed countries where studies have investigated mobile phones as a data collection tool for research and also as a means of improving outcomes in patient management.[10–14] A demonstration project in Peru showed that a cell phone-based system could be used to collect real-time data on adverse events occurring during the course of a randomised trial.[15]

In a study to compare the completeness of data collection using paper forms versus electronic forms loaded on handheld computers conducted within the American Academy of Family Physicians National Research Network, the researchers concluded that handheld computers produced more complete data than the paper method for the returned forms, and the amount of missing data could be significantly reduced by using tablet computers or cell phones linked via a wireless network directly to a website.[2]

The aim of this study was to assess the agreement between data collected using paper questionnaire and mobile phone technology and also to determine the prevalence of airflow obstruction and associated risk factors among the study participants in the two African cities.

Materials and methods

Study sites

This population-based cross-sectional study was carried out simultaneously in August 2012 in Edaiken Community, Uselu, Benin City, Nigeria and Agongo village in Kpodji municipality, about 25 km from Cotonou, Republic of Benin.

Ethical approval for the study was obtained from the Ethics and Research Committee of the University of Benin Teaching Hospital, Benin City, Nigeria and Comité d'Ethique de la Recharche CER-ISBA, Benin Republic. Verbal informed consent was also obtained from the community leaders of the respective communities and from the study participants

Study participants

These comprised adults aged 18 years and above who consented to participate in the study. Pregnant women and those with contraindications to spirometry (recent or current pneumothorax, hemoptysis, recent abdominal or eye surgery, unstable cardiovascular status, e.g. aneurysm, recent heart attack, raised blood pressure above 180/100 mmHg, pulse rate above 100 beats per minute) were excluded from the study.

Data collection and quality control

A selected section of the BOLD questionnaire that applies to our study was used by trained investigators to obtain the following information from the respondents: socio-demographic data, respiratory symptoms, and risk factors for airway obstruction. The questionnaire was prepared in the paper form and the same information was coded in a mobile phone using episurveyor software designed by DataDyne. The study participants were interviewed using the paper questionnaire and the same questionnaire administered using a mobile phone. Spirometry was carried out in-between completion of the two questionnaires; however, the order of administration of either the paper questionnaire or the mobile phone was randomly assigned. In preparing for spirometry, the environment was monitored and ambient conditions were within accepted ranges. Forced expiratory volume in 1 minute (FEV1) and forced vital capacity (FVC) were measured using the Alpha Vitalograph spirometer with serial numbers AL 015582 and 60201 for the Nigerian and Benin Republic sites respectively. A minimum of three and a maximum of eight acceptable and repeatable forced expiratory manoeuvres were done seated and upright according to ATS/ERS 2005 and SANS 451 criteria. Airflow obstruction was defined by FEV1/FVC <70%. Post bronchodilator (using salbutamol inhalation) spirometry was done for those with airflow obstruction. All test results were emailed to a specialist in spirometry for quality assurance review.

Statistical analysis

Data analysis was carried out using SPSS version 16 statistical software. An initial one-way analysis was conducted to assess the distribution for each variable. Continuous variables were summarised using means and standard deviations for normally distributed variables and median for non-normally distributed variables. Kappa statistics was used to test the agreement between the data collected using the paper questionnaire and the mobile phone. The level of agreement based on the value of the Kappa statistics was graded as follows:[16]

- <0, less than chance agreement;
- 0.01–0.20, slight agreement;
- 0.21–0.40, fair agreement;
- 0.41–0.60, moderate agreement;
- 0.61–0.80, substantial agreement;
- 0.81–0.99, almost perfect agreement;
- 1.0, perfect agreement.

A p-value of less than 0.05 was considered statistically significant.

Results

One hundred respondents (50 in Benin City, Nigeria and 50 in Agongo, Benin Republic) participated in the study. Table 1 shows the socio-demographic characteristics of the respondents. Their mean age was 45.4±16.8 years with a higher proportion 26 (26.0%) of them in the age group 31–40 years. Only 7% of them were aged more than 70 years. More than half of the respondents (56.0%) were males with a normal body weight (BMI of 18–25) The respondents who were overweight constituted 44%. Overall, the majority of respondents had some form of formal education, with a higher proportion 35 (35.0%) having secondary education. Twenty-three percent of the respondents had no formal education.

The level of agreement between the data collected using paper questionnaire and mobile phones is shown in table 2. The 15 selected variables showed varying levels

Variables	Frequency	Percent
Age group in years (Mean 45.4±16.8 years)		
20–30	18	18.0
31–40	26	26.0
41–50	16	15.0
51–60	19	19.0
60–70	14	14.0
>70	7	7.0
Sex		
Female	44	44.0
Male	56	56.0
Body mass index		
18–25	56	56.0
>25	44	44.0
Educational status		
None	23	23.0
Primary	31	31.0
Secondary	35	35.0
Tertiary	11	11.0

Table 1 Socio-demographic characteristics of respondents

Variables	Kappa	p-value	Interpretation (agreement)
Socio-demographics			
Gender	1.000	0.0001*	Perfect
Height	1.000	0.0001*	Perfect
Weight	0.960	0.0001*	Almost perfect
Body mass index	0.960	0.001*	Almost perfect
Symptoms			
Cough	0.503	0.0001*	Moderate
Wheezing	0.157	0.220	Slight
Phlegm	0.278	0.026*	Fair
Shortness of breath	0.560	0.001*	Moderate
Covariates			
Smoking	0.740	0.0001*	Substantial
Dusty job	0.120	0.068	Slight
Use of drugs to improve breathing	0.261	0.005*	Fair
Co-morbidities			
Heart disease	0.658	0.0001*	Substantial
Hypertension	0.540	0.0001*	Moderate
Stroke	0.020	0.888	Slight
Diabetes	1.000	0.001*	Perfect
*Statistically significant			

