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Technological Innovations in Healthcare to Address the Challenges Posed by Lifestyle Diseases - in the Context of Nutritive Habits

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Abstract

The study endeavored to examine the dietary habits of urban Indians and their impact on lifestyle diseases, recommending digital interventions to mitigate these issues. The research conducted in Kolkata involved 129 participants aged 30-69 using a 72-hour dietary recall survey from May to June 2022. The research findings revealed that most participants (65%) belonged to the 30 to 40 age group. Among the studied cohort, it was projected that 36% of individuals had non-communicable diseases (NCDs). The clinical manifestation of NCDs showed that 13% had elevated blood pressure, 14% had hypertension stage I, and 2% had hypertension stage II. Regarding body mass index, 52% were categorized as normal, 35% were overweight, and 11% were obese. The Global Status Report on NCDs and the United Nations Report emphasized the need for NCD surveillance, healthcare intensification, population-based prevention, and enhanced response capacities. Among the individuals with NCDs, approximately one-third were obese, and close to one-third were overweight. Among individuals interested in mobile health (m-health) technology, 37.2% existed or desired to adopt the technology. Another 3.8% had vague awareness but were enthusiastic, and 27.9% had no intention. The non-parametric statistical test was conducted using the Kruskal-Wallis H test. The results suggested a statistically significant association between an individual's physical activity level, calorie consumption, average hours spent on social communications and NCDs. However, no significant link was found between sleeping patterns and NCDs. Technology offers the potential for better healthcare through competence, proficiency, accessibility, and personalization, reducing mortality and morbidity.

Keywords: Caloric Intake, Digital Health Technology, Lifestyle Diseases, mHealth, Non-Communicable Chronic Disease, Sedentary Behavior.

Introduction

The prevalence of lifestyle diseases has emerged over time due to genetic profiles or the daily habits practiced by the concerned population. These conditions are not contagious and cannot be transmitted from person to person (1). The outcome of non-communicable diseases (NCDs) can curb the freedom of an individual with a disability and mortality and impose a substantial monetary burden on health services (2). It is a significant public health concern in a global scenario. Non-communicable diseases kill 41 million people yearly constituting 71 per cent of all causes of global mortality. It is estimated that every year, 15 million people expire from an NCD between the age range of 30 and 69 years. Over 85 per cent of premature deaths take place in low to middle-income nations (3). The prolonged urbanized way of living cumulates various lifestyle diseases. The amalgamation of four healthy life choices - sustaining a healthy weight, regular workouts, following a balanced diet, and habit of not smoking - are associated with an almost 80 per cent reduction in the development of the common and deadly NCDs (2). The nutritional transition, which consists of energy-dense meals that hover in fat and sugars, contributes to the rise of obesity (4). Obesity implies energy discrepancy; thus, nutritional intake and energy disbursement are the chief areas in which to intervene. Obesity can be prevented; thus, the global NCD target is to halt excess body mass index. In India, NCDs are responsible for 63% of all deaths (5). The frequency of overweight and obesity for women is 31% in urban regions and 15% in rural areas. In comparison, 27% of men are overweight or obese

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in urban areas, compared with 14% in rural areas (6). Reviewing the past few decades, a dramatic transition happened in how the globe is eating and drinking, which has negatively clashed with the biology of the human system, creating significant alterations in body composition (7). The nutritional transition is due to the industrialization and globalization of food systems. Urbanization can be rightly said to be the primary driving force for overweight and obesity. The trait had steadily emerged in low to middle-income nations. India has also enjoyed a significant fiscal boost in recent decades, reflected in enhanced incomes and consumer buying power (8). Unfortunately, the benefit of economic growth was not translated into strengthening the nutritional condition of the population at large but the reverse. Urban settings have provided ingress to modern eatables along with cultural and lifestyle changes. The nutrition transition in India is marked by shifting from a traditional high-cereals, low-fat diet to lower cereals and rich in saturated fat, sugar, and salt (9). The country, with 35% of the total population living on a vegetarian diet; has doubled its poultry meat consumption since 2000; a shift toward increased animal-sourced food intake (9). The transient aspect of urban life has catalysed the effects of huge time constraints on consumers, enhancing the requirement for convenience processed energy-dense foods readily available at affordable prices. In the current healthcare scenario, the problem of epidemics of infectious diseases is gradually shifting to degenerative and human-made illnesses. NCDs are the foremost causes of morbidity and mortality. The main driving force is recognizing the significant impact of the disease resulting from shifts in dietary patterns. Therefore, it is vital to evaluate these changes in nutrition and include them as a fundamental part of an appropriate policy approach. Tech-enabled healthcare practices have exhibited high efficacy. Mobiles have become an intrinsic part of our modern way of living. Mobile is multi-use and potent equipment capable of executing several responsibilities beyond its primary purpose of communication (10). Several new and ground-breaking functionalities and apps that address necessities in new areas are being launched daily. There is a built-up eagerness in mobile technology, especially smartphones. Mobile technology has tendered an exhilarating prospect of conveying obesity interventions remotely. The technologies aim to amend the behavioural dynamics leading to obesity to encourage a healthy lifestyle. These tools can potentially diminish the cost and the indisposition and impermanence burden of obesity (11). The device also has a humongous input and utilisation in a healthcare scenario. It leads to the speedy growth and improvement of medical software applications (apps). mHealth is the conveyance of healthcare amenities and information with the concerned device. The facilities presently accessible in global and Indian markets greatly vary in their intricacy and sophistication. It yields static information about the disease while others transfer considerably up the value chain, plenishing with compendious healthcare monitoring and management (12). Numerous apps are available to assist patients. Healthcare providers propagate information and time management, healthcare records and accessibility, communication and consultation, reference and data congregation, patient supervision and monitoring, prompt therapeutic decision-making, and clinical education and training. It has significantly augmented access to point-of-care for better patient outcomes (13). These various prospects and opportunities elevate the query of whether the interventions are better, more effective, or more economical than conventional practices. The study attempts to comprehend the technological support available in managing non-communicable diseases. In lower and middle-income nations like India, there is a substantial probability to clout mHealth as an alternate healthcare conveyance channel. Structural, fiscal, and behavioral elements have generated a noteworthy necessity for such channels. The structural concerns are fundamental. The number of concerned Indian patients is high and scattered. Accessibility to primary healthcare is challenging. The associate infrastructure and various resources are insufficient. Fiscal limitations like mounting healthcare expenses and fair apportionment for healthcare by the administrative bodies further constrain the healthcare ecosystem in the country (10). Behavioral factors such as lifestyle alteration have caused diseases requiring access to few specialists. These providers cannot reach the

