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All editorial correspondences should be addressed to:
The Editor, Health and Population: *Perspectives and Issues*,
National Institute of Health and Family Welfare, Baba Gangnath Marg,
Munirka, New Delhi-110 067, India.
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Self-reported Diabetes and Challenges in Its Management among Older Adults in Assam, India

[*]Puja Goswami and [**]T R Dilip

[*]Research Scholar, International Institute for Population Sciences, Mumbai, India, E-mail: puja16@iipsindia.ac.in
[**]Associate Professor, Department of Family and Generations, International Institute for Population Sciences, Mumbai, India, E-mail: diliptr@iipsindia.ac.in

Abstract

This study examines the prevalence and management of diabetes among the older adults in Assam, India. This study utilizes the data from the first wave of the Longitudinal Ageing Study in India (LASI) conducted in 2017 – '18, covering 72,250 eligible individuals residing in a sample of 42,949 households surveyed. LASI adopted a multi-stage area probability cluster sampling design, a three-stage sampling design for rural areas; and a four-stage sampling design for urban areas. Those aged below 45 years are excluded from this study. Hence, the results are based on a representative sample of 2006 eligible individuals surveyed in the state of Assam.

Multivariate logistic regression analysis is used to study the association between socio-economic factors and prevalence of diabetes. Further, the risk prevalence of unhealthy behaviours among the diabetes patients is calculated to present a clear picture of the attitude towards diabetes management by the people of Assam. Findings confirm a high self-reported diabetes in the urban, educated, and richest sections but the prevalence was substantial among their remaining counterparts. Older adults with a parental history of diabetes were 6.3 times more likely to report than others. The majority of the diabetes patients (58 %) had hypertension. Among those with self-reported diabetes, 37 per cent was not under any diabetes medication, 11 per cent was not taking a special diabetic diet, 22 per cent was physically inactive, and 33 per cent was either overweight or obese. Policy-level interventions need to be strengthened further to counter the rural-urban disparity in access to diabetic medication, unfavourable dietary regimes, and physical activity levels observed among those with self-reported diabetes.

Key words: Diabetes, Older adults, Diabetes prevalence and management, Diabetes Comorbidities, LASI, Assam, India.

Introduction

Diabetes is a widespread health issue that affects a significant portion of the world's population, with type 2 diabetes accounting for 90 per cent of diabetes cases. The condition arises when the body either cannot effectively use the insulin produced or does not produce enough insulin. India, in particular, is facing an alarming prevalence of diabetes, with more than 74 million individuals

living with diabetes in 2021, and this figure is predicted to rise to 125 million in the next 24 years[1]. This has led to India being labelled as the "Diabetes Capital of the world."

The complications of diabetes including microvascular and macrovascular complications result in increased morbidity and mortality rates[2]. This is further compounded by the fact that diabetes often leads to other comorbidities[3]. According to the Non-Communicable Disease Risk Factor STEPS Survey-India, hypertension is the most prevalent comorbidity affecting 60 per cent of diabetes patients, followed by obesity (46%), dyslipidemia (36%), hypertriglyceridemia (30%), hypercholesterolemia (16%), cardiovascular disease (13%), stroke (6%), and chronic kidney disease (5%)[4]. Similarly, the Chennai Urban Rural Epidemiological Study reports that the prevalence of diabetic retinopathy, microalbuminuria, peripheral neuropathy, coronary artery disease, and peripheral vascular is 18 per cent, 27 per cent, 26 per cent, 11 per cent, and 6 per cent respectively[5-9]. However, proper disease management can delay the onset of these comorbidities.

Unfortunately, the DiabCare Asia study on diabetes control and complications in the Asian countries paints a grim picture of diabetes management in India, with approximately half of the diabetes patients having poor glycemic control and early incidence of type 2 diabetes[10]. Moreover, the prevalence and management of this uncontrolled epidemic in the north-eastern states of India including Assam, have not been subjected to substantive investigation due to the lack of epidemiological data[11]. Assam has an estimated population of 35 million in 2021 and accounts for 68 per cent of the population of north-eastern India[12].

Recent national survey-based estimates for the population aged 15 years and above in Assam reveal that 13 per cent of females and 16 per cent of males have high or very high blood sugar levels (>140 mg/dl) or are taking medicine to control their glycemic levels which is similar to the average situation in India[13]. However, this dataset is yet to be released, and researchers rely on reported diabetes data from other national surveys to examine the prevalence of diabetes among older adults in India. Using the Indian Diabetes Risk Score (IDRS), it is found that among the Longitudinal Aging Study in India (LASI) respondents in Assam, 10 per cent are at low risk, 64 per cent are at medium risk and 26 per cent are at high risk[14].

This study aims at analyzing the prevalence of self-reported diabetes in Assam and the challenges faced by diabetes patients in terms of comorbidity and management of the disease. The findings will add to the limited epidemiological data on diabetes in the north-eastern states of India and provide insights into the situation in Assam. By understanding the prevalence and management of diabetes in Assam, policymakers and healthcare providers can develop strategies to improve diabetes prevention, management, and care.

Methodology

The study uses data from the first wave of the Longitudinal Ageing Study in India (LASI) conducted in 2017 – '18, covering 72,250 eligible individuals residing in a sample of 42,949 households surveyed[15]. LASI adopted a multi-stage area probability cluster sampling design, a three-stage sampling design for rural areas, and a four-stage sampling design for urban areas. It is India's first nationally representative household survey to estimate the prevalence of chronic

diseases among older adults and the elderly population across the socioeconomic spectrum, nationwide as well as for states and union territories. All married and non-married men and women aged 45 and above, along with their spouses in selected households, were eligible to participate in the survey. LASI covered 2366 eligible persons residing in a sample of 1511 households in Assam. The researchers excluded the spouses aged below 45 years; hence, the results presented here are based on a representative sample of 2006 eligible individuals surveyed in Assam. Results presented here were obtained after applying state-specific sampling weights presented in the LASI data set.

The self-reported prevalence of nine types of chronic health conditions/diseases including diabetes, amongst the respondents, was assessed in LASI through the question, "Has any health professional ever diagnosed/told you that you have the following chronic conditions or diseases?" This information was used in the analysis to determine the risk of self-reported diabetes in the study population. The prevalence of self-reported diabetes was analyzed by these factors: age (45-49,50-54,55-59,60+), sex (male, female), place of residence (urban, rural), number of years of schooling (no education, <5 years, 5-10 years, 10+ years), employment status (currently working, not working), monthly per capita consumption expenditure (poorest, poor, middle, rich, richest), caste (Scheduled Tribe, Scheduled Caste, Other Backward Classes, others) and religion (Hindu, Others). Social groups represent the respondent's status in the social hierarchy, which continues to be predominant in India. The four commonly used social group categories in ascending order of social hierarchy and vulnerability are scheduled tribes, scheduled castes, other backward classes, and "others" or the rest of the population. Here the economic status is based on the monthly per-capita consumer expenditure (MPCE) variable available in the data set which is derived using the information on the expenditure incurred by the sample households on 40 food and non-food items. State-specific rural-urban adjusted MPCE quintiles were created to identify the household's economic status. Bivariate analysis is followed by a multivariate binary logistic regression analysis to understand the adjusted odds/risk of self-reported diabetes within these subgroups under study.

The prevalence of selected comorbidities and risky behaviors that contribute to poor management of blood sugar levels were examined for 145 cases in the sample with self-reported diabetes. These analyses were disaggregated by place of residence due to the unavailability of enough sample size and also due to urban disadvantage in the prevalence of diabetes in this subcontinent. A similar disaggregated analysis could not be performed for other variables due to scarcity in the number of sufficient self-reported diabetes cases in the LASI sample for Assam state in India.

Among those with self-reported diabetes, the rural-urban differences in associated comorbidities were examined using data from similar self-reported questions mentioned above. Comorbidities that we examined were hypertension, chronic heart disease (CHD), stroke, and high cholesterol. Based on comorbidity status, the self-reported diabetes cases were further classified as those with only diabetes, diabetes and hypertension, diabetes and CHD or stroke, diabetes and high cholesterol, and diabetes and more than one of these conditions.

The four vital risky behaviours among the self-reported diabetic patients examined were: non-medication for diabetes, not following special diet adherence to control diabetes, physical

inactivity, and overweight/obesity. Information on the risk of not continuing diabetes treatment was obtained from the survey question to diabetic patients on "If they were taking medicines for controlling diabetes?" This is seen as a proxy indicator for treatment continuity, even though a small share of patients will not require medication. The response to the survey question- "In order to control your diabetes, are you following a special diet?" was used to understand the risk of not following a special diet for controlling this disease. The risk of a sedentary lifestyle among cases with self-reported diabetes was judged based on their physical activity levels. Physically inactive were defined as those who did not perform at least 150 minutes of moderate-intensity physical activity throughout a week or 75 minutes of vigorous physical activity throughout a week. Body mass index (BMI) was used for measuring the risk of poor body composition among self-reported diabetes patients. Proportion over-weight (BMI≥ 25) and obese (BMI ≥30) were computed for the same.

The analysis was performed using the statistical software STATA 15.0. Results presented here were obtained after applying state-specific sampling weights presented in the LASI data set.

Findings

Table 1 presents the background characteristics of the population and the prevalence of self-reported diabetes in Assam, India, during the years 2017 - '18. This Table provides an overview of the demographic distribution and the burden of diabetes in the region. The data presented in Table 1 show the prevalence of diabetes among respondents according to their background characteristics. It confirms the established pattern that the likelihood of diabetes increases with age. For example, the prevalence of diabetes is 10 per cent for the 55-59 age group, and it increases to 8.8 per cent for those who are 60 or older. In contrast, the prevalence of diabetes is relatively lower for those in the 45-49 and 50-54 age groups, at 4.7 per cent and 7 per cent respectively.

The distribution of diabetes prevalence also indicates that men are more likely to be diabetic than women. Specifically, the data show that 8.8 per cent of men and 6.6 per cent of women are diabetic. Moreover, the likelihood of having diabetes increases with social status. The prevalence of diabetes is highest for those who have at least ten years of schooling, at 14.7 per cent, and for those who fall in the topmost mpce strata, at 12.2 per cent.

The data also reveals a significant difference in diabetes prevalence between urban and rural areas. The prevalence is 13.7 per cent among urban adults and 6.4 per cent among rural adults. In terms of religion, there is no apparent distinction in diabetes prevalence. However, there is a stark contrast among castes. The prevalence of diabetes is higher among individuals of Scheduled caste, at 13.1 per cent, compared to Scheduled Tribe, at 5.7 per cent, Other Backward Classes, at 6.9 per cent, and General, at 7.8 per cent.

