

Integrating Wearable Devices for Monitoring Physical Activity in Management of Diabetes

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Abstract

Physical inactivity being a major risk factor in development of diseases such as diabetes mellitus, it is important to engage people in their own physical training programs which can help increase their activity levels. Measuring physical activity in both healthy and diseased individuals is important to understand normal body functions and its needs for wellbeing. Wearable technology can be integrated in monitoring physical activity by means of various wearable devices fitted with pedometers and accelerometers and smart phone applications. Wearable devices have shown to be effective in increasing the physical activity levels among its users. The large data collected from these devices can act as a guide for important clinical decisions for efficient patient care. Although the large amount of data gathered needs to be evaluated in real time. With new advancements in technology new light weight and small size devices are being developed to overcome the hurdles of use in daily life. Also the issues of safety and privacy of information as well as the user, concerning the general public must be addressed for these devices to be adopted widely.

Keywords: Smart watches, Pedometers, accelerometers, Diabetic Patients, Physical activity

Introduction

Diabetes mellitus is a clinical syndrome characterized by increased blood glucose levels due to absolute or relative deficiency of insulin. Long-standing metabolic derangement can lead to development of complications of diabetes mellitus, which characteristically affect the eye, kidney and nervous system. According to International Diabetes Federation, in 2019 approximately 463 million adults worldwide were living with diabetes and this is expected to rise up to 700 million by 2045. Diabetes has caused about 4.2 million deaths.¹

Physical inactivity is a key risk factor for the development of diseases such as Diabetes mellitus. Also obesity, high cholesterol levels, untreated hypertension, heavy use of alcohol, stress, unhealthy diet, as also family history add to the risk of development of diabetes.²

Simple lifestyle modifications like weight management, healthy diet and regular exercise can prove to be beneficial in the management of diabetes.

Thus it is important to promote physical activity in management of Diabetic individuals. It always requires active participation and continuous monitoring by individuals and clinicians for it to be well managed.

This tedious task can be completed with the help of technology in the form of various wearable health monitoring devices and smart phone applications. These devices allow the continuous

monitoring of physical activities and behaviour in real time. Pedometers, accelerometers and smart phone applications are some of the wearable devices used to measure the physical activity.²

Materials and Methodology:

Different wearable devices such as smartwatches, pedometers etc has been taken to measure the physical activity in normal healthy individuals and the diabetic patients. Wearable technology is an upcoming domain which everyone should be aware of. These devices make self monitoring of activity levels easier which is an important factor for reducing the physical inactivity levels in both diseased as well as healthy individuals. But to improve the efficacy of the data collected from these devices the acceptance by general population and improving the extend of research in this domain is necessary.

Discussion

Regular exercise has both immediate and long-term benefit. Regular moderate physical exercise not only improves health and reduces the risk of development of chronic diseases such as Diabetes mellitus, but also helps in managing weight, strengthening muscles and joints, boosting energy, improving mood and also help sleep better. It also helps in reducing symptoms of stress and anxiety. Simple ways to remain physically active daily include walking, cycling, active recreation and play at any level or for enjoyment purpose can be done by everyone. Wearable technology helps collect and as well as analyse this data. Such as in diabetic individuals monitoring physical activity accurately is important for it to be well managed. This can be achieved by means of the wearable technology with the help of smart phone applications, accelerometers and pedometers.

