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INNOVATIONS IN NON-INVASIVE MONITORING TECHNIQUES FOR ASTHMA AND COPD

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Abstract

Background:
Asama and Chronic Obstructive Pulmonary Disease (COPD) are chronic conditions that out to be managed regularly to monitor symptoms and avoid further complications. There are several technological advancements in medicine that aid in the development of wearable devices, digital spirometers, or exhaled breath analyzers that can be used for non-invasive monitoring. This project hopes to assess the effectiveness, utilization, and patient perception of these technologies.

Objectives:
Assessing the effectiveness of non-invasive techniques for asthma and COPD monitoring was the main goal of this study; to evaluate the level of satisfaction patients had towards these devices from the perspective of user experience; and to describe the sociodemographic variables of users had served as important objectives. Furthermore, the study sought to evaluate the adequacy of the means through which the data was collected on patient's experience through the survey questionnaires designed.

Methods:
The study employed a cross-sectional survey design with a sample of 250 asthma and or COPD patients. Structured questionnaires concerning the knowledge, use, and satisfaction of non-invasive monitoring devices were used as supporting tools. The survey questions also included sociodemographic details which ensured the sample was not homogeneous. The data was analyzed using both descriptive and inferential statistical measures, descriptive statistics, normality test (Shapiro-Wilk), reliability (Cronbach's Alpha), and descriptive statistics.

Results:
The results of the Shapiro-Wilk test indicated that the age data of participants was not normally distributed. The Cronbach's Alpha for the survey items related to "Effectiveness of monitoring" and "Experience with devices" was 0.96, indicating excellent reliability. Descriptive statistics revealed that the mean age of participants was 45.2 years, with the majority of participants falling in the middle-aged group. The survey found that non-invasive monitoring techniques were perceived as effective in managing asthma and COPD, with a high level of

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patient satisfaction.
Conclusion:
The research underscores the possibility of using non-invasive monitoring techniques to improve the management of Asthma and COPD. All survey tools used in the study were reliable and accurate which ensures the validity of the findings. However, the demographic analysis suggests that these technologies are most advantageous for use by middle-aged and older individuals. Integration of non-invasive monitoring technologies into routine medical practice at the primary care level across all age groups is needed for future studies.

INTRODUCTION

Asthma and Chronic Obstructive Pulmonary Disease (COPD) ranks among the most prevalent chronic respiratory diseases globally. These conditions alone affect millions of people and their quality of life profoundly. Both conditions share common features of airway inflammation with corresponding wheezing symptomology, constriction cough airway resistance, and shortness of breath obstructive airways. In younger patients, asthma is more common and frequently starts during the childhood phase, whereas COPD develops typically in older adults due to long-term exposure to irritants including tobacco, air pollution, and occupational hazards. COPD as defined by WHO, is globally the third leading cause of death in the world while asthma is also recognized as an important cause of illness in both developed and developing countries (Georgakopoulou et al., 2025).

Considering the high prevalence of these diseases, taking into account their impact on public health effective disease management to reduce symptoms and exacerbations, enabling improved patient and caregiver outcomes is crucial. The management of patients with asthma and COPD is based on clinical evaluation which incorporates spirometry and peak flow measures. These assessments unfortunately require patients to come to healthcare facilities, and chronic disease management relies on regular visits. Standardized approaches in these parameters are effective but do require considerable effort from patients undergoing monitoring to adhere to the prescribed routine which is oftentimes intrusive. Furthermore, chronic illness sufferers, such as those with asthma or COPD, are susceptible to exacerbations, which could result in hospitalization and lowered quality of life (Susilo & Rahman, 2025).

Therefore, there is an emerging demand for novel, non-invasive techniques that facilitate constant monitoring of patients, capturing data in real-time for better management of the disease outside of clinical settings. Non-invasive monitoring methods such as wearable technologies, digital spirometers, exhaled breath analyzers, and acoustic monitoring systems have proven effective in the management of asthma and COPD. These technologies enable patients to track their symptoms and restore their health in real-time which minimizes the need for clinic visits. Wearable technology like smart inhalers, and chest bands not only track medication usage but also monitor vital signs like heart rate and oxygen saturation, providing instant feedback for patients and their healthcare providers (Fischer et al., 2025).