Table 1

Background Characteristics of Population and Prevalence of Self-Reported Diabetes in Assam, India 2017 - '18

	Population characteristics		**Self-reported diabetes**
Characteristics	**Weighted cases (N)**	**distribution (%)**	**Prevalence (%)**

Age			
45-49	503	25.1	4.7 (3.1-7.2)
50-54	355	17.7	6.9 (4.4-10.5)
55-59	307	15.3	10.0 (6.7-14.6)
60+	841	41.9	8.8 (6.8-11.3)
Sex			
Male	944	47.0	8.8 (7.0-10.9)
Female	1062	53.0	6.6 (5.0-8.7)
Place of residence			
Rural	1660	82.8	6.4 (5.2-7.7)
Urban	346	17.3	13.7 (9.6-19.2)
Education			
No schooling	817	40.7	0.0 (2.9-6.2)
<5 years	317	15.8	9.5 (6.3-14.3)
5-9 years	496	24.7	6.5 (4.7-9.1)
10 + years	376	18.7	14.7 (11.0-19.3)
Social group			
Scheduled Caste	180	9.0	13.1 (7.7-21.4)
Scheduled Tribe	314	15.7	5.7 (3.3-9.9)
Other Backward Classes	791	39.5	6.9 (5.2-9.1)
None	720	35.9	7.8 (6.0-10.1)
Religion			
Others	1545	77.0	7.5 (6.1-9.2)
Hindu	461	23.0	8.1 (5.9-11.1)
Current working status			
Yes	954	47.5	6.1 (4.6-7.9)
No	1052	52.5	9.1 (7.2-11.3)
MPCE quintile			
Poorest	379	19.0	3.8 (2.3-6.4)
Poorer	396	19.8	7.9 (5.2-11.8)
Middle	405	20.3	7.3 (4.8-10.9)
Richer	423	21.1	7.0 (4.8-10.1)
Richest	397	19.9	12.2 (9.0-16.3)
Family history of diabetes			
yes (at least parent)	101	5.0	33.3 (23.2-45.2)
No	1905	95.0	6.3 (5.2-7.6)
Total	**2006**	**100.0**	**7.6 (6.4-9.1)**

Table 2 examines the relationship between the socio-economic factors and the likelihood of developing diabetes in the same population through a multivariate analysis. Table 2 helps in identifying the significant risk factors that contribute to the development of diabetes and can guide public health interventions. The results from a multivariate analysis examining the relationship between socioeconomic factors and the likelihood of developing diabetes are presented in Table

2. The study found that having at least one parent with diabetes increases an individual's odds of developing the disease by six times (adjusted odds ratio of 6.3, 95 per cent confidence interval [CI]: 3.6-11.0).
Regarding socioeconomic factors, individuals in the highest wealth quintile were found to have higher odds of being diabetic (adjusted odds ratio of 2.6, 95% CI: 1.2-5.6) compared to those in lower quintiles. Similarly, residing in urban areas (adjusted odds ratio of 2.0, 95% CI: 1.2-3.3) or having at least ten years of schooling (adjusted odds ratio of 2.7, 95% CI: 1.5-4.9) were associated with a two-fold increase in the likelihood of having diabetes.

The study did not find any significant impact of sex on the likelihood of being diabetic. However, in line with previous research, age was found to be directly proportional to the odds of having diabetes. Individuals aged 60 and above had higher odds (adjusted odds ratio of 2.2, 95% CI: 1.3-3.8) of having diabetes compared to younger individuals.

Table 2
Adjusted Odds Ratio from Multivariate Logistic Regression Analysis
for Self-Reported Diabetes in Assam, India 2017 – '18

Adjusted odds ratio	
Characteristics	Odds ratio (95% CI)
Age	
45-49	1
50-54	1.53(0.80-2.92)
55-59	2.48(1.32-4.66)
60+	2.19(1.25-3.83)**
Sex	
Male	1
Female	1.50(0.92-2.44)
Place of residence	
Rural	1
Urban	2.00(1.21-3.31)**
Education	
No schooling	1
<5 years	2.07(1.10-3.90)**
5-9 years	1.34(0.75-2.39)
10 + years	2.71(1.49-4.92)**
Social group	
None	1
Scheduled Caste	3.16(1.50-6.67)**
Scheduled Tribe	1.30(0.61-2.77)
Other Backward Classes	1.64(0.94-2.85)
Religion	

Hindu	1
others	2.17(1.22-3.86)**
Current working status	
yes @	1
no	1.65(1.00-2.76)
MPCE quintile	
Poorest	1
Poorer	1.93(0.93-4.01)

Table 3 presents the prevalence of selected risky behavioural characteristics in diabetes patients in Assam, India, during the years 2017 - '18, categorized by urban and rural populations. This Table helps in identifying the differences in behaviour and lifestyle between urban and rural people that may contribute to the risk or management of diabetes progression; and can help in drafting targeted interventions for diabetes.

Table 3 presents a bivariate analysis that examines the relationship between diabetes management and place of residence. To gain insight into diabetes management, the study looked at factors such as adherence to diabetic medication and diet, frequency of physical activity, and body mass index (BMI). The results reveal a sharp disparity in adherence to medical regimens, with 44 per cent of rural diabetes patients reporting not taking regular antidiabetic medication compared to 19 per cent of their urban counterparts. Urban populations enjoy a slight advantage due to the easy availability of resources, as evidenced by 14.7 per cent of urban versus 13.6 per cent of rural respondents reporting not following a diabetic diet.

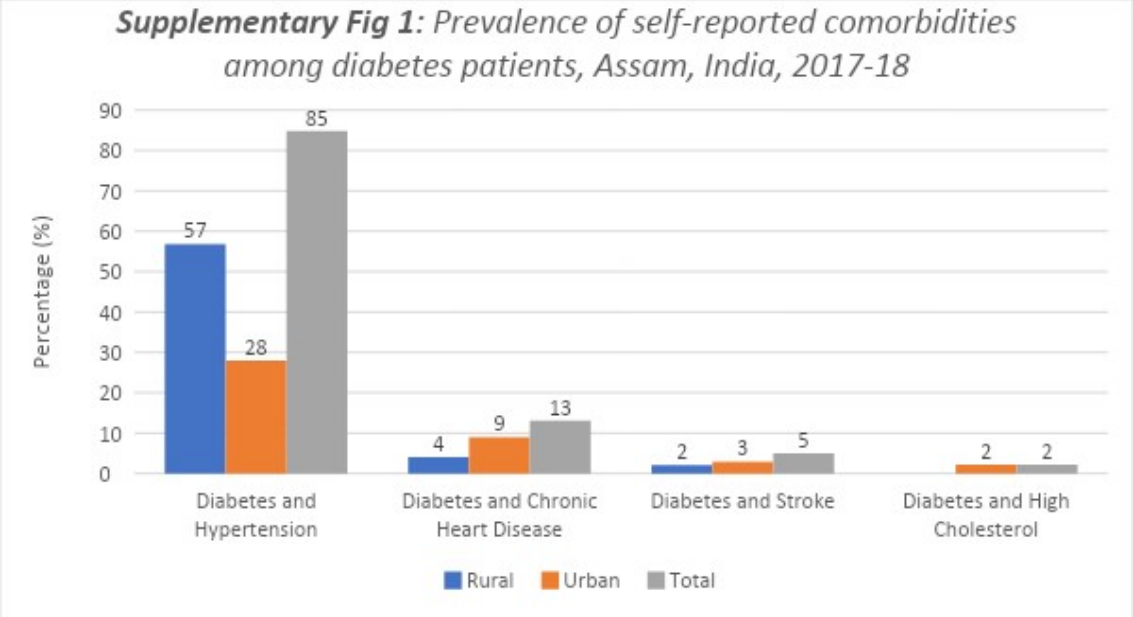
Table 3

Prevalence of Selected Risky Behavioural Characteristics in Diabetes Patients in Assam, India 2017-18

Not under medication for diabetes	**risk prevalence (%)**
Rural	44.0
Urban	19.7
Total	36.5
Not following any diabetes-related diet	
Rural	13.6
Urban	4.7
Total	10.9
Physically inactive (moderate/rigorous)	
Rural	18.9
Urban	28.8
Total	22.0
Overweight & obesity	
Rural	26.8
Urban	53.3
Total	33.2
Obesity	

Rural	5.9
Urban	1.5
Total	4.9

In addition to medication and diet, physical activity is equally crucial for regulating glucose levels in diabetic patients. Lifestyle and occupational differences between rural and urban diabetics are apparent, with 29 per cent of urban and 19 per cent of rural patients leading a sedentary lifestyle. Anthropometric measures, such as BMI, also follow the same trend, with almost half (53.3%) of urban diabetes cases having a BMI above the normal range compared to 26.8 per cent of rural respondents. Interestingly, rural diabetes patients report a higher rate of obesity, with 6 per cent falling within that range compared to 1.5 per cent of urban diabetes patients.



The supplementary figure provides a summary of the prevalence of comorbidities in individuals with diabetes in rural and urban areas. The differences in the percentages suggest that there may be disparities in the prevalence of comorbidities experienced by individuals with diabetes based on their place of residence. However, further research is necessary to understand the underlying factors contributing to these differences.

Discussion

Type 2 diabetes is a multifactorial disease caused due to the interplay of predisposed genetic makeup and environmental factors. Studies comparing Indians and European diabetic patients have found an ethnic variation of genetic factors that makes Indians with at least one diabetic parent more susceptible[16]. Moreover, the findings of this study are identical to CUPs and Viswanathan et al., which clearly showed that prevalence is higher for those with positive family history[17,18]. Further, these two studies also confirmed the "Double Gene dose effect" (both the parents are diabetic) for diabetes patients in India. Despite the empirical evidence suggesting a strong genetic role in diabetes incidence, it is worth noting that population gene pool shift occurs slowly, and the current diabetes epidemic can only be attributed to environmental changes.

Population belonging to the urban areas and upper socio-economic groups have a higher prevalence of diabetes. This is in line with the findings of the earlier studies, and the disparity can be attributed to the physical inactivity and adoption of the western dietary pattern[19-21]. The cause behind diabetes prevalence in the upper socio-economic groups of Assam can be compared with the epidemiological transition theory for developing countries mentioned by Omran AR, which states that in the developing regions, affluence is associated with a sedentary lifestyle and excess calorie consumption rather than better education and health awareness[22]. CUPS study also demonstrated the same factors to be one of the leading causes of increasing Insulin resistance syndrome among the urban population of Chennai[23].

The study exposes the large gaps in maintaining a diabetes-friendly lifestyle among diabetic patients. The nature of unevenness in access to diabetes treatment in this population is explicit, as more than one-third of the respondents reporting diabetes was not under any diabetic medication. The fact that the same was higher in the rural areas (44 %) than urban areas (20%) is a continuation of the rural-urban divide in coverage of health services in Assam as well as in India[13,15,24]. Every tenth diabetic patient (10%) did not follow any dietary restrictions to manage his/her raised blood sugar levels which is a matter of concern in rural than in urban populations. This could be considered as an indicator of the tip of the multiple challenges in following dietary restrictions recommended for diabetic patients, as the researchers of this study do not have any information from LASI on the data set on the periodicity, level of adherence to low-sugar diets, and kind of dietary diversity that is being followed by those reported to be following a special diet. In the current study, diabetes management is measured through the maintenance of a diabetic-specific diet, medical regimen, BMI, and the inclusion of physical activities in daily life. Place of residence plays an essential role in determining the availability of resources and flow of information. The impact of unverified health routines and health facility scarcity on poor diabetes management can be inferred from the urban-rural disparity[25]. Further, in assessing the inclusion of vigorous to moderate physical activities, rural areas have slightly more active individuals than urban areas[26]. The findings of this study state the same. It shows that the urban diabetic patients are better at following a diabetes diet and antidiabetic medications; on the other hand, the rural population is found to be comparatively more active on the physical exercise front.

More than one-fifth of diabetic patients led a sedentary lifestyle without adequate physical activities. One-third of the respondents reporting diabetes was either overweight or obese which also is an outcome of poor dietary practices and inadequate physical activity noted in this study. The risk of overweight and obesity is double among those with diabetes than the population in the corresponding age group in the Assam population (16 %). This shows the lack of interventions at the programme level as well as individual levels to promote a healthy body composition among the diabetic patient community. Here, urban diabetic patients were more likely to have a sedentary lifestyle and overweight/obese than their rural counterparts.