humungous masses through old healthcare delivery methods. The silver lining is the populace is getting tech-savvy with time and thus demanding more accessible and suitable modes to receive services and care. While technological modernizations and innovations offer promising solutions, hurdles such as digital literacy, approachability, and data confidentiality must be addressed. Guaranteeing equitable access to new-age technology, especially among vulnerable populations, is vital for accomplishing these initiatives. Technological advancements present a metaphorical chance to address the problems caused by lifestyle diseases, associated with dietary practices (11). To encourage healthier lifestyles, augment nutritional habits, and eventually aid in reducing the burden of lifestyle-related health problems by employing technology. In addition to being relevant, it is crucial in establishing a healthier future for individuals and communities everywhere.

Methodology

The study endeavored to examine the dietary practices of India's urban population and their consequential influence on the prevalence of lifestyle diseases. Additionally, it proposed implementing digital interventions to mitigate the adverse impact of such ailments.

Study Area and Population

Lifestyle-related illnesses have impacted individuals worldwide, across diverse age groups and geographical locations. Research indicated that a substantial number of premature deaths, amounting to 15 million, attributed to non-communicable diseases occur within the age bracket of 30 to 69 years. To comprehend the intricacies of these conditions, a study population encompassing individuals aged 30 to 69 years, of all genders, was chosen. The current evidence revealed the incidence of towering lifestyle diseases in case of mortality and disability-adjusted life years in the state of West Bengal. As per the National Family Health Survey 2015-16, around 40.6% of the women and 42.7% of men in Kolkata, West Bengal were overweight or obese. Lifestyle diseases or NCDs are strongly associated with obesity and overweight. Thus the investigation focused on Kolkata, the capital city of West Bengal, namely NSHM Knowledge Campus, Behala - College of Management and Technology, and Patipukur Pallishree Vidyalaya, South Dumdum – Government High School. Though this was selected for convenient purposes, these two institutions could represent the cross-section of academic institutions in Kolkata.

Study Design - Sampling Method and Size

The study utilised a cross-sectional survey with a stratified sampling method. A collection of 129 samples were acquired for assessment and analysis purposes. The respondents represented various societal roles, encompassing academic professionals, homemakers, office goers, retirees, housekeeping staff, security guards and doctoral students.

Sources of Data, Data Collection and Validity

In this study, the primary sources of data were utilized. It comprehensively evaluated various aspects including ordinal parameters based on body mass index and blood pressure – systolic and diastolic. Additionally, it examined demographic factors, nutritional status, and the knowledge and practices of the surveyed individuals. The questionnaire-based quantitative study was done through in-depth interviews to gather and assess the 3-day recall diet survey and lifestyle habits conducted over May and June 2022. The study advanced to the content validity index (CVI), engaging five experts in the validation process. This collaboration yielded impressive consistency for the item-level CVIs (I-CVIs). The standard benchmark for I-CVI is widely recognized as ≥ 0.78, particularly when involving a panel of 3-5 expert reviewers (14). Achieving an I-CVI of 0.8 is a commendable outcome, indicating that the individual items demonstrate strong content validity and are well-supported by expert insights.

