Wearable Health Gadgets by Xiaomi can monitor the vital parameters for preventive and curative healthcare in India-A review study (2020)

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ABSTRACT

With the advancement of microchip technology & Nano-technology in embedded electronic systems, the health gadgets are not only miniaturizing but also becoming safer and more and more useful for real-time monitoring of vital parameters in patients. India is a large subcontinent with more than 20 percent of young population who are aware about their physical fitness and approx. 10 percent of people who need long term management of chronic lifestyle disorders. This Review paper focuses on the understanding of the importance and application of wearable health gadgets especially wristband in keeping physical fitness & Self- health management of chronic disorders. In India, Xiaomi has become the market leader due to adoption of 5-step strategy. Titan and GOQii follow Xiaomi in marketing and sale of wristbands. The future of health gadgets belongs to the wearable & Implantable health gadgets.

Key words-Wristband, Wearable Health gadget, self-health management, chronic disorders, real-time monitoring, vital parameters, Xiaomi

India is a fast growing emerging economy in the world with more than 1.3 billion people with advantage of demographic dividend. The access to health information is one of the most important variable which affects health status in any community among other variables like genetics, life style, physical and social environment. Technological interventions in health care services through e- health options, mobile health solutions and wearable technology have allowed the users to self-manage their health problems. While Smartphone is the preferred choice of people today, wearable wristband is entering the user healthcare ecosystem. Wearable wristband works on electronic embedded technology; they have motion sensors based on integrated circuits (IC's) that track daily activity by monitoring their pulse rate on real time basis. Wearable sensor is of different types. Firstly flexible sensor that can be integrated and synced with textile fiber , bands or can directly be attached with human body for measuring physiological signals while second type is micro-electro-mechanical system (MEMS) based miniature motion sensors which are used to measure , detect and measure signals for cardiovascular, neurological and pulmonary diseases. Wearable wristband are encompassed with both flexible and MEMS sensors as per the required application. Further they cane integrated and synced with smartphone or laptop for further health report assessment. Wearable wristbands and sensors help people to track and monitor their own behavior and body with timely medical assistance. This paper aims to study the gadgets and wearable devices especially wristbands. The objectives of this paper are a) to explore the gadgets especially health gadgets b) To study the wearable devices c) The benefits and market of wristband in India

Health care is vast sector in our country which provides services ranging from curative, preventive, rehabilitative to palliative care (Healthcare industry, website). This sector constitutes 10 % of gross domestic product (GDP) of most of the developed nations. Indian Health Care Sector is fast growing sector projected to be of the size of US$ 280 billion by 2020 in India. The intervention of Information technology in Indian healthcare services is also increasing with booming healthcare sector at a value of US$ 1.5 billion by 2020. The world is shifting to the mobile technologies for information processing and India leads this transition being the second largest tele-communication market.

Health Gadgets: Wearable technology in Healthcare service

In today's scenario user are seeking for healthcare service which are more accurate, specific and comfortable in nature. Wearable technology and health gadget allow consumers to enjoy healthier life with manageable expenses. Health gadgets allow an individual to streamline a healthier lifestyle. The makers of wearable device and health sensors initially targeted the consumer who are extremely health conscious and seek for extensive health fitness. The acceptance of health based wearable device was steered by a preventive approach towards

high serious health risk. Health gadgets users can be segmented into (i) Motivated Healthy: extremely health conscious and fitness oriented, (ii) Chronically Monitored: requiring continuous monitoring being chronically ill. First segment will willingly invest time to learn the usage of device and ready to pay for acquiring the desired functionality while the second segment are using the health gadgets only for the treatment purpose and their usage is dependent over the caregiver. (Fraser, H et.al. 2011). Wearable technology constitutes jewellery, glasses and clothing — worn on, in and around the body — with sensory devices. Wearable devices and sensors helps person to track and monitor their own behaviour and body with timely remote medical assistance. (Barnes, K et.al. 2014).The market for wearable devices is both broad and varied. Health gadgets ranges from simple wristwatches that measure the calories count of the users to real time and continuous glucose monitoring applications Gadgets manufacturers are designing creative ways to fit gadgets on and with the human body. This market is poised to accelerate over the next few years as innovative ideas come to market and consumer interest and knowledge grows. Maximum number of users of wearbles gadgets in India are from age group of 24-34 years (37.4%) followed by age group 35-44 years (26.2%), 16% from 45-54 years , 14% from 18-23 years and 5.9% above 55 years (Staista) . On the basis of development and evolution gadgets classification can be done phase wise manner. Initially for gadgets consumer inclination was developed by introducing them as an accessory. Users were more interested to access their personalized gadget seeking their individual requirement prime. Then in the second phase the gadgets took form of the alluring textiles and fabrics integrating various other gadgets and electronics devices. Third phase was shifting gadgets from near body electronics concept to over body concept. Now it was the phase of wearable gadgets. Lastly by 2025 gadgets will take the form of body implants where its sync with organs and human safety will be essential.