To maintain good health and gain benefits of exercise it is recommended that one must indulge in minimum of 150-300 minutes of moderate intensity physical activity in a week.³

The onset and course of diseases like diabetes is strongly influenced by some simple lifestyle related behaviours such as amount of physical activity and sleep. Various studies have corroborated the fact that increase in physical activities helps improve glycemic control by enhancing insulin sensitivity and boosting glucose uptake as also reduces the chances of development of cardiovascular complications and improve well being in Diabetic individuals.⁴

Despite of known benefits the number of individuals indulging in regular physical activities remains low and sedentary lifestyle is prevalent. Approximately not more than 25% of the population is estimated to be engaged in regular physical exercise. According to WHO about 5 million deaths a year could be averted if the global population was more active.⁵

Regular observation of one's physical activity can help estimate their fitness level on a daily basis. A few studies have shown that regular monitoring of physical activity can significantly increase the activity levels.⁶ It can also be used to detect individual's physical inactivity level, thus can help to modify his/her routine to promote a more active life style. Activity monitoring engages individuals in their own fitness programs also offers real time estimation of their activity levels to health professionals.

Monitoring physical activity has been made quite easy with the advancements in wearable technology. Wearable technology or wearable devices are smart electronic devices which are worn close to the body. These devices detect, analyze and transmit information regarding body signals and/or ambient data. Along with these devices, mobile phones which are used throughout the day are considered an efficient tool for tracking activity levels in real time via smart phone applications.

Various devices which are in use today are pedometers, accelerometers, gyroscopes, sole sensors and barometric pressure sensors. Accelerometers and pedometers are used widely for monitoring physical activity. Pedometers are portable electronic devices which count every step taken by the individual via the motions of person's hands or hips. Accelerometers are devices that measure changes in acceleration and axis of motion; it works well with a gyroscope. Motion sensors are relatively inexpensive and small size devices which consume less energy having parts of accelerometers and gyroscopes. In today's world considering the large number of smart phone users interventions using these devices are a promising way to promote physical activity.⁶

Improvement in sensors and data analysis technology has broadened the scope for remote monitoring. Wearable devices can now help improve data collection in both healthy and diseased individuals under different conditions and activities. The big health related data gathered from these devices can act as a guide for important clinical decisions; such as prescribing optimal medicine from the large available range of anti-diabetic drugs and also enhance patient care. It has been shown by a systematic review and meta-analysis that interventions using computers, mobile applications and wearable devices have reduces the sitting time 40minutes/day.⁷

A recent meta-analysis with diabetic patients showed that activity monitoring based counselling had a beneficial effect on physical activity, blood glucose levels, blood pressure and weight management.⁸ These devices may also help ease the difficulties in monitoring patients in remote areas, once they are well introduced and taught to use and interpret them.

With recent advancements in technology of miniature circuits, radio transmitters and microprocessors it has paved a way for the production of light weight and small size of devices suitable for use in daily life. These electronic devices are incorporated into objects that can be worn easily and comfortably on the body. Objects like watches, shoes, jewellery, clothes all can be fitted with these electronics and transformed into smart wearable devices. Some of the wearable electronics can also be surgically implanted under the skin of the user.

Certain usability factors are to be considered before integrating these devices in daily life such as patient's understanding to visualised data, interpreting the findings and making appropriate behavioural changes. In addition to these usability factors health literacy is very important to maximize the benefits of this technology. Today a lot of people understand the value of integrating wearable devices into activity monitoring but are concerned about open-data sharing as safety and privacy are important issues, information related to health and living habits of people may be misused. Companies should have strong policies and procedures before introducing these devices.

Continuous monitoring creates a huge amount of data to be evaluated in real time. As the wearable technology is relatively new the associations between wearable device data and information from traditional methods is not completely understood.⁹

Wearable device technology being a new domain, continuous research and development is been carried out in the field of wearable technology to address the various loop holes in today's time.

Conclusion

Knowing about normal body functions is important for treating any kind of disorders. This cannot be achieved alone with physical examination via laboratory and radiological investigations as still a huge amount of data is missed. These can be used in the form of wearable devices such as watches, belts, shoes and many more. Self monitoring of physical activity will give patients greater control in their health care. Moreover accurate activity measurements may help in evaluating the efficacy of treatment. Devices which do not interfere with person's activities of daily living should be developed

keeping in mind the safety, accuracy and privacy of the collected information as well as that of the patient.

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