The above relationship between overweight/obesity and diabetes is bidirectional and confounded with many heterogeneous factors. Ramachandran et al.[27] and Huffman et al.[28] have found a positive association between diabetes and high BMI. Keeping BMI in the normal range is considered key to managing type 2 diabetes as it reduces the risk of microvascular complications[29,30]. The findings of the present study suggest that almost half of the urban and a

quarter of rural diabetic patients are at risk of developing hyperglycemia, hypertension, and hyperlipidemia due to above-normal BMI. Additionally, the current study illustrates the fact that a noticeable share of the diabetic patients also suffer from hypertension. Apart from that, no substantial comorbidity associations can be deduced due to limited data.

The study's major limitation is the use of self-reported diabetes data and hence, does not account for undiagnosed diabetes in the study population. The gaps in prevalence noted between various socio-economic groups will vary if there is a significant pattern in the prevalence of undiagnosed diabetes across these examined subgroups. LASI data set has only minimal information on access to medicines among the diabetic patients and their adherence to special diabetes diets. Hence, the researchers could only flag these critical issues noted in the population without examining them in detail. As mentioned earlier, further disaggregated analysis of comorbidity and challenges faced by diabetic patients in the management of diabetes could not be performed due to restrictions in the sample size.

The findings of this study advocate a multi-component approach to managing diabetes with an equal focus on a diet, physical activities and medicine. Also, the identification of high-risk groups is essential for optimizing the allocation of healthcare resources and the development of preventive strategies to minimize the associated morbidity and mortality.

Conclusion

The present study reveals the association between socio-economic characteristics and family anamnesis with the chance of developing diabetes. Assam is one of the states where a majority of the population is dependent on government health care services, and the limited focus on national health programmes on non-communicable diseases at the time of the survey period has contributed to poor access to diabetes medication[24]. The future depends on the implementation of the renewed National Health Mission that aims at providing comprehensive health care with a particular focus on NCDs through health and wellness centres across the country. Health programme managers in the state could use this as an effective platform to address the specific challenges in diabetes management brought out by the study relating to the access to diabetes medication, and advocacy requirement that is essential to bring about suitable changes in dietary behaviour and physical activities, for promoting the quality of life of those living with diabetes in India. Thus, from the results, it can be concluded that there is a need to spread awareness and knowledge on diabetes management, emphasis on following a diabetic diet, medical regimen, and regular physical activity.

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Availability of Trained Human Resources under the National Organ Transplant Programme at Tertiary Care Hospitals in Delhi: Opportunities and Challenges

***Prashant Bhardwaj, *Chirag Gupta and **Sanjay Gupta**

*M.D. Community Health Administration, 3rd Year Postgraduate Resident; E-mail: pbhardwajkkr@gmail.com
**Professor; The National Institute of Health and Family Welfare, Munirka, New Delhi – 110067.

Abstract

National Organ Transplant Programme (NOTP) is a central scheme for Organ Transplantation in India that started in 2013. Under the programme, National Organ and Tissue Transplant Organization (NOTTO) functions as the centre for all activities for procuring and distributing organs and tissues in the country. The study objective was to assess the implementation of the NOTP at tertiary care government hospitals in Delhi under the specific category of availability and training of Human Resources under the programme. A descriptive study was conducted at four tertiary care hospitals in Delhi. Hospital personnel were interviewed. Semi-structured interview schedules were done and an observational checklist was filled. All qualitative data were analysed thematically. There was a need of sanction of more human resources to the Organ Transplant Department. Training of Transplant Coordinators by NOTTO was being regularly done. The Transplant Registry, and Networking with NOTTO and among the hospitals were efficient. The study concluded that NOTP is being efficiently implemented in Delhi with some gaps like over-burdened staff and deficient human resources.

Keywords: Organ Donation, Organ Transplantation, National Organ Transplant Programme, National Organ and Tissue Transplant Organization, Transplant Coordinators

Introduction

Organ transplantation is one of the most successful advances in modern medicine. Transplantation most often provides the only chance of survival for patients with end-stage disease. Even before the first transplant was performed, it was clear that organ transplantation could only be successful with a multidisciplinary approach. The history of organ transplantation has involved a series of breakthroughs in medicine that has influenced all aspects of health care[1]. Organ donation and transplantation have been the subject of extensive international interest at both governmental and professional levels. This interest has been driven by two main factors. First, the universal shortage of organs for transplantation and the wide international variation in donation and transplantation activity. Secondly, the need to ensure that all developments have a firm basis in legal and ethical practice with equity, quality, and safety at their core[2]. To streamline the organ donation and transplant process and stop organ commerce, the Government of India passed the Transplantation of Human Organs Act in 1994[3,4] which became effective in 1995. However, this law did not eradicate organ commerce. Organ commerce that was being practised

in the open before the law; was now being done with the help of false documentation. The concept of brain death was new to both the public and physicians, and there was a general lack of interest to promote this concept. From 1995 to 2000, there were only 35 hospitals that had attempted organ transplants from deceased donors, and of these, only a handful of hospitals in states like Tamil Nadu and Maharashtra have regularly engaged in the use of such donations[5,6]. In 2005, a national organ registry was established as a result of the efforts of the Indian Society of Organ Transplantation[7]. In 2008 (effective 2009), the Tamil Nadu state passed 10 government orders to facilitate the programme and defined all the procedures including the declaration of brain death and special cases (e.g., medico-legal situations, such as a road traffic accident, for which post-mortem procedures are required)[8]. This set forth the intent of the government to give a push to organ donation. In 2011, the act was amended, and this resulted in the formation of NOTTO, charged with the main objectives of promoting the use of organs from deceased donors, preventing commercial trade, and creating a national registry. To integrate organ donation into the process of end-of-life care, the Transplantation of Human Organs (Amendment) Act 2011[9] included a provision whereby patients and their families must be made aware of the "option to authorise or decline for the donation of human organs or tissues" of their next of kin as part of the standard intensive care unit (ICU) care. The deceased-donor organ donation rate in India is less than 1 per million, and NOTTO aims to increase the number of donations[10].

A large gap exists between the patients who require organ transplants and the available organ donors. There is a need to promote deceased organ donation. After only natural cardiac death, few tissues can be donated (like cornea, bone, skin) whereas after brain stem death, a person can donate many vital organs like kidneys, liver, heart, lungs, intestine and pancreas and tissues like corneas, skin, bones and heart valves etc[11]. Currently, India is facing issues and challenges for Organ Transplantation like high Burden of organ failure cases, poor availability of donors (demand Vs. supply gap), lack of awareness of the concept of Brain Stem Death, less number of Brain Stem Death certification by hospitals, inadequate infrastructure especially in Government sector institutions, lack of awareness and attitude towards organ donation, gaps in data reporting especially online entry by hospitals/ States in National Registry, high cost (especially for uninsured and poor), maintenance of standards in transplantation,[12] etc. The roles of registered organ/tissue transplant hospitals according to programme guidelines in terms of human resources are to train transplant coordinators, lab technicians and retrieval teams; to conduct training on Brain Stem death for doctors; and to conduct short orientation training for doctors, nurses and technicians[13].

Objectives

There were very less studies assessing the programme implementation. Hence, this study intends to

i) assess and evaluate the National Organ Transplant Programme at tertiary care government hospitals in Delhi under the specific category of availability; and
ii) analyse the training of Human Resources of various categories under this programme.

Methodology

The study design was descriptive in nature. The study was done at four government hospitals in Delhi, namely- All India Institute of Medical Sciences, Safdarjung Hospital, Dr. Ram Manohar Lohia Hospital and Institute of Liver and Biliary Sciences. 16 Hospital Transplant personnel (8 Transplant coordinators, 4 Nodal officers and 4 Transplant Specialists) were interviewed. Permission was taken from the Ministry of Health and Family Welfare (MoHFW), Government of India (GoI) for data collection from the above-mentioned hospitals. A semi-structured interview schedule questionnaire was developed. Secondary data were collected from records, reports produced by the concerned authorities and various published literature (articles, reports and research studies) and unpublished data in the form of observation. Websites of states, NOTTO/Hospitals were also referred. Previous annual reports of the programme were also referred to. The data collection for the study were done between January 2022 and April 2022. All qualitative data obtained through in-depth interviews with transplant personnel were analyzed thematically. Observation findings and secondary data collected were presented with the help of an appropriate table and thematic matrix (Table 1).

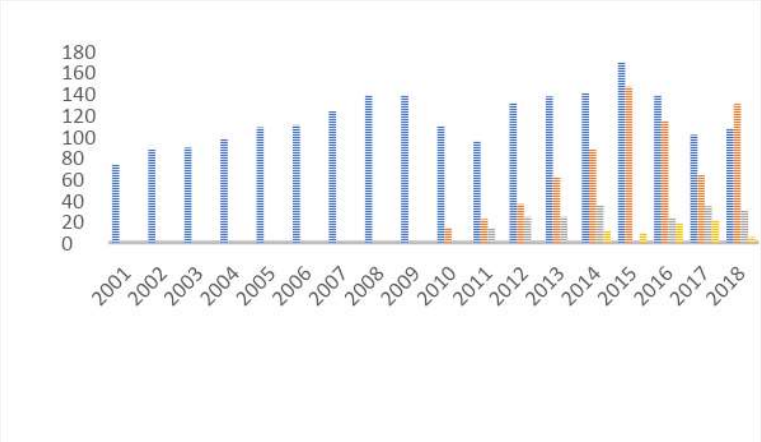
Table 1
Themes and Sub-themes for Thematic Analysis

Theme	Sub-Theme
Human Resource Availability and Training	1. Available versus Sanctioned Human Resource details 2. Training a. Induction training by NOTTO b. Regular periodic trainings by NOTTO c. Training by the hospital d. Duties performed by Transplant Coordinator in the hospital e. Duties performed by Nodal Officer in the hospital f. Duties performed by Transplant Specialist in the hospital g. The utilisation of training in performing duties h. Educational qualification of Transplant Coordinators i. Utilisation of educational qualification in performing duties j. Hurdles faced in accomplishing job responsibilities k. Recommendations by study participants for better implementation of the programme 3. Training of doctors 4. Training of nurses and paramedical staff

Findings

Figure 1 shows the total annual organ transplants in the study hospitals from 2001 to 2018. It clearly shows an improvement in the number of transplants after the 2011 amendment of the Transplantation of Human Organs and Tissues Act which provided the basis for the establishment of the National Organ Transplant Programme (NOTP) scheme and the National Organ and Tissue Transplant Organisation (NOTTO).