**Exhibit1: Showing the phase wise growth of body mounted gadgets**

Phase 1	Accessories	Easy to access, New technology, more comfort
Phase 2	Textile of Fabric	Higher device integration, flexibility
Phase 3	Wearbles	Easy to mount, Real Time tracking and reporting
Phase 4	Body Implants	Safe, Faster communication, Accuracy

Source: Table prepared by Authors based on information from European Commission report 2016

There lies a vast base of applications for wearable technology for medical and health care services. Through such wearable, patient's vital information such as heart rate, brain activity, sleeping patterns, sugar levels, blood pressure measure, stress index etc. can be collected and be shared with doctors, physicians and healthcare service providers. For instance, a cardiac sensor based wearable device–Body guardian Remote Monitoring by preventive, tracks patient's biometric signals. One such wearable device approved by FDA monitors non-lethal arrhythmias in ambulatory patients and connects the health information in real time through wireless network to doctors. Doctors and clinicians have expanded the ability to access their patients outside of their facility mostly by body mounted fitness wearable. Mobility is attached to their healthcare services due to such gadgets. Thus the prime most benefit of wearable based health gadgets used for medical and health purposes is connecting with real time health data, hence the accuracy and reliability are two dimensions which must be high. Wearable health gadgets are classified into near-body electronics, on-body electronics, in-body electronics by The International Electro technical Committee (IEC) Standardization Management Board. Also, the Moving Pictures Expert Group (MPEG), a working group of ISO/IEC, sets new conceptual model of wearable health gadgets. Wearable health gadget includes various sensory devices which are integrated under a single system. These sensors are continuously monitoring the physiological changes happening on the body over which they are mounted and also tracking the changes occurring in the environment. Once they sense the changes and collect the information they send the alert and feedback to the users in the form of audio or video content or text information. Over which user can further interact with the gadget with set of command signals. Various body dynamics can be sensed and monitored in real time. (European Commission, 2016). Health wearables provide various benefits to the users whether it is doctors or the individual users. It allows them to capture, monitor and analyze the real data which in practical sense often remain un-captured in their absence. The real time quotient here defines each moment and daily life activities. Hence the patient need not require fixing an appointment and undergoing nervousness and stress. Such efficient monitoring and tracking also catalyze the line of treatment provided by the physicians and doctors with improved diagnosis and disease management. Wearables boost up the complete health care delivery services. (Forester, 2014). In today's time, most of the health fitness band are fitness oriented and many smart wearables fabric provides the user to track the self health dynamics during the workout. User are also using smart fabric apart form fitness goals. They are using it to develop a unique non-verbal way of communication through which just with flicking a finer over screen text can be delivered to the dear one with help of audio pattern stored on their wearable. The digital gadget by Apple and other digital watch

by makers provide the same function(Ericson, 2016). Use of wearable technology can be categorized into five modes (i) monitoring (ii) assisting (iii) augmenting (iv) tracking and (v) delivering content. In the first category the wearbles are used to collect the self- health data like heart rate, blood pressure , sleep patterns , weight , diet charts etc.; it helps the user to understand and study the different mood level like happy, excited, sad, disappointed, stressed, tired and surprised. In the second category related the use of wearbles for self-physical assistance like posture correction, lifting or muscular relaxation. Third category includes the augmentation through wearbles by remote guidance, health and safety improvement, health awareness and interaction with various content via pictures, text and images. Tracking it's the fourth category which includes the self- health maintenance and management. Now days the users are most of the time indulged in physical activity and sedentary behaviour so it become essential to have a track of total step counts and calorie count which enable the user to manage their physical activity to a threshold. In the last category i.e. delivering content allows the user to have access to third party material by reading, listening and watching manuals, charts or set diagrams. (Kahukrel, J et.al. 2017).