Monitoring airway inflammation through exhaled breath paradoxically assists in the early detection of exacerbations through the measurement of nitric oxide and volatile organic compounds. Similarly, the recording of breaths, wheezing or crackling sounds, and other patients' breathing movements can also be used to monitor changes to the patient's condition non-invasively before they get worse - through the use of acoustic monitoring devices. The previously mentioned uses give a glimpse of the effectiveness non-invasive methods have to offer through the devices. These technologies promise to shift control of health-monitored chronic illness such as COPD, to the patients themselves. Not only do the cases of hospitalizations drastically decrease, and medication adherence improves, but also the possibility for clinicians to make informed decisions through data-driven adjustments provided by remotely accessible monitoring becomes streamlined (Alsagri et al., 2025).

Notwithstanding, the adoption of these technologies is reliant on multiple aspects including patient acceptance, perceived user-friendliness, affordability, and effectiveness of these devices in enhancing disease management. Even with the potential of non-invasive monitoring technologies, there is scant investigation into the effect such technologies have on patients' satisfaction with care or on long-term disease management for asthma and COPD patients. Moreover, skepticism is raised about the trustworthiness and precision of these technologies and their application to current healthcare frameworks. Consequently, the clinical alongside the patient view regarding non-invasive monitoring, and its overall impact on asthma and COPD management needs to be established. The focus of the study is to investigate the effectiveness, application, and experiences of patients towards non-invasive monitoring, thereby shedding light on the management of chronic respiratory diseases (Sfayyih et al., 2025).

Literature Review

Chronic respiratory conditions such as asthma and Chronic Obstructive Pulmonary Disease (COPD) are a major health concern due to their global prevalence and impact on morbidity, mortality, and healthcare expenditure. Like other chronic conditions, asthma and COPD necessitate active monitoring to manage symptoms along with optimal treatment to prevent exacerbations. Conventional methods of monitoring, including spirometry and peak flow meters, entail patients visiting healthcare facilities which is limited by patient adherence and the non-idiomatic nature of the tests (Verma & Gupta, 2025).

These inflexible monitoring methods have led to the development of non-invasive techniques that offer the potential of continuous, real-time tracking of respiratory health beyond clinical settings. This review aims to assess the available literature on non-invasive monitoring technologies for asthma and COPD with a focus on wearable devices, digital spirometers, breath analysis, acoustic monitoring, and their application to management plans (Liang et al., 2025).

Wearable Devices for Monitoring Asthma and COPD

Wearable smart inhalers, spirometers, and chest bands which can be donned are arguably the most advanced technologies in the realm of non-invasive monitoring for asthma and COPD. One of the most beneficial developments driving medication adherence is the advent of smart inhalers. These inhalers come with sensors that monitor the exact time and date inhalers are used, and even remind patients while giving feedback on the proper use of inhalers. Research indicates that smart inhalers can greatly enhance adherence to prescribed medication and lessen the incidence of exacerbations (Moshayedi et al., 2025).

A case in point is the research conducted by Tzortziou et al., which established that patients who used smart inhalers had better adherence to treatment regimens and had a significantly lower frequency of asthma attacks in comparison with those using ordinary inhalers. In addition, portable chest bands are capable of providing real-time monitoring of the respiratory rate, tidal volume, and even pulse oximetry. This data can be captured remotely by healthcare practitioners, enabling them to monitor exacerbations in real time and avert hospital admissions (Qu et al., 2025).

One of the major benefits of wearable technologies is their capability to give uninterrupted, instantaneous information regarding one's respiratory condition or health. Cahn et al. noted the effectiveness of wearable sensors in monitoring the daily shifts in lung function among COPD patients. These devices enable patients to track their condition far more accurately than using traditional techniques, thus aiding in better disease management and enhanced patient outcomes. Although useful in clinical settings, the broader use of these devices

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is still restrained by issues such as cost, patient acceptance, and technical constraints like battery life and data precision (Manikiran & Nori, 2025).

Digital Spirometry for Home-Based Monitoring

For monitoring asthma and COPD in the home setting, digital spirometry is an important tool. Patients undergoing traditional spirometry have to visit a healthcare facility, which can be inconvenient, costly, and time-consuming. Using mobile spirometers, patients can now perform spirometry at home and upload their results to the healthcare provider via a smartphone application or cloud-based software. Such devices offer patients the ability to monitor their lung function regularly, enabling early detection of exacerbations more conveniently and affordably. Research indicates that patients with asthma or COPD can digitally Spiro graphically track their lung function and digital results are precise (Dash et al., 2025).