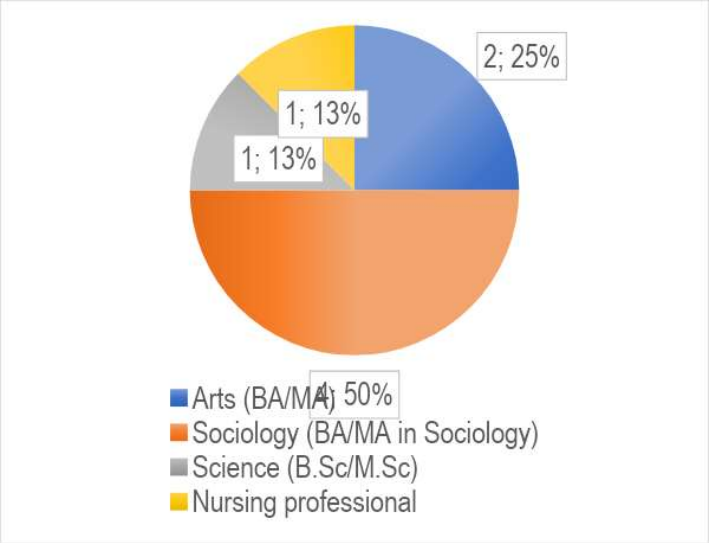
Figure 1
Total Number of Annual Organ Transplants in Study Hospitals from 2001 to 2018



Data source: Organ report, NOTTO. Available at: https://notto.gov.in/organreport.htm

It was found that the availability of human resources under the organ transplant department was compliant with the programme guidelines. The staff present was according to sanctioned strength in all the study institutes i.e. one Nodal Officer and two Transplant Coordinators. The transplant coordinators had different educational qualifications. As shown in Figure 2, most (N=4) transplant coordinators were graduates of Sociology and graduates of Arts (N=2). Some transplant coordinators were Science (N=1) and Nursing (N=1) graduates.

Figure 2
Educational Background of Transplant Coordinators (N=8)



The study participants responded that NOTTO conducts annually a one-week duration Transplant Co-ordinators Training course. NOTTO also conducts training courses for doctors,

nursing and paramedical professionals. NOTTO also conducted regular programmes, talks and workshops under GOI and in collaboration with various NGOs for organ donation awareness and organ retrieval and transplantation training. 7 out of 8 transplant coordinators had completed their induction training conducted by NOTTO at the time of the interview, the eighth transplant coordinator, being a recruit during the COVID-19 pandemic was going to attend the next training by NOTTO. All the study hospitals regularly conducted short training courses for nurses and paramedical staff in organ transplantation. In addition to trainings by NOTTO, AIIMS also conducted its own short training courses for resident doctors, transplant specialists and transplant coordinators along with training for nurses and paramedical staff.

The transplant coordinators performed various duties in the organ transplant department. They conducted daily rounds in the departments of Medicine, Surgery and ICUs to identify brain-dead patients and patients in critical condition for checking their organ transplant eligibility. After certification of brain death by the brain death certification committee; the transplant coordinators prepare for deceased organ transplantation. Transplant coordinators conducted counselling of relatives of the deceased patient for organ donation followed by taking consent for organ transplantation from the relatives of the deceased patient. They get legal affidavits signed by the deceased patient's relatives to prevent illegal organ trafficking. There is a hospital-based committee headed by the Director/Medical Superintendent of the institute that decides about the suitability of living organ donation based on the examination details and interview of the donor, proposed recipient and other family members. After approval for living organ donation, the transplant coordinators prepare the patient for living organ donation. The transplant coordinators get legal affidavits signed by the donor, recipient and relatives of the donor; and recipient stating that the transplantation is being done with the consent of all persons involved. The transplant coordinators also maintained organ transplant records in both physical and digital forms. Separate registers are maintained for the number of donors, deceased organ transplants and live organ transplants. They also maintained the hospital waiting list for organ transplantation for AIIMS and update it to NOTTO regularly for contribution to the regional organ transplant waiting list for Delhi NCR maintained by NOTTO. The transplant coordinators responded that they conducted various IEC activities. The transplant coordinators under the supervision of the nodal officer, annually organised National Organ Donation Day on 27th of November in all the study hospitals. They organized a poster exhibition comprising posters on organ donation awareness on National Organ Donation Day 2021. They conducted various outreach programmes for organ donation awareness. The transplant coordinators gave regular daily feedback to the nodal officer of the institute and weekly, monthly and annual feedback to NOTP Cell and NOTTO. They send monthly and annual reports to the nodal officer of the hospital, NOTP organ transplant cell and NOTTO. The nodal officers of the respective hospitals responded that they regularly supervised and monitored the staff in the transplant department. They also coordinated between hospitals in the Delhi NCR region for efficient compliance with the Delhi NCR transplant waiting list maintained by NOTTO.

Transplant specialists conducted organ retrieval and transplantation. They conducted pre-transplant and post-transplant recipient and donor clinical and biochemical workups. They also administered pre-transplant and post-transplant immunosuppressive therapy to transplant patients. The transplant specialists managed any complications if present post-transplantation like graft rejection etc. They conducted regular follow-ups of patients after the transplant procedure. The transplant coordinators felt that they were able to perform their duties effectively

because of the training skills taught to them in the training programmes conducted by NOTTO under the NOTP. The transplant coordinators were able to counsel the patients and their relatives about organ donation effectively by utilising the counselling skills taught in training programmes. The transplant personnel faced various hurdles in accomplishing their job responsibilities (Table 2) which included inadequate infrastructure for the organ transplant department (75%), feeling overburdened by duties (75%), less salary and number of leaves (50%) and lack of coordination between various departments (12.5%).

Table 2

Hurdles Faced in Accomplishing Job Responsibilities in All the Study Hospitals

S. No.	Hurdles faced	No. of Respondents (N=16)	*Percentage (%)
	Inadequate infrastructure for the organ transplant department	12	75%
2.	Overburdened by the roles and responsibilities assigned	12	75%
3.	Less salary	8	50%
4.	Less number of leaves	8	50%
5.	Lack of coordination between various departments	2	12.5%

*The transplant personnel gave multiple responses.

Figures in Table 3 reflects the transplant personnel's various recommendations for improving the implementation of the programme which included the recruitment of one more Transplant Coordinator (75%), improvement of infrastructure under the organ transplant department (75%), arrangement of incentives for the hospital employees for good work (50%), an increase in salary with regular experience-based increments (43.75%), availability of one driver on call (12.5%), recruitment of two types of transplant coordinators: one with a clinical background and the other with social work background (12.5%); and faster action by the brain death certification committee (6.25%).

Table 3

Recommendations by Transplant Personnel of All the Study Hospitals

S. No.	Recommendations	No. of Respondents (N=16)	*Percentage (%)
1.	Recruitment of one more Transplant coordinator	12	75%
2.	Improvement of infrastructure under the organ transplant department	12	75%
3.	Arrangement of incentives for the hospital employees for good work	8	50%
4.	An increase in salary with regular experience-based increments	7	43.75%
5.	Availability of one driver on call	2	12.5%
6.	Recruitment of two types of Transplant coordinators: One with a clinical background and the other with social work background.	2	12.5%
7.	Faster action by the brain death certification committee	1	6.25%

*The transplant personnel gave multiple responses.

Discussion

The human resources were according to the strength sanctioned under the programme guidelines in all the study hospitals. There was an apparent need to sanction more human resources under the organ transplant department in most of the study hospitals. A study done by Kute V et al. in 2020[14] found that the status of human resources is not up to the mark for programme implementation. All the nodal officers and the transplant coordinators regularly participated in the trainings and conferences organized by NOTTO. The same study also found that the NOTTO regularly conducts the transplant coordinator training course. AIIMS conducted regular short training courses for transplant coordinators. Other hospitals (3 out of 4) were not conducting their own training for the transplant coordinators. AIIMS regularly conducted short training courses for doctors in organ transplantation.

All the study hospitals regularly conducted short training courses for nurses and paramedical staff in organ transplantation. The transplant coordinators, nodal officers and transplant specialists of all the hospitals performed duties according to the guidelines of the programme. The transplant coordinators felt that they were able to perform their duties effectively because of the training skills taught to them in the training programmes conducted by NOTTO under the NOTP. They were able to counsel the patients and their relatives about organ donation effectively by utilizing the counselling skills taught in the training programmes. Figure 2 shows that the transplant coordinators had different educational qualifications. Sociology graduates felt that they were able to fulfil their duties in a better way as they could apply their skills better in counselling and motivating the donors.

A study by Singh NP and Kumar A in 2016[15] found that there was a lack of basic and essential medical infrastructure for organ transplants in most of the hospitals in India. A study by Mariappan M in 2017[16] found that there is inequity existing in the organ donation scenario in the country. The infrastructure in government and private hospitals to conduct transplantation needs to be strengthened. The concept of organ donation should reach the public and the role of various stakeholders is pivotal in this process. A study by Kute V et al. in 2020[14] found that there is poor infrastructure, especially in the government sector hospitals. The same study found that the NOTTO organizes awareness activities for the public. Social media tools like Twitter are used to increase awareness about organ donation and transplantation. This study had found that there is a need to increase IEC activities. Another study by Vasanthi R in 2020[17] found that NOTTO has, since its inception, been crucial in regulating and streamlining organ donation and transplantation activities; and maintains the National Registry. The procedure followed for the deceased and living organ retrieval and transplant process is similar in all the study hospitals. All the study hospitals were performing the procedures according to the standard guidelines under the National Organ Transplant Programme.

The strength of the study was that it was one of the few studies assessing the implementation of the National Organ Transplant Programme. The limitation was a relatively small sample size. A larger study sample could not be taken owing to time constraints.

Conclusion and Recommendations

This study assessed the implementation of the National Organ Transplant Programme at tertiary care hospitals in Delhi. There was a need to sanction more human resources under the programme for programme implementation. Regular trainings were conducted by NOTTO for Doctors, Transplant Coordinators and other healthcare workers. All the study hospitals regularly conducted short training courses for nurses and paramedical staff in organ transplantation. AIIMS conducted its own short training courses for Doctors and Transplant Coordinators along with training for nurses and paramedical staff.

Monthly and annual reports were regularly sent to NOTP Organ Transplant Cell and NOTTO. Regular feedback was given to NOTTO and NOTP Cell both by phone and in person. Each study hospital was maintaining its own transplant registry. A digitized waiting list for organ recipients was maintained by NOTTO in coordination with all the officials of NOTTO and participating institutions of Delhi, including Organ Transplant Cell officials. The procedure followed for the deceased and living organ retrieval and transplant process was similar in all the study hospitals. All the study hospitals were performing the procedures according to the standard guidelines under the National Organ Transplant Programme.

In conclusion, the National Organ Transplant Programme is being efficiently implemented in Delhi with some gaps like over-burdened staff, deficient human resources and inadequate infrastructures.

At the hospital-level, Electronic and Mass Media like TV, News Papers can be used for mass awareness among the public. Existing IEC activities should be expanded at a mass level as awareness in the community is low. There should be more sensitization of the public towards organ donation. For organ donation awareness activities, the Community Medicine department of each hospital can be involved. There can be faster action by the brain death certification committee. Discussions about donations should be a part of end-of-life care, when appropriate, and early involvement of transplant coordinators and counsellors should be ensured. At policy-level, there can be an arrangement of appreciation certificates and incentives for Doctors, Nurses and other coordinating staff for good work. One more Transplant Coordinator may be sanctioned for each hospital to strengthen the coordination within hospitals. There may be a provision for experience-based increments in salary. There should be an enhancement in funding grants for infrastructure and facility development. NGOs can also be involved in IEC activities more actively. A chapter on organ donation can be added to the syllabus for school students. Organizational support in the form of more transplant centres with good dialysis programmes, adequate staff and experienced members should be provided. Research should be promoted in the area of organ transplantation.

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Global Undernutrition Convergence: Evidence from Club Convergence

***Gulnawaz Usmani; **Bhaswati Das; ***Aftab Anwar Shaikh**

*Assistant Professor, Department of Economics, Poona College of Arts, Science & Commerce, Camp, Pune, Maharashtra-01. https://orcid.org/0000-0002-6728-5325, gulnawaz.usmani@poonacollege.edu.in.
**Associate Professor, Centre for the Study of Regional Development, JNU(Corresponding). https://orcid.org/0000-0001-6578-1416, bhaswati2004@gmail.com.
***Professor, Department of Commerce, Poona College of Arts, Science & Commerce, Camp, Pune, Maharashtra-01. principal@poonacollege.edu.in.