Exhibit 2: Categorization of wearable gadgets
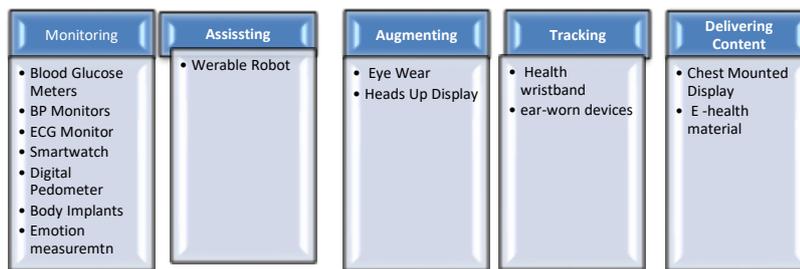
Source: Exhibit prepared by authors on the basis of research paper by Kahukrel, J et.al. 2017

Exhibit 3: Different types of wearable health gadgets with applications

S.No	Position of health gadget	Name of Health gadget	Application of health gadget
1	On - Body	*Smart T-shirts*	Provide complete fitness metrics and workout analysis
2	On - Body	*Smart Shoes*	Tracking time , distance , pace and calories
3	In - body	*Pacemaker*	Placed in chest or abdomen region to control rhythm of heartbeat
4	On - Body	*Smart Watches*	
5	On - Body	On Wrist-**Wrist bands**	
		Nike Fuel band	Track daily calorie count and steps taken
		Fitbit Force and Fitbit Flex	Track steps taken , distance covered, calorie count , floor climbed , sleeping efficiency
		Jawbone UP wrist band	calorie count, steps taken ,distance and pace, active & inactive time and sleep quality and efficiency
		Air health	Nutrition management, exercise analysis, stress index and sleep tracker
		On Arm-**Arm band**	
		PUSH by Design Solution Inc.	Complete firness metrics , pace tracker and collaboration platform with coaches and trainer through mobile app.
6	On - Body	On trunk—**Chest or Trunk bands**	

		Posture Pod by Engage Biomechanics	Prevent occurrence of ulcers due to pressure , commonly termed as bed sores. It monitor patient's position and intimate the same to nurse or health service provider
		Playbox	Monitor sports performance and provide collaboration with trainers or coaches.
		Hexoskin	For monitoring heart rate, breathing, steps, calories,
		OM Signal	User can track heart rate, breathing, steps, calories burned, and the unique OM index (relaxation/ lack of stress).
7	On - Body	**On head- Head Gadgets**	
		Shock Box	Sensor is placed in helmet and measures the degree of shock over helmet at time of accidents or sports
		Muse	Equipped with sensors to detect the brain activity and monitor it. The complete brain movement are decoded into audio and video signal which can be analysed over Smartphone or tablet through application
8	On - Body	**Knee bands**	
		Lynxio	User can track their physiotherapy treatment plan and share it with their physiotherapist for review.

Source: prepared by authors on the basis of MaRS Market Insight, 2014

Wearable Wristbands:

Wearable gadget applications are *broad spectrum* thus categorizing the customers into (i) Consumer market & (ii) Non-consumer market. Consumer section includes general consumers, fitness & sports gadget consumers, fashion & apparel consumers, consumers of home automation, of gaming & animation. The non-consumer section of gadgets includes the gadgets used in defence & security, Enterprise & industrial and Healthcare sector. Health wristbands provide fitness, sports and healthcare services. (Salah, H et.al. 2014). Indian focus is increasing over health and fitness and for the same the health wristbands are emerging as a good solution (Hariharan, S. 2019). According to a report from Canalys, A Singapore based market research firm, the total number of wristband shipments in India for last quarter of 2018 were *8 lakhs units* which grew to *1.5 million* units in the last quarter of 2019.The market of health wristband is driven by daily activity trackers and smart watches (Canalys report , 2019). A report from International Data Corporation (like Canalys) states that there was a shipment of *1.2 million* units of health wristbands in last quarter of 2019 with decrease in average selling price by approximately 10% in comparison to 2018 due to affordable options in the segment. The report also claims that India stands at third position globally after United States of America and China. In the second quarter of 2019 the wristband markets showed a decline of 24% due to inventory problems and deficit stockings though shipments encountered a growth of approx. 20% in the quarter, (Singh, J. 2019). The market for health wristband have increased in size after 2015 due to various macro factors like increasing social awareness about health and fitness, technological interventions, high speed & low priced mobile internet facility. The estimated expansion is about to be approximately 16 million units by 2024 at compounded annual growth rate of 27%. The popular product category of wearbles in India include wristbands, Smart-watches and ear-worn health gadgets. In the year 2019, the *wristband* leads the product category with a market share 47.9% while the emerging segment of ear-worn devices include a market share of 44%. The ear-worn segment showing growing popularity because of, firstly the intervention of Bluetooth technology in earphones segment, secondly many smartphone companies have discontinued the earphones as a default accessories (Wood, L 2020). In 2019, the total revenue generated from this health wearable segment amount to 1,556 million US dollars with a penetration rate of 4.6%. The annual revenue collection shows a promising growth to 1,870 million US dollars by 2024 with a compounded annual growth rate of 4.7 %. The health wristband are equipped with sensors that analyse and track