Statistical Techniques

The study undertook a descriptive analysis using Statistical Package for the Social Sciences Version 20. The non-parametric statistical test was conducted using the Kruskal-Wallis H test. It was used to determine if there were significant differences between the four mutually exclusive groups (15).

Results

Based on the study results, the majority of participants (65%) felt within the age range of 30 to 40, followed by 19% in the age range of 41 to 50, 8% between 51 to 60 years, and another 8% in the age range of 61 to 69. Regarding gender, females accounted for 52% of the respondents, while males accounted for 48%. Regarding occupation, the breakdown showed that 8% were academics, 43% were employed in services, 11% were homemakers, 6% were retired, and 2% were entrepreneurs. The observation suggested that 36% of the studied cohort exhibited non-communicable diseases, 11% had other diseases such as communicable diseases and the remaining 53% had no significant illness. The clinical manifestation of NCD depicted 13% had elevated blood pressure (120 -129/<80 mm Hg), 14% with hypertension stage I (130-139/80-89 mm Hg), and 2% suffered from hypertension stage II (≥140/≥90 mm Hg) (16). Analyzing the body mass index, 52% were found in the normal range (18.5 – 24.9 kg/m^2), while 35% were overweight and 11% were obese (Grade I, II and III) (17). When focused solely on the 46 patients with NCDs, which accounted for 36% of the total sample, the data illustrated the breakdown of BMI categories - 14 individuals (30.4%) were categorized as obese, suggesting that around one-third of the said population fell into the obese category of grade I, II or III. Whereas 13 (28.3%) respondents were characterized as overweight, indicating that nearly one-third of the population was overweight, which is quite alarming. This data analysis showed the distribution of individuals based on their reported daily sleep duration (6-8 hours) and various health concerns. Figure 1 highlights that most participants reported no significant health concerns (62 out of 69) when sleeping 6-8 hours daily. However, some reported other diseases (11 out of 14) and non-communicable diseases (36 out of 46) despite meeting the recommended sleep duration.

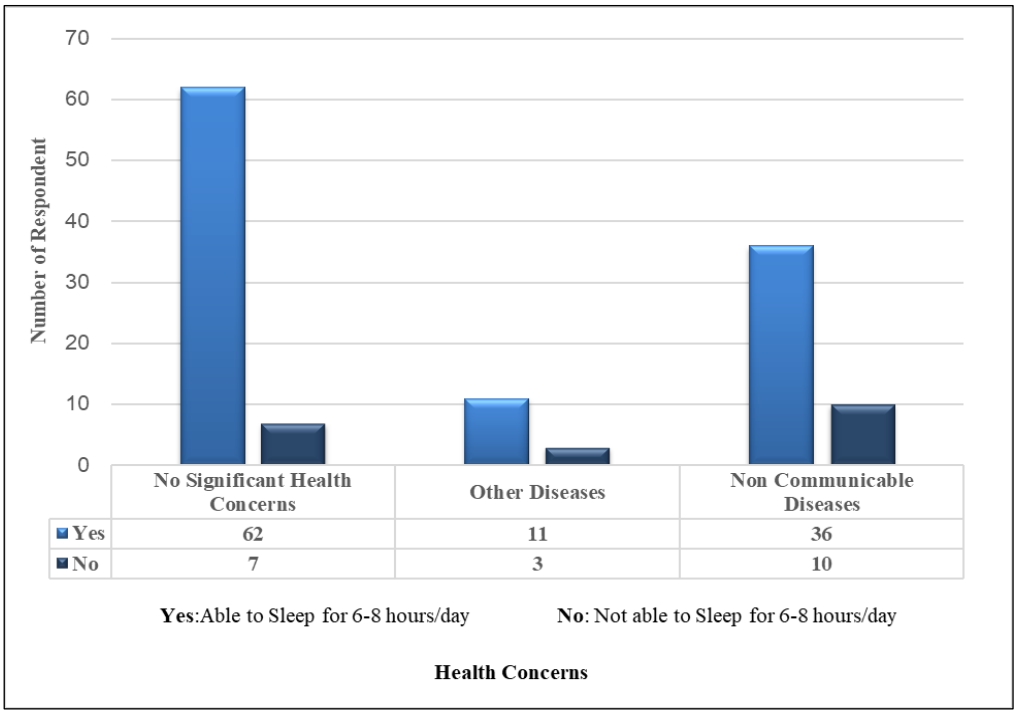

Figure 1: Sleeping Habits

The provided data illustrated the distribution of physical activity levels categorized by health concerns (Figure 2). Among individuals with no significant health concerns, 53 were classified as highly active, 9 as moderately active, 4 as lightly active and 3 as sedentary. In contrast, among those categorized under other disease profiles, 5 were highly active, 4 were moderately active, 5 were lightly active and none were sedentary. Regarding individuals with non-communicable diseases, only 1 was highly active, 2 were moderately active, 6 were lightly active and 37 were sedentary.