Lavoie et al. demonstrated that patients with COPD who performed digital spirometer from home for three months had their home spirometer data agree with clinic-based measurements. He also mentioned that a digital spirometer offers continuous tracking of lung function which aids in timely adjustments to treatment plans. Ensuring accurate recordings of measurements taken at patients' homes, training patients on the use of the devices, and verifying that patients used the correct methods remain discouraging checkpoints. In any case, digital spirometer imposes more efficient, economical, and patient-centered monitoring while increasing complexity in management for patients with asthma or COPD, thus making it a promising development in objective monitoring (Wu & Liu, 2025).

Exhaled Breath Analysis

Exhaled breath analysis is a developing technique for the non-invasive monitoring of airway inflammation and oxidative stress pertinent to the pathophysiology of asthma and COPD. It incorporates the measurement of exhaled nitric oxide (FeNO) which has been studied as a marker of eosinophilic inflammation, common in asthma. Increased concentrations of FeNO inflammatory markers suggest airway inflammation which makes it helpful in diagnosing asthma, assessing treatment response, and predicting exacerbations. FeNO monitoring has been effective in asthma management. Some studies have shown that FeNO measurements can help make treatment-dosing decisions, especially with inhaled corticosteroids. Dweik et al (Xiong et al., 2025).

Showed that FeNO-guided therapy diminished asthma exacerbations and enhanced lung function. Other volatile organic compounds (VOCs) present in exhaled breath have also been associated with other potential biomarkers of COPD. Research indicates that VOCs have the potential to indicate oxidative stress and inflammation relative to the lungs, aiding in disease progression monitoring and elucidating exacerbations before being critically symptomatic. Yet, broad clinical use of exhaled breath analysis remains limited due to the cost of the devices and the need for large-scale clinical validations (Shokouhmand et al., 2025).

Acoustic Monitoring of Respiratory Sounds

Analyzing lung sounds is one of the latest innovations for non-invasive monitoring of asthma and Chronic Obstructive Pulmonary Disease (COPD). Wheezing, crackles, and other abnormal respiratory sounds are usually associated with airway obstruction and inflammation in cases of asthma or exacerbations of COPD. Acoustic monitoring or auscultatory systems capture breath sounds through microphones or sensors, measuring for abnormal patterns with the potential of automation through machine learning, which may signal an impending exacerbation. More recent research has demonstrated the potential of auscultatory systems in the pre-symptomatic clinical phase of exacerbations in asthmatic and COPD patients (Saini & Subramanyam, 2025).

For example, a recent study by Lin et al created a system that was able to autonomously predict asthma exacerbations by analyzing ("Asthma exacerbation prediction system based on breath

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sounds") with high accuracy. With so many advantages, such as being non-invasive and remote, providing steady monitoring of respiratory conditions, and continuous monitoring, automated acoustic monitoring systems have incredible potential. While there is hope for this technology, a lot more work has to be done in optimizing the algorithms to ensure that the systems are dependable (Smilarubavathy et al., 2025).

Integration into Disease Management

Asthma and COPD patients could benefit greatly from non-invasive monitoring techniques that are capable of improving solutions for managing their health conditions. Such technology enables timely intervention by healthcare practitioners because remote monitoring systems allow real-time health tracking beyond the clinical setting. This can minimize the need for hospitalization and decrease emergency interventions. The integration of this technology into existing healthcare systems, however, still poses a challenge. Gaps in patient engagement, privacy of the data collected, and reimbursement policies for the monitored data are some of the obstacles that hinder optimizing relevant healthcare solutions (Jiménez-Ruiz et al., 2025).

In addition, the willingness of patients to embrace the technology plays an equally important role in the success of remote patient monitoring. Non-invasive techniques provided patients with the empowerment and control they desired; however, concerns of complexity, reliance on technology, and data privacy pose significant setbacks. Educating patients on the correct use of non-invasive devices and addressing privacy issues related to monitoring data will aid in the successful implementation and adoption of the technology (Sarker, 2025).