Abstract

Being the most essential element for a healthy life, nutrition plays an important role in maintaining the health standard. Any deficiency in terms of nutrient intake is a leading risk factor of death and morbidities among infants, especially new-borns. This study investigates the undernutrition convergence globally by employing Philips and Sul club convergence test for the period 2001 to 2018. Results from Philips and Sul club convergence test shows that the evidence of overall convergence is not found rather selected countries cluster themselves into 3 clubs and one non-convergent group. This proves that selected countries are not converging to a single steady path; however, it revealed the existence of the club-specific steady state. The study recommends that club-specific policies need to be implemented to tackle the incidence of undernutrition.

Key words: Nutrition, Undernutrition, Club convergence.

Introduction

Being the most essential element for the healthy life nutrition plays an important role in maintaining the health standard (Barasi 2003)[1]. Nutrition is very crucial for the overall development of a human being; hence, efficiency and productivity of the labour force heavily depend on the balanced nutrition intake (Kim et. al., 2013)[2]. Having a diet with sufficient calories requirement of body is very essential for being healthy (Strauss, 1986)[3]. Any deficiency in terms of nutrients intake is a leading risk factor of death and morbidities especially among new-borns (Tomkins, 2000)[4] ([4]*If the variable is slowly moving towards the upward trend in a nonlinear way, then there would not be any cointegration between the series. This is considered by PS method.*) It is estimated that by eliminating under nutrition, 32 per cent of the world disease burden can be reduced (Ahmed et. al., 2012)[5]. National and International organizations started various programmes and policies to improve the nutrition availability to the most vulnerable groups of the world. But the problem of under nutrition is still persisting globally especially in the developing countries (Popkin et. al., 2012)[6]. Undernutrition occurs due to an imbalance in nutrition intake and the requirement of the body. Undernutrition affects every country of the world despite its geographical boundaries and socio-economic status. Hence, it has become a global issue in the recent years. Every country can experience undernutrition, but most susceptible are the developing and poor (under-developed) countries due to the challenge of poverty in these

countries. Undernutrition is the main hunger indicator used by the Food and Agriculture Organization (FAO).

According to World Health Organization (WHO), 11 per cent (820 million) of the world's population is taking lesser calories than what they require. It means they are undernutrition. As a result of poor nutrition intake, 22 per cent of children under 5 are stunted and around 697 (9 % of world population) million people are food insecure globally (Roser & Ritchie, 2019)[7]. According to the UN's 'depth of the food deficit' metric majority of the developing nations are under the food deficit. In other words, most of the developing countries had a food deficit of 200 kilocalories per person/day. Some of the Sub-Saharan African countries have a food deficit between 300-500 kilocalories per person/day (Van et. al. 2012)[8]. The consequences of undernutrition are manifold but the way to eliminate undernutrition is the availability of nutritious food to all the people around the world. This can happen by eradicating the prevalence of poverty especially from the developing regions of the world. Other factors in removing the undernutrition are compulsorily breastfeeding for the first 2 years of life, access to basic necessities for instance; healthcare, water, hygiene and sanitation, pregnant women's nutrition pattern etc.

International organizations continuously reaffirmed their agenda to eliminate undernutrition. The 1992 International conference on nutrition held in Rome adopted a world declaration of plan of action to eradicate undernutrition and hunger. Later in 2002, Rome Declaration on World Food Security and World Food Summit Plan of Action set a target of reducing hunger 50 percent by 2015. In 2004 FAO's council adopted the food for all to achieve food security and nutrition for all. In this order United Nation has adopted 8 development goals popularly known as millennium development goals in the year 1990 two of which are dedicated to improve the quality of life through eradicating hunger and reduced child mortality by 2015. Target was set to halve the proportion of people who suffer from poverty and hunger by 2015. Recently in 2016 united nation formulated sustainable development goals (SDGs) focused on nutrition to achieve by 2025. Collaboration between the International community and concerned governments of respective countries can help their people by ensuring equal access to quality food which will eventually boost their economic growth (Sachs 2012[9]; Soubbotina, 2004[10]). Inspection of programme and policies implemented by the government is needed to find whether the existing action plans are working or not.

Since the year 2000, world regions experienced substantial fall in undernutriton (Van et. al., 2012)[8]. An improvement in the nutritional intake is being recorded in the past decade (Müller & Krawinkel, 2005)[11]. Hunger has fallen from 14.8 per cent of people to 10.8 per cent between 2000 and 2018 (Otekunrin, et. al. 2019)[12]. Sub-Saharan Africa is an exception in a way that instead of taking numerous efforts by the world organization to reduce the prevalence of undernutrition & hunger for the region, undernutrition in terms of stunted children increased between 1990 to 2015. The International Food Policy Research Institute (IFPRI) formulated an index known as Global Hunger Index to measure the extent of hunger. In terms of GHI scores, Sub Saharan Africa and south Asia are the leading regions in terms of hunger hence prevalence of undernutrition is also highest in these regions. Although a significant improvement has been recorded in terms of elimination of hunger, however; undernutrition remains a serious problem in many developing countries. Apart from the negative consequences of undernutrition on human health, economy of the world is also adversely affected by this (Alderman, et. al., 2014; Headey, 2012)[13,14]. High prevalence of undernutrition causes poor growth and development on one hand

and enhances poverty on the other by effecting efficiency and productivity (Gupta & Mitra, 2004; Mehta & Shah, 2003)[15,16]. Furthermore, due to negative consequences of undernutrition on health, expenses incurred on seeking healthcare has also been increased which again become a cause of hunger and lower nutritious diet (World Health Organization, 2019)[17].

Data form various published sources shown that huge differentials are existed in terms of undernutrition between developed and developing countries (Abdullah, 2015)[18]. The burden of undernutrition is unacceptably high especially in developing regions of the world. More than hald of undernourished children live in South Asia. Nearly 479 million people is facing undernutrition in the region of Asia and the Pacific.

Though several studies are available on undernutrtion and its impact of socio-economic condition across countries by employing different methodologies but very little literature has been found on convergence issue. Existing literature (Ved & Menon 2012; Guriev & Vakulenko 2015; Klasen 2008; Haddad et. al. 1999; Ouyang et. al. 2019)[19-23] have investigated convergence in poverty, gender nutrition, urban nutrition but literature on undernutrition convergence is scanty. This study complements this research gap by investigating undernutrition convergence across the world.

Thus, the researchers of the current study have employed the concept of neo-classical growth convergence theory, which states that poor countries trace the growth path of rich nations in the long run. However, in reality this is not possible because each nation has its own steady path of transition. Hence, we relax this assumption of single steady state rather we assume that they require relative growth rates to trace a single steady path (Jones 1997; Evans & Karras 1996)[24,25]. This study applies the club convergence methodology propounded by Philips and Sul in 2007 to examine the above research objective i.e. whether the undernutrition in countries are converging or diverging over time across world.

Methodology

This research adopts the Philips and Sul club convergence (2007; hereafter PS)[26] test. PS method is more robust than neo-classical growth theory of convergence. In a way, the neoclassical theory says that the developing economies move faster than the developed economies in terms of their per capita income. Reasons for tracing developed nations faster are: developing nations imitate the production techniques, technology and institutions of highly advanced economies in the long run. Furthermore, PS test also resolve the problem of single steady state of transition. The neoclassical theory assumed that all the countries trace a single steady state which may not apply to those sections where huge diversity is persisting. PS test takes care of this issue and endogenously form the clubs of cross-sections based on the "nonlinear time-varying factor" in such a manner that each club will follow a unique steady transition path based on their relative growth trend. Thus, PS method is based on relative convergence and describes a series as non-stationary which is moderately converging considering individual heterogeneity. PS test provides the convergence of that series which has both stationary and non-stationary characteristics and that makes PS test better than panel unit root test. Altogether PS test takes care of the biasness comes from the mix of stationary and non-stationary misidentification in the panel. This method offers the basics of modelling transitional dynamics as well as long-run pattern and includes both the common and individual-specific components. Thus, the authors of this paper consider the Philips and Sul convergence test better in terms of effectiveness than panel unit regression model and co-integration test.

The researchers have used the annual data on undernutrition (UNT) for 162 countries provided by World Bank. World Bank provides data on prevalence of undernutrition in terms of percentage of population undernourished. The single factor model of PS can be shown as:

$$UNTit=it+it \quad (1)$$

Where i=1, 2, 3,4,…,15 (no of countries)
t=1987,1988,….,2018 (Time period).
δi = idiosyncratic distance between the systematic part of UNTit and common factor t.
t = Accumulated common behavior of UNTit of individual units. uit refers to the error term.

Equation 1 explains the progression of the UNTit with respect to the common factor by means of systematic element (i) and the error (uit).

UNTit is categorised into two parts: First- Systematic component (S_{it}) and Second- Transitory components (tit):

$$UNTit=Sit+tittt=itt, \quad \forall\ i,t \quad (3)$$

Where t = common steady path having both deterministic component and stochastic components.
it = idiosyncratic element (Time and Country-specific effects)
t = Share of the common Factor for each country).

Convergence follows the dynamic process (Philips and Sul, 2007)[26]. Hence, it in Equation (3) represents the transition paths. PS test does not focus on parametric form for t rather it factors out and focuses on it. To find out coefficients of it , structure restrictions must be imposed on δ_{it} and t. Hence, PS test assumes a semi-parametric form for it that help to conduct a formal test for convergence.

To estimate long-term convergence, PS test has suggested the below form that ignores the common component (t) from equation (3) by dividing the panel average:

$$hit=UNTit1Ni=1NUNTit=it\ 1Ni=1Nit \quad (4)$$

Where hit = Relative measure for the transition path with the panel average.

In the short run hit varies across the selected units, but attain convergence in the long run when $hit \rightarrow 1$ for all units (i), when $t \rightarrow \infty$. It can be achieved in the long term when the variance of the country of $hit \rightarrow 0$. The below assumption is required for algorithm club convergence in a semiparametric form including time-varying coefficients δit :

$$it =i +itit \quad (5)$$

Where it=iLtt, i>0, t≥1 and it is poorly dependent over t, and traces independent identically distributed (iid) (0, 1) over i. The function L(t) is gradually increasing and diverging at infinity (LT→∞ as t→∞). PS assumes the null hypothesis of convergence for all units (i) for the countries including a specific form of it: H0:i =δ,∀ i with a≥0. And the alternative hypothesis is: H1:i ≠δ,∀ i with a≥0 or a<0. Null hypothesis can be tested by following the below regression:

$$\log H1Ht - 2\log Lt = c + b\log t + ut \quad (6)$$

Where t=rT, rT+1,……, T and r>0.
Moreover, H1Ht show the countries variance.

Lt=log (t+1) is applied in Equation (5). Further, Ht=1Ni=1N(hit-1)2 and b=2. indicates the least square parameter of a. in case of null hypothesis logH1Ht diverge; whether a>0 or a=0. For testing convergence, one-sided t-test of the inequality, a≥0 using b might be useful. t- Statistic follows the "standard normal distribution asymptotically" that is created by the estimate b. PS has suggested that the null of convergence is accepted if the value of t-statistic is lower than the critical value -1.65. The speed of convergence can be calculated following the expression b = 2α (Phillips and Sul 2007, 2009)[26, 27].