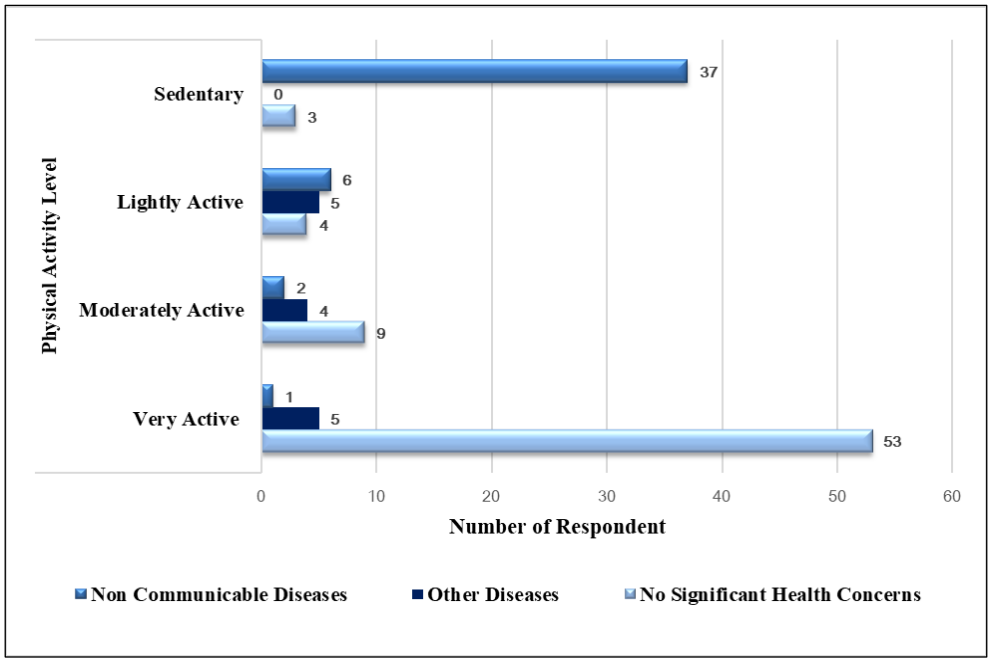

Figure 2: Physical Activity Level Vs Health Concerns (Frequency)

The analysis shown in Figure 3; shows the health concerns and the distribution of calorie consumption. Among individuals with no significant health concerns, 22 were observed to have a calorie surplus, 32 had adequate consumption and 15 exhibited a calorie deficit. For the other diseases, 9 individuals had a calorie surplus, 3 had adequate calorie and 2 had a calorie deficit. Notably, among individuals with non-communicable diseases, 26 individuals had a calorie surplus, 18 had adequate calorie intake and 2 had a calorie deficit in their diet.

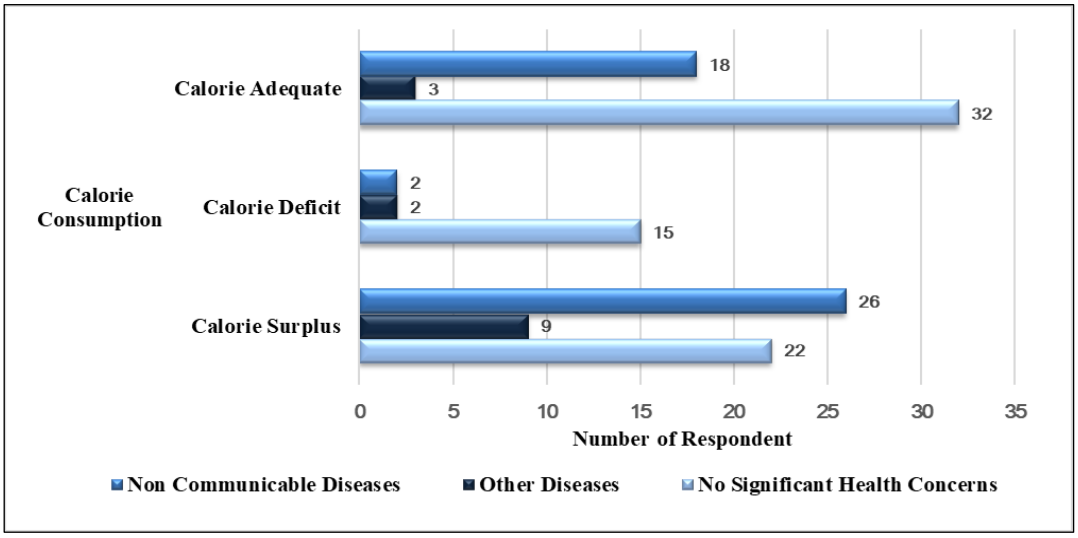

Figure 3: Calorie Consumption Vs Health Concerns (Frequency)

Another vital aspect that the data highlighted was that the concerned population had access to mhealth facilities while spending significant time on social media platforms. The data in Figure 4 specified the average hours spent on social media categorized by health concerns. Among individuals with no significant health concerns, the majority (38 individuals) spent 3 hours on social media daily, 18 individuals spent less than 1 hour, and 7 individuals spent 2 hours. Notably, there were no individuals in this category spending more than 5 hours. In the case of other diseases, the highest number (9 individuals) spent 3 hours, while 4 individuals less than 1 hour. For individuals with non-communicable diseases, the highest number (21 individuals) spent more than 5 hours on social media, followed by 10 individuals spending 4 hours.