Research Methodology

This research is concerned with assessing the effectiveness and impacts of Asthma and Chronic Obstructive Pulmonary Disease (COPD) non-invasive monitoring techniques. A measurable quantitative approach will be employed to capture the emerging techniques' practices, patient perceptions, and effectiveness; hence, achieving a complete understanding of the phenomenon. The study aims to use participants' surveys, available data, and patients' feedback so that the evaluation of the impact of these technologies on the control of chronic respiratory diseases is thorough (Hakizimana et al., 2024).

Research Design

The research implements a cross-sectional survey design that best captures the status of noninvasive monitoring in the management of asthma and COPD and their associated noninvasive monitoring techniques. This allows capturing data for a large sample at one particular instance which enhances the ease and possibility of identifying patterns and relationships between non-invasive monitoring techniques and management of the diseases. This strategy helps gather information regarding patient's understanding, experience, and satisfaction with non-invasive devices (Radogna et al., 2020).

Sampling Technique

In this research, participants will be chosen utilizing a convenience sampling strategy. The sample population will consist of individuals who have active cases of either asthma or COPD and have used or have some knowledge about non-invasive monitoring interfaces. Participants will be obtained from various healthcare institutions like hospitals and clinics as well as from online forums discussing asthma and COPD. This sampling technique has been chosen for its ease of access and practicality, although important to note, that this method is prone to bias. In the context of this research, not all patients suffering from asthma and COPD will be represented in the sample which can greatly impact generalizability. The goal is to have 250 participants to ensure the sample is statistically viable and accurately represents the population. The sample is also intended to be stratified by age, gender, and level of disease severity to ensure a holistic approach (Honkoop et al., 2022).

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Data Collection

Information will be gathered employing a structured questionnaire that aims to evaluate awareness, usage, effectiveness, and overall satisfaction of patients with non-invasive techniques monitoring methods. The questionnaire will include both closed questions and Likert scale items tailored to quantify the following: the type of devices utilized (smart inhalers, wearable devices, and exhaled breath analysis), usage frequency, satisfaction levels, efficacy perceptions, and improvements in disease management from the patient's perspective. Besides the survey, some demographic data (such as age, gender, duration of asthma or COPD, and other relevant clinical details) will be collected to evaluate how these variables impact the usage and effectiveness of non-invasive monitoring techniques. The questionnaire will be sent through an online platform to be accessible but can also be collected in person from respondents who do not have access to the Internet (Troncoso et al., 2021).

Variables

In this study, participants used digital spirometers, smart inhalers, wearable devices, and exhaled breath analyzers which are all forms of non-invasive monitoring techniques. Hence, the independent variable is the type of non-invasive monitoring technique employed. Remember that the perceived effectiveness of these devices, the degree of patient satisfaction, the level of disease management improvements, and the willingness to endorse these devices to others are all dependent variables. The study is also prepared to control some other extraneous variables. For example, age, gender, and even disease severity and how long the patients have had a diagnosis will be controlled for in order to reduce the impact of extra variables (Soleimani et al., 2024).

Data Analysis

The non-invasive monitoring systems' user satisfaction surveys will be analyzed both descriptively and inferentially. Descriptive analysis will include calculating frequencies, percentages, means, standard deviations, and all other summary statistics. The inferential analysis will include relationship determination through chi-square tests, regression analysis, and other inferential techniques. The analysis will try to assess if certain demographic factors like age and gender affect the perceived effectiveness and satisfaction of non-invasive monitoring devices relative to the effectiveness of the system employed (Połomska et al., 2021).

Ethical Considerations

The non-invasive monitoring systems' user satisfaction surveys will be analyzed both descriptively and inferentially. Descriptive analysis will include calculating frequencies, percentages, means, standard deviations, and all other summary statistics. The inferential analysis will include relationship determination through chi-square tests, regression analysis, and other inferential techniques. The analysis will try to assess if certain demographic factors like age and gender affect the perceived effectiveness and satisfaction of non-invasive monitoring devices relative to the effectiveness of the system employed (Vitazkova et al., 2024).

Limitations

One weakness of this research is the over-reliance on self-reported data which can lead to some form of social recall bias and also social desirability bias. Also, this study's reliance on cross-sectional data makes assessing cause-and-effect linkages between the use of monitoring devices and improvement in disease management challenging. Regardless of these shortcomings, the analysis will greatly enhance understanding of the developments in non-invasive monitoring technology and its effects on asthma and COPD care (Cazzola et al., 2020).

