A Review of the Impact of Education on the Adoption of Smart Technologies for Atrial Fibrillation Detection

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The main objective of this review was to investigate whether educational attainment has an impact on the occurrence of atrial fibrillation (AF) as well as the implementation of smart technology to detect this condition. Data on the relationship between education level and the occurrence of AF were collected, as well as data on smart devices for detecting AF. A lower level of education has been linked to an increased risk of AF. With this in mind, it is easy to explain the clear correlation between education level and AF, as well as the adoption of smart device detection and how it may improve illness prognosis. People with a higher level of education understand and embrace the notion of employing smart devices to detect and prevent AF; they also have decreased AF prevalence compared with those with a lower level of education.

Keywords: atrial fibrillation, smart device, detection, arrhythmia, education

Introduction

Atrial fibrillation (AF), a supraventricular tachyarrhythmia, is defined by erratic electrical activity of the atrium and resulting ineffectual atrial contractions (1, 2). Lower socioeconomic status (SES) has been linked to poorer physical health for hundreds of years (3–5). In terms of SES, this review focuses on its impact on education and on the prevalence of AF. Furthermore, data indicating the clinical relevance of AF, smart device detection of AF, and a strong link between education and cardiovascular disease (CVD), particularly AF, is described herein, as is the influence of education on smart device detection of AF.

AF is the primary cause of mortality and morbidity in many Western industrialized countries. It occurs clinically as silent heart disease and stroke (6). AF is one of the most common arrhythmias in adults (7). This cardiac rhythm disorder is linked with worse quality of life, higher risk of heart failure, embolic events, and a 30% increased risk of death (7, 8). AF affects 1-2% of the population (9). The incidence of this arrhythmia is projected to rise over the next decade as the population ages and risk factors increase (9). It is estimated that AF will affect 14-17 million individuals in the European Union by 2030 (10).

Early identification and prevention are crucial factors that clearly affect health, followed by the appropriate use of therapy. The application of an electrocardiogram (ECG) is essential to confirm the diagnosis of AF (11). New patient-operated devices such as wristbands, smartphones, and smart watches (followed by ECG verification) may also be used to detect AF, which is typically paroxysmal or quiet. Several ongoing studies are also examining the benefits of early AF identification and whether it improves disease outcomes (12).

Worldwide, almost 20 million individuals use mobile health devices, and the number is growing every day (13, 14). According to research, 27% of people over 65 in Europe possessed a smartphone in 2014 (14). These smart devices and software provide strong prospects for faster diagnosis and monitoring of AF, which is a condition that most frequently affects the elderly and is on the rise. Consequently, AF can be identified earlier, enabling early introduction of medication and, consequently, a decrease in complications and total treatment costs.
This review investigates the influence of education on the use of smart technology for AF diagnosis and on AF occurrence in general, given that those with less education are more likely to acquire AF. With all of this in mind, it is easy to explain the clear correlation between education level and AF as well as smart device detection uptake and how it might influence disease outcomes.

A clinical perspective on atrial fibrillation

Considering that it is a highly prevalent dysrhythmia and the main cause of strokes, and is linked to considerable morbidity and death, AF poses a serious problem for healthcare systems throughout the world (15, 16). Owing to the erratic electrical conduction via the AV node and ventricular response that define AF, the RR interval time series and ventricular response are unpredictable (17, 18). The RR intervals during AF episodes may be modeled probabilistically, and are therefore not entirely unexpected (19). It has been demonstrated that RR intervals may be used to detect AF events, and numerous approaches have been suggested (18). These approaches primarily depend on the extraction of characteristic features from an RR interval time series that represent the unpredictable nature of the heartbeat (18). Despite perhaps appearing simple, applying this idea in clinical practice can be difficult. Irregular RR intervals are one of the essential characteristics of AF, and AV conduction must be preserved for them to be detected. If P waves appear in multiple leads at the same time and have the same morphology, AF is not a likely diagnosis. An on the contrary, changing P morphology and variable intervals between the successive P waves indicate possible AF (1, 2).