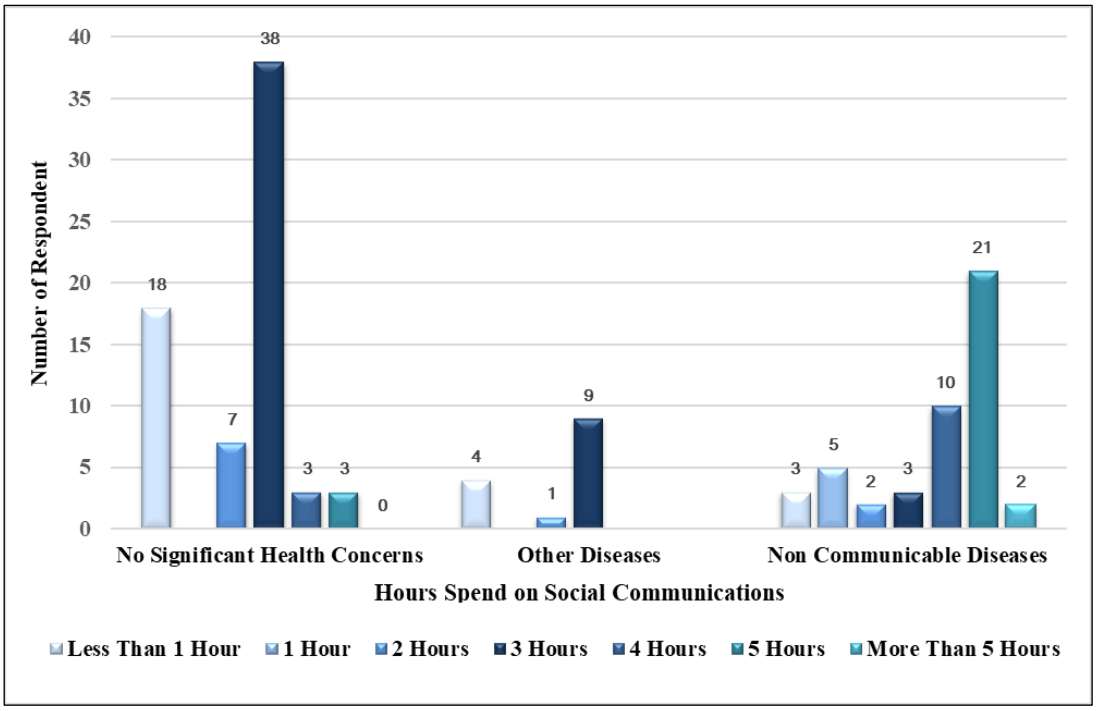

Figure 4: Average Hours Spent on Social Communications Vs Health Concerns

The information presented in Table 1 included the test statistics obtained from the Kruskal-Wallis test. The test was conducted using four variables: physical activity level, sleeping habits, calorie consumption, and average hours spent on social communications with the health concerns of the respondents.

Table 1: Significant Association of Various Attributes with Ncds – Kruskal Wallis Test

Variables	Test of Significance			Effect
	χ2	df	p	
Sleeping Habits	3.228	2	0.199	Not Significant
Physical Activity Level	52.386	2	0.001	Significant
Calorie Consumption	6.165	2	0.046	Significant
Average hours spent on Social Communications	32.232	2	0.001	Significant

***A significance** level of $p < 0.05$ was considered statistically significant.

The chi-square value for the physical activity level variable was calculated as 52.386, and the corresponding p-value is 0.001. These results suggested a strong and statistically significant association between an individual's physical activity level and NCDs. The chi-square value for the variable of sleeping habits was determined to be 3.228, with a corresponding p-value of 0.199. These findings indicated that there was no statistically significant association between sleeping habits and NCDs. Regarding calorie consumption, whether it was in surplus, adequate, or deficit, the chi-square value obtained was 6.165, and the corresponding p-value was 0.046. These results suggested a statistically significant association between calorie consumption and NCDs. When examining the average hours spent on social communications, it was found that the chi-square value was 32.232, with a p-value of 0.001. These results indicated a highly significant association between the amount of time spent on social communication and the occurrence of NCDs. The data provided in Figure 5 indicated that among individuals already using or interested in adopting mhealth technology, 37.2% were aware of the technology, while 2.3% (3) expressed no inclination towards its usage. A further 3.8% (5) displayed vague awareness but

were enthusiastic about adopting mhealth, whereas 27.9% had vague awareness but were not inclined to utilize it. Additionally, among those unaware of mHealth, no individuals expressed an eagerness to adopt it, while 28.6% demonstrated no inclination towards its utilisation.