the user physical activity and bodily functions .Some of the wristband suppliers in India are Xiaomi, jawbone and Fitbit, (Statista, 2020). The acceptance of health wristbands mainly depends upon user *specific intention, technology and user surrounding factors*. The *specific intention* is related to user perceived benefit and ease of use of a particular health wristband. Health wristband along with health tracking and monitoring must integrate with user lifestyle also. *Technology* is directly related with technology benefits for the user such as compatibility, features and gadgets specifications etc. It is associated with the improvement in performance which user is identifying by using wristband for health monitoring. The *surrounding factors* include the social influences which users are seeking for the use of health wristband (Talukder, S et.al. 2018). *Acceptance of wearable technology, health management behaviour and confidentiality of health data* affects the user purchase decision for health wristband. Also users can be segmented in two types (i) fitness freaks (ii) users with chronic diseases. *The fitness savvy users* generally use health wristband because they are influenced by social surroundings, peer motivation and device vulnerability hence they are more focussed on luxury, comfort and pricing while chronic diseased users are influenced to use health wristband for better management of disorder, health improvement and reduced illness severity (Gao, Y et.al. 2015). *Performance expectancy* as a variable in model refers to the degree to which individual perceives that using health wristband for managing health and the *effort expectancy* is the level of easiness related while using health wristband (Venkatesh *et al*, 2003), & *both* performance and effort expectancy are directly related to user behavior, intention of purchase, adoption and use of health wristbands (Mercado, P. 2018). The acceptance of health wristbands largely depends upon the *value perceived* by the user individually and by the influence of social gathering or surrounding. It affects both the purchasing decision, satisfaction level and re-purchase intention. Other factors such as look, style or aesthetic value does not affect the purchase of health wristbands among user (Oyedele, A. et.al. 2018). Due to driver drowsiness, nowadays, road accidents are increasing in number. By recording the physiological signals through health wristbands to a large extent such accidents can be prevented (Kundinger, T., et.al. (2020). Recent developments in the creation of wearable sensors can continuously track essential medical activity, evaluate athletic activity, track infants and support industrial applications. Wearable wristband can substitute doctors with real time health tracking and in the working environment the supervisors can also monitor the health of employees and workers through health wristbands (Bloss, R. 2015). By 2019 Xiaomi, leads the Indian health wristband market with a share of approximately 49%, followed by titan which holds the market share of 14.5 % and GOQii with considerable market share (Sheth, H. 2020).

Xiaomi: Health Wristband market leader in India **--**The marketing strategy of Xiaomi is simply to connect with Indian users in a holistic way. Xiaomi focussed on *five path* approach;

S.No.	No. of path strategy	Strategy
01	First path strategy	*Customization of product* • Defining the needs of target audience, • To make their wristband accessible to Indian users • To make sure to offer high specifications at lower prices. • Distinction with android feature by launching their own operating platform MIUI which provides instant, unique and continuous updates to their users
02	Second path strategy	*Use of Social media*-Xiaomi have played and utilized their marketing mix very efficiently by leveraging over social media platform for launching of their products, better reachability, vast user review club through blogging and generation of product demand , wait and hype by anticipating the sales of product under " flash sales campaign". Flash sales created a sense of curiosity among users and developed a feeling of product exhaustion in the market;

03	Third path strategy	*Use of Culture for acceptance and adoption-* Connecting with local culture, by introducing the interactive voice response system for Indian users and creation of local fan community where Xiaomi directly interact with them by organizing fan festival & gathering
04	Fourth path strategy	*Promotion of sale through electronic platforms* Collaboration with e-commerce platform for sale like Flipkart and Amazon so that their product can obtain a maximum coverage;
05	Fifth path strategy	*Continuous up gradation,* Xiaomi ensured that with their low price offering they will introduce products with new feature so that user can purchase their product more frequently to be updated with technology

Source--Sachdeva, S.2018 & Tong, J. 2020

Exhibit 4: Market Mix of Xiaomi in India

Product	*Wide and SMART* Product range including Smart TVs, Smartphones & Wristbands etc.
Place	*Low Pricing* ranging from 999 INR to 2500 INR.
Place	*Collaboration* with FLIPKART and AMAZON
Promotion	Flash Sales and Micro blogging

Source: Table prepared by Authors based on data from website of MI and (Sachdeva, S.2018) (Tong, J. 2020)