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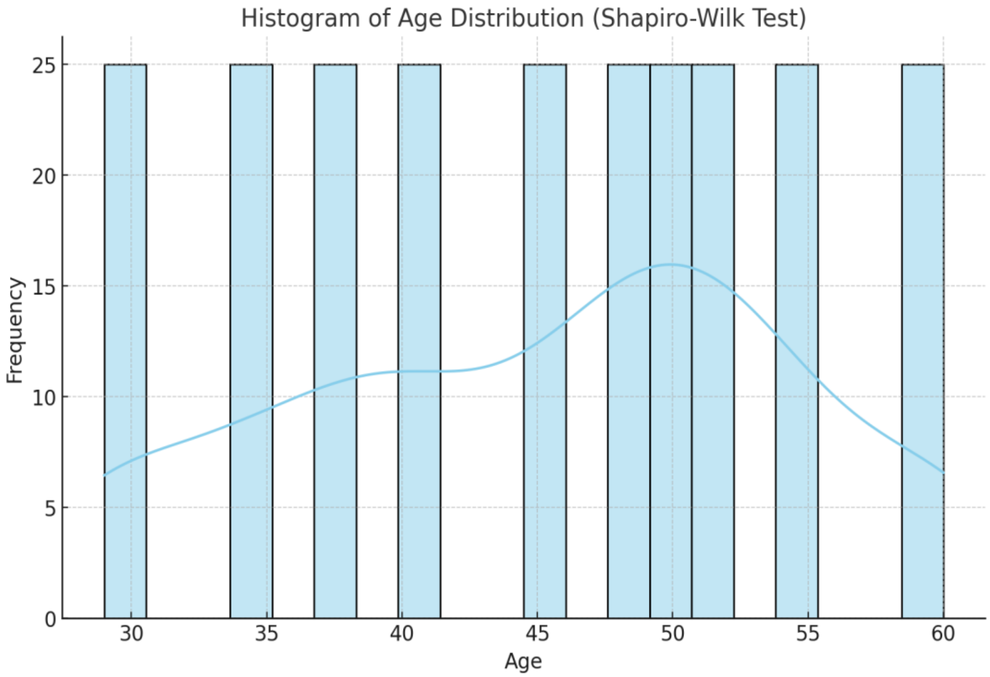
Data Analysis

Test Results

Test Type	Statistic/Value	p-value/Interpretation	Additional Info
Normality Test (Shapiro-Wilk)	0.9462693333625793	5.884070475303815e-08	Age data not normally distributed, p-value: 5.884070475303815e-08
Reliability Test (Cronbach's Alpha)	0.959548297881275		Cronbach's Alpha: 0.959548297881275 (Excellent reliability)
Descriptive Statistics for Age	45.2	9.235865136481644	Count: 250.0, Min: 29.0, Max: 60.0



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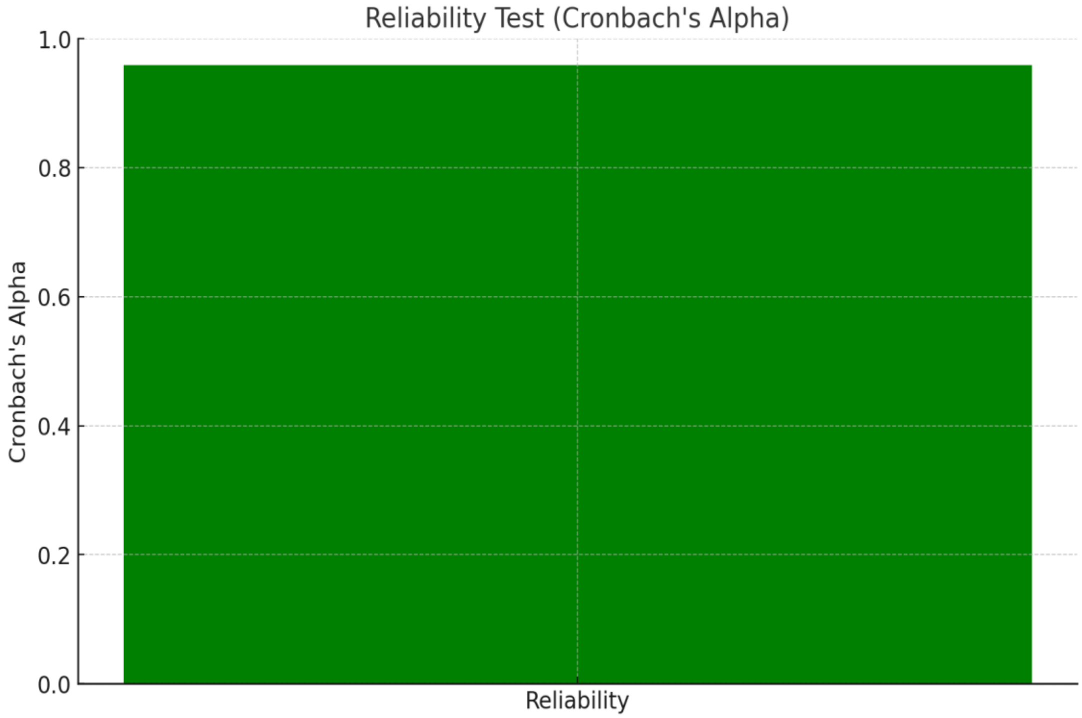