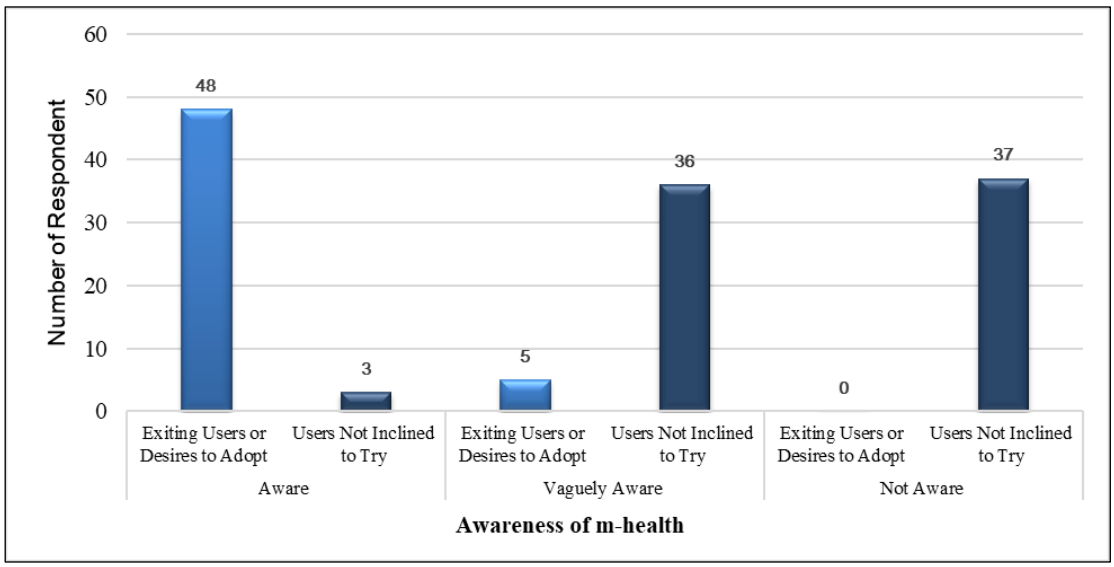

Figure 5: Knowledge and Awareness of mHealth

Discussion

The Global Status Report on Non-Communicable Diseases, World Health Organization and the United Nations Report thoroughly account for the global burden of NCDs, related risk factors, and various determinants. They highlighted the instant opportunities to cater to the epidemic in all available settings. It broadly focused on NCD surveillance, intensifying health care, population-based deterrence, and nations' capacities to respond to outbreaks. These lifestyle-related factors contribute to the development of NCDs and can be influenced by an individual's activity level. The data (Figure 1) provided a snapshot of the distribution of health conditions within the studied cohort of sleeping habits. The majority of the respondents sleep for 6 to 8 hours a day. The research findings did not demonstrate a significant statistical association with NCDs (Table 1). However, the timing of sleep is also vital to be captured and understood in the context of the impact of NCDs (18). The fact that sedentary behaviour was more common among people with NCDs was another important factor that emphasised the value of physical activity in maintaining health and preventing chronic diseases. The data (Figure 2) suggested a relationship between activity level and health status, with individuals without significant health concerns demonstrating higher activity levels than those with non-communicable diseases. The analysis (Figure 3) provided insights into the relationship between calorie intake and health concerns. Notably, individuals with a calorie surplus or deficit are more likely to experience health issues compared to those with an adequate calorie intake. With the advent of urbanisation, the alteration in diet from high-fibre to processed foods comprised of fat and sugar was the prime reason for a calorie surplus, as proposed by Barry M Popkin (19). The evidence suggested rapid changes in dietary habits, physical activity levels, and body composition within low to middle-income countries, resulting in potential health consequences. Behavioural modification and nutrition education theories highlighted the importance of adopting social and trans-theoretical approaches to promote a healthier lifestyle. The Nutrition Care Process model aims to deliver comprehensive nutritional care, including expert assessment, education, goal setting, and self-control strategies like meal planning and portion control (20). Popkin, Adair, and Ng addressed the global shift in dietary patterns, starting from the 1970s with increased consumption of processed foods, fast food, oils, and sugary beverages, accompanied by reduced physical activity and a rise in sedentary behaviour (8). These changes became more prominent in low to middle-income countries during the 1990s, coinciding with a surge in lifestyle-related diseases such as hypertension and obesity. The