Benefits of Wristbands

- **Self-health analysis by monitoring physiological parameters:** Gadgets and wearable devices allows patient to rehearse their and body and participate in self-health analysis rather on a continuous basis like step counts, calories used, water intake, sleeping pattern , heart rate and pulse rate.
- **Mobility:** Wearable gadgets allow real-time health check-up and access to track alarming situation providing incident based health treatment. It gets easily mounted over the wrist and like watch allows the user track and monitor the health status.
- **Reporting and sharing of health Data:** Gadgets make reporting of body dynamics through graphs and indicators which are easy to understand, easily viewed over Smartphone and tablets and can be shared through mobile network. The vicinity of health data increases for health care providers also.
- **Easy Integration:** Health Wristbands can easily integrates with phone's calling, texting and Bluetooth features of the smart phone
- **Personalized :** Wristbands are personalized as they are integrated with personal mobile number and email ids
- **No special Training:** Special training is NOT required by user to apply wristband as they are "plug and play" in nature.
- **Personal accountability for health:** Health wristband track and monitor your health status and thus create an individual motivation for achieving health goals, providing a true retrospective health analysis.

- **Group dynamics –** While personal motivation is ultimately a key component of good health, many users also enjoy the benefits of posting their health status on social media and many health tracking mobile applications are promoting your self-health management efforts and getting linked up with other users in your area, creating workout groups, and hosting challenges.

Exhibit 5: Various features offered by Health wristband in India

S.No	Features	Description
1	*Monitoring heart rate*	It gives clear insights of heart for daily routine works and activities
2	*Monitoring breathing*	It measures heart rate variations throughout the day & helps to determine the comfortable breathing pattern. It also monitors inhaling and exhaling pattern of consumer.
3	*Tracking calories burnt*	It measures the total calorie burnt by consumer. It helps user to maintain weight and vital body functions.
4	*Watching cardio fitness levels*	It calculates the amount of oxygen used by your body when you perform different activities. This shows the functionality of your vital organs like lungs, and heart which process osygen for our body Higher the score, better your cardiovascular performance.
5	*Sleep tracking*	It helps to measure and record sleeping time and sound sleeping time. User can review the sleeping pattern with other body dynamics.
6	*Tracking holistically*	Besides just tracking walking and running, there are several other activities like hiking, biking, yoga that a fitness band can track. All drills and exercise are added to routine list

Source: from Xiaomi website

Heart rate monitoring

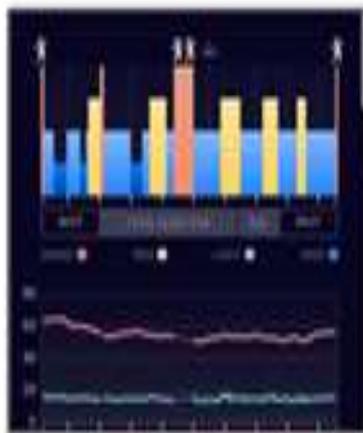
Guided Breathing

S

Tracking Calorie Burnt

Cardio Fitness Level

Source : Images from websites

Tracking Sleeping Pattern

Tracking Holistically

Source : Images from websites

Summarizing the health wristbands in India it seems that the consumers are undergoing shift in the device and gadget use wherein users are adopting various types of new gadgets and electronic devices for self-health monitoring and managing their fitness level on a daily basis in real time way. The wristbands manufacturers are continuously developing gadgets with close match to user needs and setting up an approach for boosting their fitness regime and inducing self-motivation. Health wristbands serve as an affordable, easy to use, understand alternative for the users on the application part. Also on the pricing part it bridges the gap between the wristbands and Smart watches for Indian consumers. In the wearbles market for health fitness the coming technological update is ear-worn gadgets. Seeking its growth figures for last quarter of 2019 it seems that it has overcome wristbands and marked annual growth of 374.9%. This category includes earphones that track and monitor health with a touch of a button or word detection process. This category accounted for most of the market shipments with 55.9% share, followed by wrist bands at 35.2% and watches at 6.9%.the reason for exponential growth of ear-worn health gadgets is that traditional audio vendors are moving their production towards wireless technology which provide ease of operation, comfort, luxury and understanbility for the user for carrying out self-fitness tracking activity. In current scenario, when pandemic Corona Virus has affected the World the market of health wristband is also getting affected because of saturation in the e-commerce business and lockdown situation across the globe. Though the business and purchase is affected but it is temporary in nature as the benefits of wristband is enabling user to do self-body monitoring in better way like breathing rate, heat rate and pulse count. Through such body dynamics monitoring user can proactively fight against lifestyle challenges and keeping healthy.

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