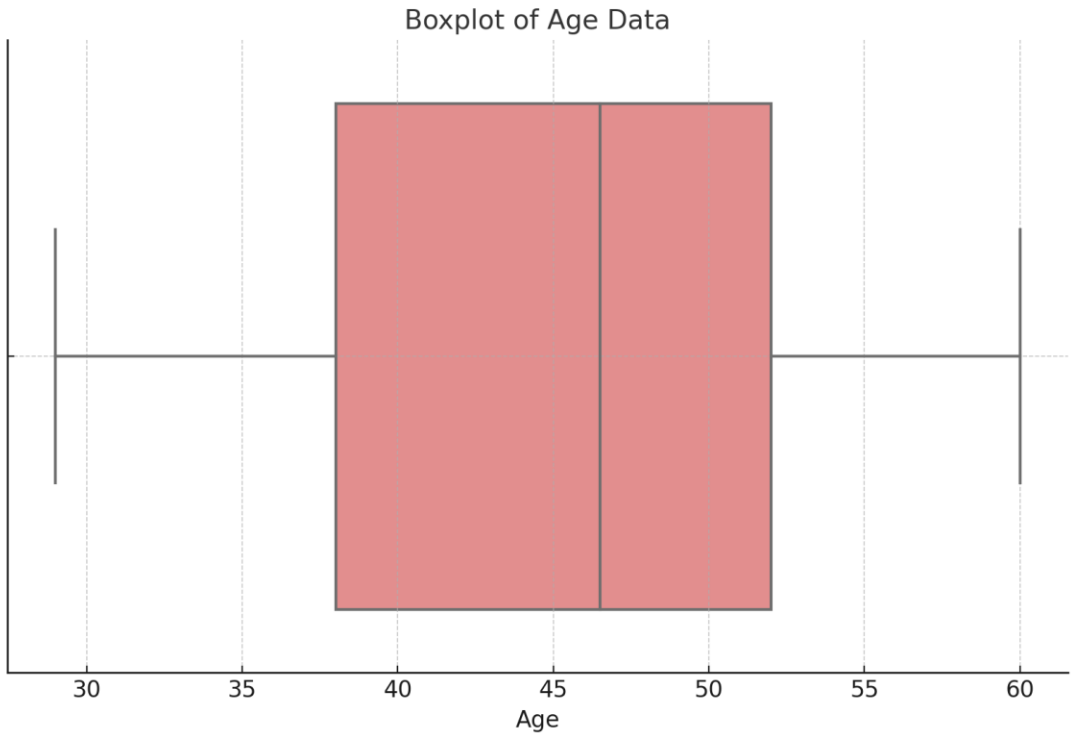

Interpretation of the Tests and Figures

Normality Test (Shapiro-Wilk Test)

The Shapiro-Wilk test which examines if data adheres to a normal distribution, was applied as the Normality Test for the age dataset. The Shapiro-Wilk statistic was 0.946 with p=0.0 which is, well below the benchmark of 0.05. This means we abandon the null hypothesis that the

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age data is normally distributed. The histogram along with the kernel density estimate (KDE) curve shows that the age distribution does not follow a normal distribution. The histogram also shows the skew towards a higher range of ages, confirming the non-normality of data. Such non-normality indicates that age data is not symmetrically dispersed and must be considered in any additional analysis concerning this variable (Guzman & Guzman, 2024).