author, Matthew Kelly, also elaborated on the enhanced intake of processed and packaged convenience foods (9). It traced various aspects of between-country variances, considering the propagator of dietary change. The fiscal growth with better income, urbanization, changes in family size, food system, industrialization, and liberalization of world trade contributed to the process. Various factors reckoned the inception of the nutrition transition, and it also impacted the epidemiological transition. Biswajit Ghose expanded on the dual burden of diseases which brought serious health and fiscal conundrums (21). The healthcare system and the socio-economic status of the South Asian countries have been well depicted. The theoretical and evidence-based nutritional intervention can be implemented for secondary to tertiary inhibition or preventing obesity and NCDs. They are physically sedentary, have unhealthy diets, smoke, and have a high level of stress. Addressing these health behaviours in the early, developing years of life is essential because the risk factors grow in childhood and continue into adulthood (22).It aided in understanding behaviour and thus plans health promotion programming by considering and addressing the various reasons and features affecting the behaviour alteration processes. In public health, data quality is indispensable for improving and forming the right health policy and programs. The dietary assessment instruments currently employed were insufficient for evaluating diets related to nutrition transition. A national survey was conducted by Ponce *et al.,* for the Mexican populace with a stratified, multistage, probabilistic sample design (23). The diet quality indices detected nutrients and eatables whose endorsed amount was not sufficiently devoured by the people. Dietary diversity implies the qualitative analysis of food intake reflecting household ingress to various foods (24). The Food and Agriculture Organization of the United Nations described in guidelines the simple tally of food groups the household or the individual can consume over the preceding 24 hours. India exhibited divergent demographics and epidemiology. The transition in lifestyle and food habits had been catalyzed by internal migration and urbanization (25). This change in food intake and activity patterns has negatively contributed to increasing sedentariness, widespread obesity, and other non-communicable diseases (26). The detailed overview of the unadorned inequalities in pay, health hazards, contamination of food sources by insecticides, globalization of trade boosts cash crops for export, and adopting western-type diets had been prime reasons for the health issues (27). It is vital to identify dietetic patterns and their connotation with micronutrients and related undernutrition, such as Calcium, Iron, and Zinc, and also NCD risk factors, such as underweight, obesity, and waist: hip ratio, hypertension, total cholesterol, diabetes as described by Joy *et al.,*. (28). Dietary-guided principles accentuate the precedence of health and the preclusion of disease. The National Institute of Nutrition guideline combined food-centric approaches in qualitative and quantitative dimensions (29). The stress is on constructive dietary habits through using the diversity of foods in traditional ways. B. Srilakshmi, in her book "Dietetics" also stressed the competence of intake of eatables from entire food groups to maintain optimal health (30). It is essential to comprehend that NCD prevention can be achieved through lifestyle modification, where diet plays an enormous role. This data (Figure 4) suggested that individuals with non-communicable diseases tend to spend more time on social media compared to those with no significant health concerns or others. The various apps, digital health trackers, and telemedicine provide a mammoth prospect to propagate awareness and educate the populace of diverse social strata (Figure 5) (31). Additionally, it hints at potential differences in social media usage patterns based on health status. In the era of hybrid working and rebooting our work-life balance, digital health and wellness companies have enumerated convenient and tailored healthcare guidance regarding nutrition, water intake, and fitness (32). It aims to achieve a healthy lifestyle at the fingertips. The customized action plan would follow depending on age, gender, food preferences, major ailments, lifestyle choices, and practices (33). The live workout sessions with experts and exercise at home are commodious. The food scanners inform the users about specific ingredients and their nutritional capacity (34). With Food and Activity Tracker**,** keeps a tab on the food and trails the activities throughout the day. The count of macro

and micronutrients in the food, such as proteins, carbohydrates, fats, fibre, calcium, zinc, etc., are closely monitored. The calorie insights and analysis are received regularly. Artificial intelligence nutritionists and fitness experts can motivate and solve the probes in real time (35). They empowered the patients with well-curated knowledge about wellness and health with various updated articles, videos, and documentaries. The copious healthy, delicious recipes are shared as per the users' preference. Wearable health and fitness tracking equipment bestows information about activity levels, calories burned, sleeping patterns, heart rate, and many more, depending on the type of device (36). It can be a fitness tracker, smartwatch, or running watch. Weighting scales aid in transferring information about the person's weight and body composition to smartphones, and the associated app assists in managing the fitness and goals set. While retaining privacy and confidentiality, the websites recording personal health records needs to permit patients to monitor their health information on the hosted website or mobile application. It is an individual's moral right to control when and how their data is retrieved and shared is known as privacy (37). The space is sufficient for the data to be organized and can be shared with the physicians, call schedules, track and schedule the appointments and clinical obligations, and respond to emergencies (38). Cloud-based storage and file-sharing facilities are also available and easily accessible using smartphones. It is recommended for a virtual repository as it allows the users to store, apprise, and share documents without needing a flash drive. Most cloud-based storage systems grant the users some gigabytes of memory, which is free of cost. The additional space can be acquired with the stipulated payment with the annual subscription. The cloud-based info storage has the supplementary advantage of authorizing information to be retrieved or accessed instantly from several devices (39). These assist the healthcare providers in collaborating to share materials for prompt decision-making quickly. The data from Google Trends stated India ranked amongst the top five nations for the search of 'mobile health,' 'health apps,' 'medical apps,' or 'mHealth' (10). Only mHealth and digital technology can grow whenever there is a demand. The statistical data pointed to the people's interest. In Pricewaterhouse Coopers, the critical barriers for the providers were lack of interest amongst the primary users, the culture of medicinal professionals, and deficiency of information on mHealth (10) . Another relevant aspect highlighted that the patients found the services helpful but expensive, needed relevant applications, and willingness to use mHealth. People from affluent or intermediary social milieus were likely to use the apps, while there was reluctance from lower milieus style to use concern digital devices (40). Multi-component intercessions will have more efficacy than stand-alone app interventions. Technical advancement in healthcare must be imbibed into mainstream therapeutic services (41). It is vital to create a sense of the possibilities of available technology and implementation for the target population to achieve the desired outcome (42). It can only be possible with partnerships with foundations, government authorities, telecom operators, etc. There is an urgent need to concede that united and collaborative efforts by the numerous stakeholders in the healthcare industry. It will be necessary to make mHealth a success in India. The study's limitations are a substantial disparity in access to technology between urban and rural populations in a country like India. The infrastructure is essential for digital health solutions lacking in rural regions. Thus restricting the adoption of technological advancements (43).It is also necessary to take into account the cultural barrier. India's dietary customs have their roots in cultural traditions. Adopting healthier eating habits may be impeded by local food preferences and cultural attitudes, which may make technological treatments ineffective (44). The digital health technologies also raise concerns about data security and privacy, which makes patients reluctant to share personal health information. It does limit the effectiveness of mHealth applications and telemedicine (2). The regulatory framework is still evolving. The high installation cost of the digital system is a barrier in low-income settings. The lack of awareness of the benefits of technological innovations in healthcare among both healthcare providers and patients. This can lead to underutilization of available resources (45). Consequently, it can be asserted that digital interventions for managing