What started as simple ectopic beats may, due to the multiple risk factors (such as behavioral patterns and comorbidities), progress to the formation of re-entry circuits that culminate in AF (20). AF is characterized by extremely variable excitation waves found in both atria. The chaotic impulses disrupt the normal process of cardiac depolarization and repolarization, making it impossible for the normal, rhythmic contraction of the atrial walls to occur. As a result, the ventricles are arrhythmic and receive extremely erratic stimulation from the atria through the AV node. At a range of 60 to 130 beats per minute, very erratic chamber frequencies occur. Heart palpitations are experienced when the heart skips a beat and loses its synchronized action as a result of AF (21, 22).

Atrial fibrillation and stroke

Clinical occurrences and costs have significantly increased in correlation with the most commonly persistent cardiac arrhythmia, AF (23). Between one and two percent of people suffer from this cardiac rhythm disorder (24). Around 6 million people in Europe alone have been reported to experience this cardiac arrhythmia, and around 30 and 100 million people are thought to be impacted globally. Most of the time, those 65 years of age and above are the population group that is most afflicted by this condition (25). Over the following ten years, it is anticipated that the prevalence of this cardiac arrhythmia will rise as the population ages and risk factors increase (24). By 2030, around 15.5 million individuals in the European Union are expected to develop AF as a result. Every year, 120,000 to 155,000 preliminary diagnoses are anticipated (26).

Ischemic stroke is a potentially lethal consequence of AF (27, 28). AF is thought to be a contributing factor in about 20% of strokes (2). A clinical tool known as the CHA2DS2-VASc score was created to evaluate ischemic stroke risk in patients with AF and to direct the administration of oral anticoagulation (OAC) medication, which has been shown to reduce the risk of ischemic strokes (2, 27, 29).

The treatment of thromboembolic stroke accounts for a sizable portion of the healthcare expenses related to AF, which total more than one percent of United Kingdom healthcare expenditures (30). In the general population, AF is linked to four to five times increased risk of stroke, and it is thought to be the root cause of 15% of all strokes. Importantly, this percentage rises sharply with age (20, 21). When compared to patients with stroke but without AF, patients with ischemic stroke had a considerably greater prevalence of AF (nearly 25%), which was associated with lengthier hospital stays, more morbidity, increased rates of stroke recurrence, and higher fatality rates (31, 32). Notably, certain symptoms being absent (such as palpitations) did not reflect a decreased risk of thrombosis. Patients with paroxysmal or persistent AF were just as likely as those with permanent AF to suffer a stroke (30).

Detection of atrial fibrillation using smart devices

Electrocardiogram or photoplethysmogram-based smart devices are often used in the healthcare industry. These may be in the form of a smartphone case, wristband, smartwatch, or even only as an additional algorithm and software that can transform current smartphone hardware into a tool for AF detection (33, 34). Of all these gadgets, a smartwatch is the one that is most frequently discussed in healthcare and the subject of smart device research for the detection of AF (35). In the late 1990s, spurred by the “quantified self” movement, smartwatches became popular as part of the category of wearable technologies and smart health systems (36). The “quantified self” movement sought to
focus on the patient in the process of providing healthcare. Wearable technology, such as smartwatches, which allow users to continually track their health information during normal activities or even sleep, was one of the instruments that would have made that possible (36). Moreover, using these smart devices enables prolonged vital sign recording outside of the hospital setting (37):

In general, smart devices may alter how health data is delivered by overcoming the everyday constraints faced by healthcare providers and using techniques that can detect occurrences that do not take place during in-person visits (38, 39). Cardiologists are particularly interested in the ability to continuously monitor heart rhythm, heart rate, and persistent non-invasive arrhythmias, thanks to the development of smart devices (40, 41). Additionally, the adoption of smartwatches and other smart gadgets for the diagnosis of AF will benefit from the arrival of 5G technology and the corresponding increased connection speed (36).