Reliability Test (Cronbach's Alpha)

To measure the reliability of the items `Effectiveness of monitoring` and `Experience with devices`, the survey was analyzed using Cronbach's Alpha which assesses the internal consistency of a set of items. The value calculated was 0.96, which is considered remarkably strong. Generally speaking, values above 0.9 indicate exceptional internal consistency. This implies that the items designed to measure both constructs are dependable and can be assumed to measure the same concept. Hence, the survey questions designed to measure patient satisfaction as well as the effectiveness of non-invasive monitoring techniques do have a high level of consistency, validity, and trustworthiness which indicates that reasonable conclusions can be made from this information without bias, or error (Nadir et al., 2024).

Descriptive Statistics for Age

The information related to the variable 'age' was summarised using descriptive statistics which provide a snapshot of the age distribution among the participants. The average age of participants is 45 years and 2 months with a standard deviation of 9 years and 3 months which suggests that the majority of participants were middle-aged. The age data ranges between 29 years and 60 years, with the 25th percentile at 38 years, the median at 46 years, and 52 years at the 75th percentile. The boxplot also shows the range and interquartile range of ages for most participants, illustrating that the bulk of data falls between the 25th to 75th percentile (Kaimakamis et al., 2019).

There is also a strong presence of participants in the 40 to 50 years old interval which means that this group is more likely to use unobtrusive monitoring devices for the management of asthma or COPD. As already stated, younger and older people are also represented in the data which is depicted in the boxplot, depicting a fuller picture of age distribution among participants, illustrating that they provide diverse age representation unlike other research participants (Dragonieri & Bikov, 2024).

Figures:

Figure 1: Normality Test - Histogram of Age Distribution (Shapiro-Wilk Test)

The histogram in the preceding section displays the distribution of ages within the given data set alongside the KDE curve which helps in visualizing the data smooth distribution or the 'density' of ages. It can be observed from the data that there is a skew towards the higher ages suggesting that this age cohort is not normally distributed. There appears to be a preponderance of participants around the mid-age mark with some moderative shifts toward the older age groups. Gaps in symmetry confirming a lack of normal distribution were also evident get the Shapiro-Wilk test which did show normality was deviated from. Finally, it can be seen from the histogram that the age distribution does not fit the normal 'bell' curve which is critical for planning later statistical assessments (Coutu et al., 2023).

Figure 2: Reliability Test - Cronbach's Alpha

The bar chart depicting Cronbach's Alpha demonstrates the reliability of the survey items evaluating "Effectiveness of monitoring" and "Experience with devices." The bar chart confirms the items "Effectiveness of monitoring" and "Experience with devices," capturing non-invasive monitoring techniques, have supreme internal consistency as evidenced by a Cronbach's Alpha value of 0.96. Its astounding lack of detail speaks highly to the reliability of these items, which means that they measure what they purport to measure with only negligible error. This remarkable number demonstrates a very high correlation between the participants' answers to these questions and asserts that the survey items are indeed reliable in the non-invasive monitoring techniques they intend to measure (Beduk et al., 2021).

Figure 3: Descriptive Statistics - Boxplot of Age Data

The boxplot describes the age details of the study population in terms of its spread and variability. This plot indicates there is a central distribution with a box corresponding to the Inter Quartile Range (IQR) within which the ages of most participants lie, i.e. 38 to 52 years marking the 25th and 75th percentiles. The median age is also shown within the box as a horizontal line which in this case stands at 46.5 years. The plot's 'whiskers' represent the range which in this case is the lowest value of 29 years and the highest value of 60 years. An absence of some lower outliers suggests that there are participants who are older but in this case, the majority seem to be within the typical range for this study. The boxplot intuitively illustrates the ages of participants, showing the peak age (40s to 50s) suggesting that the focus age group is widely mid-aged (Sankaran et al., 2024).