NCDs in India can be achieved by overcoming the limitations and strengthening the numerous mHealth applications, telemedicine, and online health education platforms. mHealth apps empower patients to monitor the patients' conditions, enabling better self-management and adherence to treatment (46). Improving access to healthcare and endorsing lifestyle changes, mHealth has substantial potential to plummet NCD burdens across diverse populations. Telemedicine also augments access to healthcare, particularly in remote areas (47). In the Indian context, digital health interventions are used to bridge gaps in access to primary care (48). The e-learning programs - interdisciplinary education for health workers aids in improving the quality of integrated care for NCDs. Creating an interdisciplinary workforce in nations like India helps to prevent and control lethal diseases (49). The awareness amongst the natives will aid in accepting the technology. The government of India has instigated several efforts in the last few decades to enhance access to and opportunities for healthcare in urban and rural communities. These interferences will leverage technology to augment health outcomes, accessibility, and patient engagement in managing NCDs across diverse communities in India.

Conclusion

India is enduring a speedy transition in healthcare due to the shift from infectious diseases to lifestyle or NCDs. The transformation and imbibing of urbanized lifestyle patterns are the key drivers in amplifying various ailments. Non-communicable diseases are the prevailing cause of morbidity and the principal cause of mortality in our country, especially in urban India. Technology enables healthcare enactments to have incredible potential in improving the well-being and healthcare delivery, with competence, proficiency, accessibility, and personalization of the services (32). A cohesive digital health strategy is crucial for effective management of NCDs. The strategy should focus on six main components of digital health: leadership and strategy, governance, regulations and policies, infrastructure, services and applications, and workforce development. A structured intervention to digital integration must syndicate telemedicine and mHealth solutions while prioritising healthcare professionals' digital education and training (47). An important step ahead is to make the public aware of digital health tools and their advantages. It will foster greater adoption and engagement. Ongoing evaluation is compulsory to guide improvements and ensure that these initiatives achieve the intended health outcomes (46). The Indian government has initiated numerous efforts over the past few decades to improve healthcare access and opportunities for both urban and rural populations. These initiatives utilize technology to augment health outcomes, increase accessibility, and promote patient involvement in managing NCDs across various communities in India. The interventions can gain acknowledgement and better responses for treating and managing lifestyle diseases. Various apps, digital health trackers, and telemedicine provide a mammoth prospect to propagate awareness and educate the populace of diverse social strata. Despite the benefits, some sections of society remain reluctant to adopt the technology. Better canons and validation practices must be established and integrated with refined tools with enhanced quality and safety features. By putting usability, safety and connectivity – digital technology can shape the future of connectivity and personal health management (50). The study can potentially guide policymakers' decisions to assimilate feasible interventions for treating and managing lifestyle diseases.

Abbreviations

mHealth: Mobile Health, NCDs: Non-communicable diseases.

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Author Contributions

Dr. Soumi Ray was involved in conceptualizing the project, curating data, and preparing the original draft. Dr. Sukanti Bhattacharyya contributed to visualization, and methodology, and provided review and supervision. Pabitra Sahoo assisted with the methodology, validation, and editing.

Conflict of Interest

There is no conflict of interest.

Ethics Approval

Not applicable.

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