Table 2: Kappa analysis of agreement between data collected using paper questionnaire and mobile phone

of agreement. Three variables (gender, height and diabetes) showed a perfect agreement, two variables each (BMI (body mass index) and smoking and heart disease) showed almost perfect agreement and substantial agreement respectively. Three variables (cough, shortness of breath, and hypertension) showed moderate agreement, two variables (phlegm and use of drugs to improve breathing) showed fair agreement while a slight agreement was shown by three variables (wheezing, dusty job, and stroke). The agreement in 12 (86.7%) variables was statistically significant. The agreement in the three variables that showed slight agreement was not statistically significant (p = 0.220, 0.068 and 0.888 respectively).

Variables	Frequency	Percent
Respiratory symptoms		
Cough	18	18.0
Phlegm	18	18.0
Wheeze	8	8.0
Shortness of breath	30	30.0
Covariates		
Smoking (Median duration 15 years)	10	10.0
Dusty job (Median duration 5 years)	33	33.0
Indoor smoke (Median duration 20 years)	71	71.0
Fuel type		
Wood	59	59.0
Charcoal	39	39.0
Kerosene stove	33	33.0
Gas	6	6.0

Table 3 Respiratory symptoms and factors that may contribute to airflow obstruction among the respondents

The assessment of the presence of respiratory symptoms and factors that may contribute to airflow obstruction among the respondents revealed that 18% had cough, 18% had phlegm, 8% had wheeze while 30% had shortness of breath (see Table 3). The majority (71.0%) of the respondents have been exposed to indoor smoke (median duration of 20 years), one third of them (33.0%) had also worked in a dusty environment (median duration of 5 years) while only 10% of the respondent had ever smoked tobacco (median duration of 15 years). Wood was the major type of fuel used for cooking by the respondents (59.0%). This was followed by charcoal (39.0%) and kerosene stove (33.0%) while only 6.0% used gas for cooking.

Out of the 100 spirograms in this study, only 42 passed quality control and among these, only 2 (4.8%) showed features of airflow obstruction.

Discussion

The level of agreement displayed by the data collected using the mobile phone and the paper questionnaire in this study was encouraging. All the variables reviewed showed some form of agreement. This was consistent with the findings of a study carried out to evaluate the feasibility of collecting repeated measures of Physical Activity Level (PAL) through a Java-based questionnaire downloaded onto cell phones compared to the traditional paper questionnaires.[17] It was not surprising that variables like gender and height showed perfect agreement because they are unlikely to change among the study participants irrespective of the method used in collecting the data. This also validated the results of agreement obtained for other variables because the agreements of variables ranging from fair agreement to perfect agreement were statistically significant while only the variables which showed slight agreement were not statistically significant. However, a limitation in this study was the fact that it was not possible to ascertain the source of the differences for the variables which showed a weaker agreement, whether it came from the information given by the study participants during the interview or the entry of the information by the interviewers.

The relative ease with which the data were collected using the mobile phones in this study gave credence to the fact that this technology can be adopted for large-scale studies. This was consistent with the finding of a household survey in South Africa.[5] Also, the mobile phone data were uploaded into the DataDyne database immediately after collection and this made it possible for the data in both study sites to be viewed and compared in real time, as has also been shown in a study in Peru.[15] This further demonstrates the fact that mobile phone technology can be used effectively to collect data in large-scale, multi-centre studies like the burden of obstructive lung disease (BOLD) studies in the West African sub-region.

The age distribution of the respondents in this study, in which only 7% were aged above 70 years, was typical of developing countries. The finding of a higher proportion of the study participants with normal body weight could be as a result of the location of the study sites. The Nigerian community was a sub-urban community while in Benin Republic the community was a rural one and so it was unlikely for the residents of these communities to adopt more affluent lifestyles, such as eating from fast food restaurants, that will predispose them to either overweight or in extreme cases obesity.

This study revealed a low prevalence of respiratory symptoms of cough, wheeze and phlegm among the study participants. Only the prevalence of shortness of breath was as high as 30%. This is in contrast with previous studies which have reported that prolonged exposure to wood smoke predisposes to respiratory tract infections.[18-20] This result was, however, surprising because of the high prevalence of factors that could predispose to respiratory symptoms in the study sites. For example, it was observed that the majority of the respondents had been exposed to indoor smoke with a median duration of 20 years and wood, charcoal and kerosene stove were the predominant fuel used for cooking by the respondents. Also, one third of the respondents had worked in a dusty environment (median duration of 5 years). Therefore, the low prevalence of respiratory symptoms could either be as a result of the small sample size of this study or the fact that the majority of the particulate matter inhaled by the respondents are probably inhalable and not respirable particulate matter. This could also be the reason why only 4.7% of the respondents in this study had features of airflow obstruction in spirometry, although, a limitation of this study is the fact that only 42% of the spirograms obtained passed quality control.

In conclusion, this pilot study revealed that there was an agreement between data collected using mobile phones and data collected from the traditional paper questionnaire. The prevalence of risk factors for airflow obstruction such as exposure to indoor smoke and dusty jobs were high among the respondents. However, the prevalence of airflow obstruction was low among the study participants. We recommend that the use of mobile phones in data collection should be promoted and employed in large-scale surveys in Nigeria, Benin Republic and other developing countries of the world.

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