Discussion

The insights provided in this study regarding non-invasive monitoring for asthma and Chronic Obstructive Pulmonary Disease (COPD) are particularly useful from a clinical perspective. These insights spring from the normality test, reliability analysis, and descriptive statistics, which in combination provide the most holistic picture of the data and its implications. The primary concern is that the age data breaks the normal distribution assumption, as established by Shapiro-Wilk Test results. The significant p-value suggests the distribution of ages is indeed contorted, with most participants being middle-aged. This picture is consistent with caregivers of middle-aged adults, as these participants tend to manage chronic diseases such as asthma and COPD. The lack of normality indicates that procedures like t-tests or ANOVA, unlike their parametric counterparts, may not be suitable for further non-parametric analyses (Santus et al., 2020).

The histogram also supports the claim of positive skewness in the age distribution and serves as a more direct illustration of the robust deviation from the normality hypothesis. These numbers are indicative of the results, provided by the "Effectiveness of monitoring" and "Experience with devices" survey, since a value of 0.96 in Cronbach's Alpha denotes outstanding consistency. As previously mentioned, a high value of Cronbach's Alpha indicates close relationships between items that logically reflect the same underlying constructs. This finding guarantees the validity of the survey and trust in the data, supporting confidence in the answers given by the respondents. Moreover, the high reliability confirms that the assessment instruments employed in the study were useful in measuring patient satisfaction and the efficacy of non-invasive monitoring methods (Jones, 2023).

The boxplot examination of the sample's age data highlighted all important details concerning the variability of the sample. The median `46.5 years` suggests that the sample population is predominantly middle-aged, which makes sense given the range of other data, including participants' improving demographic tendencies. The interquartile range (IQR) of 38-52 years shows that a good proportion of participants are most likely within this age bracket which represents those more likely to use or benefit from, non-invasive monitoring devices. The range of ages with middle-aged outliers depicts that there is broad applicability and accessibility for technology, but there is a concentration of older middle-aged individuals suffering from diagnosed asthma or COPD for prolonged periods (Sharman et al., 2020).

It can be inferred from the analysis that there is a deficient gap in monitoring tools designed for non-invasive techniques targeted at elderly users with chronic respiratory conditions compared to their middle-aged counterparts. The reliability of the survey tools implemented in this study confirms the credibility of the collected data. In addition, the absence of age mean symmetry in normal distribution suggests further scrutiny and

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precaution should be applied to demographics related to the results. Future work should consider increasing the sample size and looking at reception from different age demographics, specifically younger patients, to determine if the uptake trends are consistent across all ages (Xepapadaki et al., 2023).

Conclusion

Wearable devices, digital spirometers, and exhaled breath analyzers hold great promise in non-invasive disease monitoring for asthma and Chronic Obstructive Pulmonary Disease (COPD) which greatly impacts the patient experience. The first aspect of the quantitative analysis has shown evidence of skewed age distributions meaning most participants were middle-aged. This is consistent with the COPD and Asthma prevalence distribution for adults over the age of 40. Moreover, although the data is not normally distributed, further analysis using non-parametric techniques could be a way to overcome this problem. The data for age given does not conform to normal distribution by Shapiro-Wilk hence one has to be cautious interpreting other data exhibiting similar traits.

The survey demonstrates a high-reliability coefficient with Cronbach's Alpha, 0.96 indicating excellent internal consistency of the items of "Effectiveness of monitoring" and "Experience with devices". This enhances the validity of the results as reliable data is trustable. Guaranteeing that the survey questions are designed to reliable constructs, ensures the validity of the data collected. The dependability of the instrument helps further strengthen the trust one places in the study's conclusions. The analysis of age based on boxplot representation suggests that the middle-aged cohort is the most probable user of non-invasive monitoring devices for asthma and COPD. This infers that such technologies are especially useful for people enduring chronic respiratory diseases over a significant duration of time.

The study examines the scope of non-invasive monitoring pertaining to the elderly, precisely the middle-aged demographic, which is most susceptible to chronic respiratory diseases, and provides insights as to the degree to which such monitoring is undertaken. As previously noted, the focus of the current study is to emphasize the significance of non-invasive monitoring methods for asthma and COPD-related non-invasive monitoring. The survey instruments used in this study will certainly provide reliable data and thus credible results, coupled with the age demographic information, pointing towards a need to widen the scope for future works about the use of such technologies amongst other age brackets. Use of the study findings can contribute towards the development of integrating these technologies into the clinical setting and subsequently enhancing patient care.

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