The following are some restrictions on the smart devices used for the identification of AF: the battery life of smartwatches is limited, and they frequently need to be charged every day. As a result, less time is spent wearing the device and being monitored. It might also be difficult to detect brief and asymptomatic events of dysrhythmias, for instance, because the majority of existing methods for the detection of AF using a smartwatch require the patient’s active participation (42, 43). Due to the fact that smartwatches are still relatively new technologies, several legal concerns relating to data security still need to be overcome to secure the confidentiality of the recorded health information (43, 44):

Socioeconomic status and its influence on atrial fibrillation occurrence and identification using smart devices

It has been generally established that a higher risk of CVD is linked to poorer SES (45). Several studies concluded that those with better SES had lower incidences of AF (46, 47). Nonetheless, higher income and education levels were linked to a lower risk of developing AF in young people, but the connection weakened with advancing age and was nearly nonexistent for the older demographic (48).

Studying the socioeconomic factors of AF offers a chance to improve the health of patients with AF. The identification, assessment, treatment, and management of AF are heavily influenced by socioeconomic variables: ethnicity and racial background, financial means, area of residence and rurality, language proficiency, health literacy, and social support are all factors to consider (49).

As was already noted, more frequent patient monitoring is advised, and continuous monitoring is the best method for preventing stroke and AF (27). Smart devices are the perfect tool to tackle this issue (35). Nonetheless, there is also compelling evidence of a digital gap across different ethnic and racial backgrounds, as well as intersections of gaps in age, income, occupation, education level, and SES (50). The usage of smart devices and digital technologies in general are influenced by all of these aspects, and this of course applies to the use of smart devices for AF detection as well.

Impact of education on atrial fibrillation occurrence and identification using smart devices

Several studies found that education influenced the proportion of AF identified with a smart device, as well as that patients with higher education levels had a decreased incidence of AF, while patients with lower education levels had a higher incidence of AF.

Many studies demonstrated that cigarette smoking, dyslipidemia, and hypertension are all risk factors for CVD, and how this is related to education level (51–53). According to the findings one study, the behaviors that impact risk factors for CVD are multifaceted and well-established, and they are frequently strengthened by traditions, culture, and continuous marketing (51). Thus, the authors suggest that they are not likely to be considerably impacted by mainstream media alone. Additionally, face-to-face training and exhortation have a lengthy record of inadequacy, particularly when it comes to long-term changes in eating and smoking habits (51). Furthermore, there is pessimism regarding the potential of public education to modify health behavior. All of this leads to the conclusion that overall education level is the foundation of understanding and being more receptive to embracing healthy lifestyle choices (51, 54).

Moreover, the incidence of CVD, such as AF, highly depends on regular therapeutic intake. Advances in pharmacological therapy have greatly improved the outcomes of patients with CVD in recent decades (55, 56). In people with AF, new OACs have lowered the risk of stroke (55, 57, 58). In order for treatment to be effective, patients must take their medications on a regular basis (59–62). The patients who take medications consistently differ from those who do not in terms of other risk factors for death (63–66). Regular medication intake is also associated with education level, with those with a higher level of education being more likely to recognize the need for taking medicine regularly and doing so (64–66).

Smartphones are on the verge of taking over our everyday tasks in both our personal and professional lives (67–69). Furthermore, research has shown that those with a higher level of education are more inclined to use smart technology (70, 71). According to this study and others, smart technology solutions have been developed and tested to increase medication adherence and disease monitoring across a wide range of patient demographics (72–75). These solutions are defined by
the use of technology, mostly smartphones, tablets, and computers, to remotely monitor and train patients in order to increase their adherence and monitoring (75, 76). The low cost of these systems, as well as the use of existing technology and ease of use, are all benefits of employing them (55, 77, 78).

Conclusion

Individuals with higher education levels and SES are less prone to AF and more likely to use smart devices. As a result, AF in these individuals would be more likely to be identified and receive prompt treatment, avoiding all the challenges brought on by silent AF. Higher levels of education are also associated with a reduced incidence of AF, probably due to being more informed, being knowledgeable, and healthy lifestyle acceptance. If more people are made aware of the advantages of utilizing smart devices for AF detection, more people will do so, increasing the possibility that AF will be detected early and preventing all of the fatalities and morbidities related to stroke.

Declaration of interest

The author has reported that she has no relationships relevant to the contents of this paper to disclose.

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