Discussion

We have applied Philips and Sul club convergence method. Result shows that there is no evidence of overall convergence among the selected countries. -57.0766 is the log (t) regression value for the full sample which is lower than the critical value of -1.65, hence overall convergence hypothesis for the full sample is rejected in case of selected countries (Table 1).

Table1
Club Convergence Across Countries

Club	Countries	Coefficient	T-Value	Decision
Full Sample		-1.0318	-57.0766	Divergence
Club 1	| Chad | Haiti | Korea, Dem. People's Rep. | Lesotho | Liberia | | Madagascar | Venezuela, RB |	0.640	3.741	Club Convergence
Club 2	| Cabo Verde | Eswatini | Rwanda | Sierra Leone | Timor-Leste |	0.554	5.654	Club Convergence
Club 3	| Congo, Rep. | Iraq | Mozambique |	0.067	0.583	Club Convergence
Club 4	| Afghanistan | Angola | Botswana | Cote d'Ivoire | Ethiopia | | Gabon | Kenya | Nigeria | Sao Tome and Principe | | Solomon Islands | Tanzania | Togo |	0.678	6.810	Club Convergence

Club 5	| Bangladesh | Bolivia | Burkina Faso | Cambodia | El Salvador | | Guatemala | Honduras | Jamaica | Jordan | Malawi | Mauritania | | Mongolia | Namibia | Nicaragua | Philippines | Vanuatu |	0.360	3.420	Club Convergence
Club 6	| Belize | Cyprus | Dominica | Georgia | Mexico | New Caledonia | | Pakistan | Paraguay | Sudan |	0.816	4.493	Club Convergence
Club 7	| Albania | Argentina | Australia | Austria | Barbados | Belarus | | Belgium | Benin | Bosnia and Herzegovina | Brunei Darussalam | | Bulgaria | Canada | Chile | Colombia | Costa Rica | Cuba | | Czech Republic | Denmark | Dominican Republic | Ecuador | | Egypt, Arab Rep. | Estonia | Euro area | Fiji | Finland | France | | Gambia, The | Germany | Ghana | Greece | Guyana | | Hong Kong SAR, China | Hungary | Iceland | Indonesia | | Iran, Islamic Rep. | Ireland | Israel | Italy | Japan | | Korea, Rep. | Kuwait | Kyrgyz Republic | Latvia | Lebanon | | Lithuania | Luxembourg | Macao SAR, China | Malaysia | Malta |	0.280	3.120	Club Convergence

	| Mauritius | Montenegro | Morocco | Myanmar | Netherlands | | New Zealand | Norway | Oman | Panama | Poland | Portugal | | Romania | Russian Federation | Saudi Arabia | Senegal | Serbia | | Slovak Republic | Slovenia | Spain | Sri Lanka | | St. Vincent and the Grenadines | Suriname | Sweden | | Switzerland | Thailand | Trinidad and Tobago | Turkey | | Turkmenistan | Ukraine | United Kingdom | United States | | Vietnam |			
Club 8	| Cameroon | Croatia | Kiribati | Mali | Nepal | Peru | Samoa | | Tunisia | United Arab Emirates | Uruguay |	0.826	3.931	Club Convergence
Club 9	| Algeria | Azerbaijan | Brazil | China | Kazakhstan | Uzbekistan |	0.273	0.975	Club Convergence
Not convergent Group 10	| Armenia | India |	-3.687	-123.531	Neither convergence nor divergence

Club	**log (t) regression value**
Full Sample	-57.0766

This shows that the selected countries are not following a single steady path rather these countries merged and formed 10 clubs. According to Philips and Sul, in the first step of analysis we may not get the true number of clubs, thus to find out the true number of clubs and to find out the evidence of any merger of clubs log (t) regression is repeated again. Results presented in Table 2 (Annexure) shows the evidence of merger of clubs to large clubs. Final clubs are tabulated in table 3. Result shows that finally, we get 3 clubs and one group of 2 countries which is neither converge nor diverge. Club 1 includes 15 countries namely, Cabo Verde, Chad, Congo, Rep., Eswatini, Haiti, Iraq, Korea, Dem. People's Rep., Lesotho, Liberia, Madagascar, Mozambique, Rwanda, Sierra Leone, Timor-Leste, Venezuela, RB. These countries have highest incidence of undernutrition. A large number of countries in this club is from African continent

which is well known for their well spread food insecurity (Lopriore C & Muehlhoff E 2003)[28]. Demographic, socio-economic and agro-ecological characteristics of the region often to be blamed for poor nutrition condition of the children in this region (Anand & Ravallion 1993)[29]. Moreover, rapid population growth and desertification has affected food production, access and availability. Poverty and unemployment are the other determinants of poor nutritional qualities in the countries of this club (Mamabolo et. al. 2005)[30]. Higher Income inequality is persisting in these countries consequently, lower human development leading to higher undernutrition (Adeleye et. al. 2020; Mukherjee et. al. 2019)[31,32]. 37 countries namely Afghanistan, Angola, Bangladesh, Belize, Bolivia, Botswana, Burkina Faso, Cambodia, Cote d'Ivoire, Cyprus, Dominica, El Salvador, Ethiopia, Gabon, Georgia, Guatemala, Honduras, Jamaica, Jordan, Kenya, Malawi, Mauritania, Mexico, Mongolia, Namibia, New Caledonia, Nicaragua, Nigeria, Pakistan, Paraguay, Philippines, Sao Tome and Principe, Solomon Islands, Sudan, Tanzania, Togo, Vanuatu formed the club 2. These countries have recorded highest undernutrition incidence but that is lower as compared to the club 1 countries. The economy of these countries is of developing in nature consequently higher population growth, lower per capita income, lower human development, lower employment opportunity leads higher undernutrition in this group of countries (Kennedy, 2002; Anand & Ravallion, 1993; Smith & Haddad, 2000; Madanat, et. al., 2008)[33,27,34,35].

Table 2
Results of Merger of Clubs

Club Merger	Coefficient	T-Value
Club 1+2	0.073	0.861
Club 2+3	0.482	5.179
Club 3+4	0.236	4.074
Club 4+5	0.452	5.243
Club 5+6	0.089	1.100
Club 6+7	0.094	1.320
Club 7+8	0.246	2.983
Club 8+9	0.024	0.285
Club 9+10	-2.838	-20.538

A total of 98 countries namely, Albania, Algeria, Argentina, Australia, Austria, Azerbaijan, Barbados, Belarus, Belgium, Benin, Bosnia and Herzegovina, Brazil, Brunei Darussalam, Bulgaria, Cameroon, Canada, Chile, China, Colombia, Costa Rica, Croatia, Cuba, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, Arab Rep., Estonia, Euro area, Fiji, Finland, France, Gambia, The, Germany, Ghana, Greece, Guyana, Hong Kong SAR, China, Hungary, Iceland, Indonesia, Iran, Islamic Rep., Ireland, Israel, Italy, Japan, Kazakhstan, Kiribati, Korea, Rep., Kuwait, Kyrgyz Republic, Latvia, Lebanon, Lithuania, Luxembourg, Macao SAR, China, Malaysia, Mali, Malta, Mauritius, Montenegro, Morocco, Myanmar, Nepal, Netherlands, New Zealand, Norway, Oman, Panama, Peru, Poland, Portugal, Romania, Russian Federation, Samoa, Saudi Arabia, Senegal, Serbia, Slovak Republic, Slovenia, Spain, Sri Lanka, St. Vincent and the Grenadines, Suriname, Sweden, Switzerland, Thailand, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Uzbekistan, Vietnam are included in club 3. Club 3 countries are the developed countries with high HDI index as compared to the countries listed in club 1 and club 2 (Crafts, 1997)[36]. Higher per capita income, lowest income inequality, advanced healthcare facilities are some of the

reasons for better nutritional qualities in the countries of this club (Dabla-Norris et. al. 2015; Diaz-Bonilla et. al. 2000; Verma & Usmani 2019)[37-39].

A non-convergent group of 2 countries namely Armenia and India were also found during the analysis. These countries do not club with any of the groups. These two countries need further exploration to understand their distinctiveness.

Table 3
Final Club

Club	**Countries**	**Coefficient**	**Log(t)**	**Decision**
Club 1	| Cabo Verde | Chad | Congo, Rep. | Eswatini | Haiti | Iraq | | Korea, Dem. People's Rep. | Lesotho | Liberia | Madagascar | | Mozambique | Rwanda | Sierra Leone | Timor-Leste | | Venezuela, RB |	-0.043	-0.585	Divergence
Club 2	| Afghanistan | Angola | Bangladesh | Belize | Bolivia | | Botswana | Burkina Faso | Cambodia | Cote d'Ivoire | Cyprus | | Dominica | El Salvador | Ethiopia | Gabon | Georgia | | Guatemala | Honduras | Jamaica | Jordan | Kenya | Malawi | | Mauritania | Mexico | Mongolia | Namibia | New Caledonia | | Nicaragua | Nigeria | Pakistan | Paraguay | Philippines | | Sao Tome and Principe | Solomon Islands | Sudan | Tanzania | | Togo | Vanuatu |	0.177	2.600	Cub Converge
Club 3	| Albania | Algeria | Argentina | Australia | Austria | | Azerbaijan | Barbados | Belarus | Belgium | Benin |	0.109	1.578	Cub Converge

	| Bosnia and Herzegovina | Brazil | Brunei Darussalam | | Bulgaria | Cameroon | Canada | Chile | China | Colombia | | Costa Rica | Croatia | Cuba | Czech Republic | Denmark | | Dominican Republic | Ecuador | Egypt, Arab Rep. | Estonia | | Euro area | Fiji | Finland | France | Gambia, The | Germany | | Ghana | Greece | Guyana | Hong Kong SAR, China | Hungary | | Iceland | Indonesia | Iran, Islamic Rep. | Ireland | Israel | | Italy | Japan | Kazakhstan | Kiribati | Korea, Rep. | Kuwait | | Kyrgyz Republic | Latvia | Lebanon | Lithuania | Luxembourg | | Macao SAR, China | Malaysia | Mali | Malta | Mauritius | | Montenegro | Morocco | Myanmar | Nepal | Netherlands | | New Zealand | Norway | Oman | Panama | Peru | Poland | Portugal | | Romania | Russian Federation | Samoa | Saudi Arabia | Senegal | | Serbia | Slovak Republic | Slovenia | Spain | Sri Lanka | | St. Vincent and the Grenadines | Suriname | Sweden | | Switzerland | Thailand | Trinidad and Tobago | Tunisia |			

	| Turkey | Turkmenistan | Ukraine | United Arab Emirates | | United Kingdom | United States | Uruguay | Uzbekistan | | Vietnam |			
Not convergent Group 4	| Armenia | India |	-3.687	-123.531	Neither convergence nor divergence

Conclusion

The main aim of this study was to investigate the convergence hypothesis of undernutrition globally from 2001 to 2018. To do so this study employed the Philips and Sul (2007)[26] convergence method. Our result showed that there is no evidence of overall convergence in terms of undernutrition rather it shows multiple clubs of similar convergence pattern. This means that selected countries are not converging to a single group instead they followed a club specific steady state path after clustering themselves. The clusters observe somewhat similar growth pattern which is reflected in their clubbing pattern depending on undernutrition, except Armenia and India.

The result of the present study offers the following policy recommendations: First, countries lie in club 1 and club 2 should revise their programmes and policies to ensure the food safety for all. Second, results found that some of the developing countries like Sri Lanka, Nepal, Myanmar and Thailand etc. are catching up the countries where human development is high and undernutrition is on moderate level but these countries have to make adequate effort to sustain the same level of undernutrition. Third, club-specific programmes and policies should be taken into consideration to resolve the problem of undernutrition convergence in the long run.

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Knowledge, Attitude and Practice of Contraception among Adolescents in Bangladesh

***Sakar Kanti Deb and **Raj Narayan**

*Training Officer, NIPORT, Dhaka, Bangladesh
**Assistant Research Officer, Department of Statistics & Demography, NIHFW, New Delhi, India-67

Abstract

A cross-sectional study was conducted to assess the knowledge, attitude and practice of contraception among the adolescents in Bangladesh. The authors used the Bangladesh Adolescent Health and Wellbeing Survey (BAHWS) 2019 – '20 conducted by the National Institute of Population Research and Training (NIPORT). Data were collected in five phases, with each phase taking about four weeks to complete, that started on 25 July 2019 and completed on 10 January 2020. Knowledge, attitude and practice of contraception among 4926 ever-married females, 7800 unmarried females and 5523 unmarried male adolescents aged 15-19 from 67093 households were evaluated from the findings of the successfully interviewed respondents. Three types of individual questionnaires (ever-married female adolescents, unmarried female adolescents, and unmarried male adolescents) were piloted before data collection began. The researchers used descriptive statistics for data analysis.

The contraceptive prevalence rate among currently married female adolescents ages 15-19 years was 56 per cent. Modern method use was 51 per cent, and traditional method use was 5 per cent. The pill was by far the most widely used method (33%), followed by condoms (9%) and injectable (7%). Among contraceptive method non-users, 38 per cent said that they want to have children, while 26 per cent said that their husband stays elsewhere or abroad, and they thus have no need for a contraceptive method. Overall, more unmarried male adolescents (84%) and unmarried female adolescents (75%) knew of at least one of the three common contraceptive methods (oral pill, condom, and emergency contraceptive pill). Knowledge of the pill was higher among females (72%) than males (61%), but the opposite was true for knowledge of condoms and ECP (only 40% of females knew about condoms compared to 82% of males; ECP was known by 9% of females, compared to 19% of males). The study highlights the need to empower the adolescents with the information and self-efficacy to make and act on their decisions on use of contraceptives and communication programmes for unmarried adolescents should be strengthened to arrest the trend towards unwanted pregnancy.

Key words: Family planning, contraception, knowledge, practice.

Introduction

Adolescence is the phase of life between childhood and adulthood, from 10 to 19 years. It is a unique stage of human development and an important time for laying the foundations of good

health. Adolescents experience rapid physical, cognitive and psychosocial growth. This affects how they feel, think, make decisions, and interact with the world around them[1]. Of the estimated 1.2 billion adolescents worldwide, many have missed out on health services that consider their specific needs. Over 2000 adolescents die every day, mainly from preventable causes[2].

Contraception means the use of drugs, devices, or surgery to prevent pregnancy. There are many different types of contraception. These include barrier methods to keep sperm from fertilizing the egg, hormone methods, intrauterine devices (IUDs), and surgery to close the fallopian tubes in women or close off the two tubes that carry sperm out of the testicles in men; also called birth control[3]. Comprehensive sexuality education and condom promotion and distribution can contribute to prevent unintended pregnancy and STIs including HIV. Enrolling and keeping adolescents in school can contribute to a range of positive health outcomes[4]. One in 20 adolescents worldwide contracts a curable sexually transmitted infection each year, and each day, over 6500 adolescents and young people aged 10–24 are infected with HIV. In 2020, there were 1.7 million adolescents living with HIV worldwide, of whom 88 per cent live in sub-Saharan Africa. Adolescents account for 11 per cent of new HIV infections. In 2020, there were 1,50,000 new HIV infections among adolescents, more than three quarters of which were among adolescent girls[5].

As of 2019, adolescents aged 15–19 years in low and middle-income countries (LMICs) had an estimated 21 million pregnancies each year, of which approximately 50 per cent were unintended resulting an estimated 12 million births[6]. Based on 2019 data, 55 per cent of unintended pregnancies among adolescent girls aged 15–19 years end in abortions which are often unsafe in LMICs[6].

Contraceptives are not easily accessible to adolescents in many places. Even when adolescents can obtain contraceptives, they may lack the agency or the resources to pay for them, knowledge on where to obtain them and how to correctly use them. They may face stigma when trying to obtain contraceptives. Further, they are often at higher risk of discontinuing use due to side effects, and due to changing life circumstances and reproductive intentions. Restrictive laws and policies regarding the provision of contraceptives based on age or marital status pose an important barrier to the provision and uptake of contraceptives among adolescents. This is often combined with health worker bias and/or lack of willingness to acknowledge adolescents' sexual health needs[6].

The Government of Bangladesh (GoB) is committed to ensure adolescent-friendly Family Planning and Reproductive Health services, and supporting adolescents to engage in healthy behaviours from a very young age. The GoB has developed the National Strategy for Adolescent Health 2017-2030 to meet the health needs of this critical population[7]. The 4th HPNSP has recognized the importance of addressing adolescents in order to improve their health and also to achieve a demographic dividend, in line with the country's commitment to meet the SDGs by 2030[8].

Because of the young age-structure of Bangladesh's population, the reproductive attitude and behaviour of teenagers are likely to have an important impact on overall reproductive health, demographic and social outcome. Adolescent sex and exposure to the risk of pregnancy has

attracted considerable research attention to understand its magnitude; and address it as a problem. These facts warrant an investigation into the knowledge and attitude of this age-group regarding fertility control and contraception.

Methodology

A cross-sectional study was conducted in Bangladesh. The researchers used the *Bangladesh Adolescent Health and Wellbeing Survey (BAHWS) 2019–'20* conducted by National Institute of Population Research and Training (NIPORT). Data were collected in five phases, with each phase taking about four weeks to complete, that started on 25 July 2019 and was completed on 10 January 2020. The study was to evaluate the knowledge, attitude and practice of contraception among the total of 4926 ever-married females, 7800 unmarried females and 5523 unmarried male adolescents aged 15-19 years. All the respondents were successfully interviewed from the 67093 households using three types of individual questionnaires (ever-married female adolescents, unmarried female adolescents, and unmarried male adolescents) that were piloted before the data collection began. The authors used descriptive statistics for data analysis.

The inclusion criteria: For contraceptive use; contraceptive prevalence rate and the percentage of currently married female adolescents who used any contraceptive method were included. Sample respondents included the currently married female adolescents aged 15-19 years. Modern contraceptive methods included female and male sterilization, implants, intrauterine devices (IUDs), injectable, oral contraceptive pills, and male condoms.

Source of Modern Contraceptive Methods: Information on the place from where the modern contraceptive method that was currently being used was obtained from the sample respondents. Sample respondents were currently married female adolescents aged 15-19 years who were currently using a modern contraceptive method.

Knowledge of Contraceptive Methods: Spontaneous knowledge: Respondent who spontaneously mentioned that she/he heard of the oral pill, condom, or emergency contraceptive pills (ECP). Prompted knowledge: If the respondent reported that she/he heard of the oral pill, condom, or ECP after the method was described to them. Sample respondents were unmarried females and unmarried male adolescents aged 15-19 years.

The sample for BAHWS 2019-'20 is nationally representative and includes adolescents aged 15-19 years residing in non-institutional dwelling units. The main sampling goal of the survey was to provide estimates of primary indicators related to adolescent health and wellbeing at the national, urban/rural, and regional levels in Bangladesh. Indicators were estimated separately for adolescents in three groups: ever-married females, unmarried females, and unmarried males. The urban/rural classification we used follows that of the Bangladesh Population and Housing Census 2011; the three regions were defined and stratified as: Eastern (Chattogram and Sylhet Divisions), Central (Dhaka, Mymensingh, and Barishal Divisions), and Western (Rangpur, Rajshahi, and Khulna Divisions). Sixteen sample strata were formed, from which the sample was selected separately.

The survey was based on a two-stage stratified sample of households which involved sampling of primary sampling units (PSUs), and sampling of households. Once the lists of PSUs were prepared, PSUs, households, and adolescents were selected from each stratum.

Variables were knowledge, attitude, and practice of students regarding family planning and contraception. Descriptive statistics was used for data analysis. The collected data were analyzed with regard to the information given by the subjects according to the set questionnaire items and the analyzed data are presented in the following tables.

Findings

Seventy-two per cent of the unmarried female adolescents were aware of the pill; 35 per cent responded spontaneously and 37 per cent mentioned a particular method after prompting. In contrast, 40 per cent of the females had heard of condoms as a family planning method, 28 per cent responded after prompting and 12 per cent mentioned a contraceptive method spontaneously. A small proportion of unmarried female adolescents had heard of ECP (9%) (Table 2). A large majority of unmarried male adolescents (82%) knew of condoms as a family planning method followed by the oral pill (61%). Unmarried male adolescents were more knowledgeable about ECP (19%) as compared to the females of the same age group.

Figure 4 reflects that less than half (48%) of unmarried females and one-quarter (25%) of unmarried males mentioned the public sector as a sources of contraceptive methods. In contrast, 61 per cent of unmarried females and more than three-quarters (76%) of unmarried males mentioned the private medical sector as a source of contraceptive methods. Pharmacy or drug store which is part of the private medical sector was mentioned by a majority of females (53%) and males (66%) adolescents (data not shown).

Thirty-eight per cent of the currently married female adolescents who were not using any family planning method reported that they wanted to have children at the time of the survey. Only 6 per cent stated that their husband or others were opposed to using a contraceptive method, and an additional 6 per cent stated that they thought that contraceptive use interfered with normal physiological processes (Table 1).

Nearly two-in-three contraceptive users (64%) obtained their methods from the private medical sector, mostly from a pharmacy or drug store (Figure 2). About one-in-ten users (9%) received their methods from their husband, and one-in-twenty (5%) received methods from other sources (a shop or friends/relatives). Nearly one-in-five users (19%) obtained their methods from the public sector, and only 3 per cent of users obtained their methods from non-governmental organizations (NGOs) (Figure 2 and Table 3). The source of modern contraceptive methods varied to a great extent by the specific method. Long-acting methods, such as implants were mostly obtained from a public sector facility (77%), while 20 per cent of the users obtained implants from the private medical sector. Nearly 40 per cent of the injectable users obtained the method from a pharmacy/drug store and 38 per cent obtained it from the public sector. In contrast, 68 per cent of the pill users and 64 per cent of the male condom users obtained their method from a pharmacy or drug store (Table 3).

The contraceptive prevalence rate among the currently married female adolescents aged 15-19 years was 56 per cent. Modern method use was 51 per cent, and traditional method use was 5 per cent (Figure 1) The pill was by far the most widely used method (33%), followed by condoms (9%) and injectables (7%). Modern method use was the highest in the Western region (58%), followed by the Central region (52%) and the lowest in the Eastern region (34%). The variation of overall method use by education and wealth quintile was not pronounced.

Figure 1
Percentage of Currently Married Female Adolescents Aged 15-19 Years Currently Using a Contraceptive Method in Bangladesh, 2019-'20

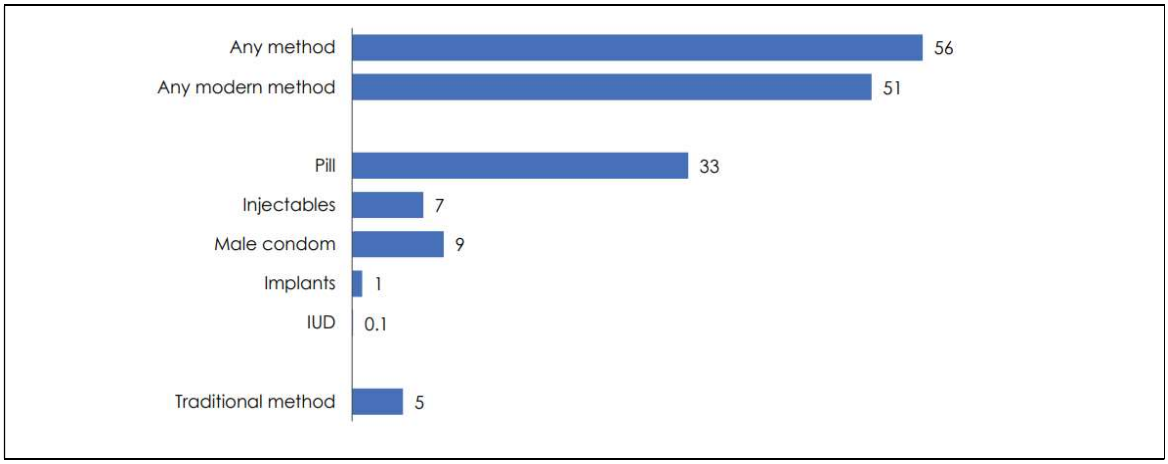

Figure 2
Per cent of Currently Married Female Adolescents Aged 15-19 Years Currently Using a Modern Method of Contraception by the Most Recent Source in Bangladesh, 2019-'20

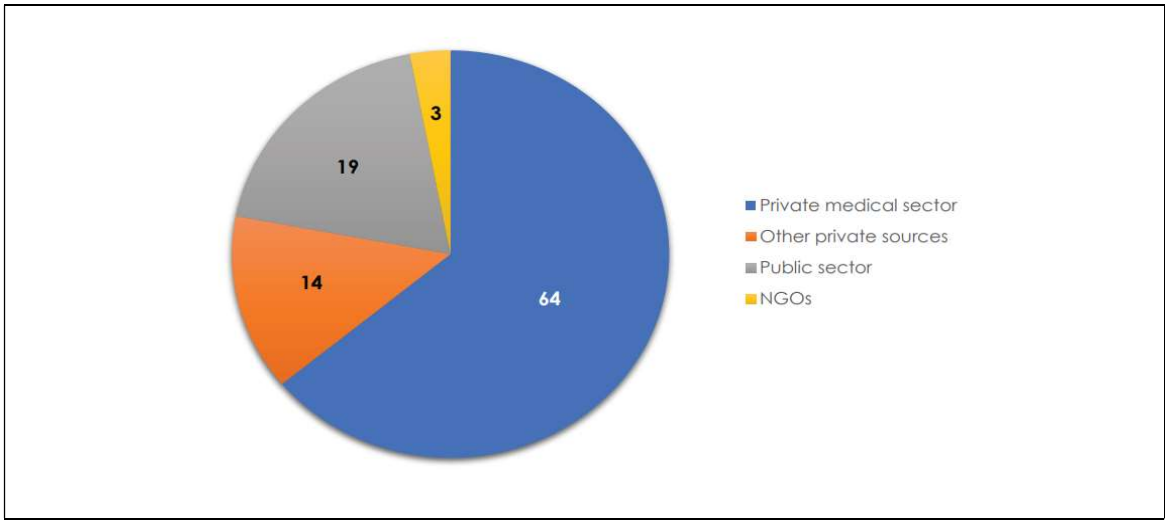

Figure 3
Percentage of Unmarried Adolescents Aged 15-19 Years Who Had Heard of Oral Pill, Condom or Emergency Contraception Pill in Bangladesh, 2019-'20

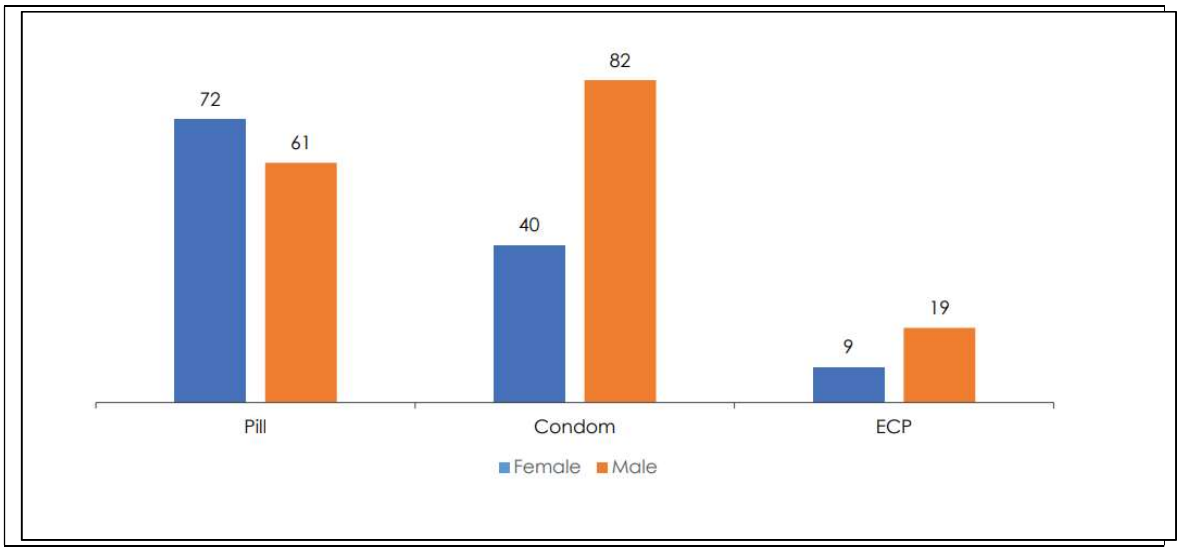

Figure 4
Percentage of Unmarried Adolescents' Knowledge on Sources of Modern Contraceptive Methods among Those Who Have Heard of Contraceptive Methods in Bangladesh, 2019-'20

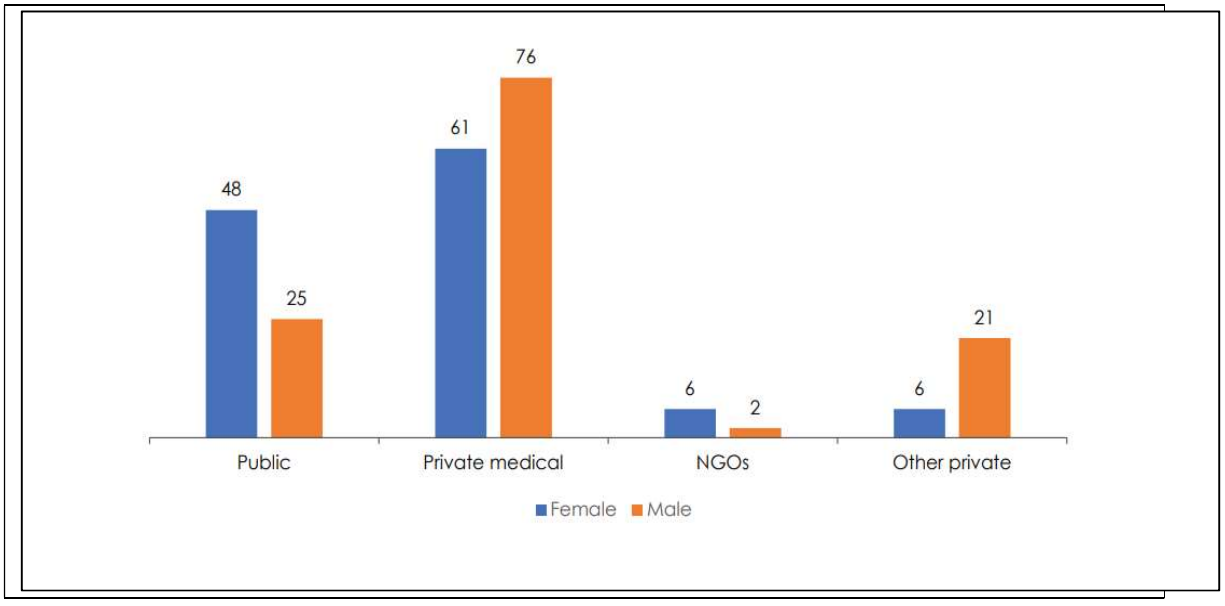

Table 1

Percentage of Currently Married Female Adolescents Aged 15-19 Years Who Are Not Using Any Contraceptive Methods by Reasons Stated in Bangladesh, 2019-'20

Reasons	Percentage
General health concern/side effects	01.5
Difficulty in having sex	00.6
Interfered with normal physiological process/do not like methods	06.2
Husband/others opposed	05.9
Social stigma/religious prohibition	00.4
want children now	38.0
Husband stays elsewhere/abroad	26.0
Other reasons	21.4
Number of Adolescents	**2,110**

Table 2

Percentage of Awareness of Family Planning Method Among Unmarried Female and Male Adolescents Aged 15-19 Years in Bangladesh, 2019-'20

Background Characteristics	Spontaneous Prompted	Heard about				Number of Adolescents
		Pill	Condom	ECP	At least one of the three methods	
Unmarried Females	Overall	71.8	39.7	09.3	74.5	7,800
	Spontaneous	35.0	11.8	01.3		
	Prompted	36.8	28.0	08.0		
Unmarried Males	Overall	60.6	82.1	19.4	84.1	5,523
	Spontaneous	23.6	31.6	03.5		
	Prompted	37.0	50.5	16.0		

Table 03

Percentage Distribution of Currently Married Female Adolescents Aged 15-19 Years Who Used Modern Methods by the Recent Source in Bangladesh, 2019-'20

Source	Pill	Injectable	Male Condom	Implants	All Modern Methods
Public Sector	**16.0**	**37.5**	**07.1**	**77.2**	**19.2**
Medical College hospital/district hospital	00.0	00.6	00.0	06.4	00.3
MCWC	00.0	01.1	00.3	14.4	00.6
Upazila health complex	01.5	05.1	00.5	47.7	03.1
UH & family welfare center	01.6	00.7	00.9	08.7	01.6
Satellite clinic/EPI out reach	01.1	09.8	00.0	00.0	02.0
Community Clinic	03.9	09.8	00.8	00.0	04.0
Government field worker	08.0	10.4	04.6	00.0	07.5
Private medical sector	**68.6**	**50.3**	**64.1**	**20.1**	**63.9**
Private medical college hospital/clinic	00.1	01.4	00.3	10.6	00.6
Qualified doctor's chamber	00.4	03.7	00.0	03.1	00.9
Non-qualified doctor's chamber	00.5	05.9	00.0	00.0	01.1
Pharmacy/Drug store	67.6	39.4	63.9	06.3	61.3

NGO sector	**01.5**	**11.3**	**1.7**	**02.7**	**02.9**
NGO static clinic	00.3	02.9	00.2	01.6	00.6
NGO satellite clinic	00.2	02.6	00.7	01.1	00.6
NGO depot holder	00.1	01.1	00.0	00.0	00.2
NGO field worker	00.9	04.8	00.7	00.0	01.4
Other private	**13.9**	**00.9**	**27.1**	**00.0**	**14.1**
Shop	01.7	00.0	03.9	00.0	01.8
Friend/relative	02.0	00.3	00.4	00.0	01.4
Husband	09.6	00.0	16.7	00.0	09.3
Other private	00.6	00.5	06.1	00.0	01.6
Total	**100**	**100**	**100**	**100**	**100**
Number of adolescents	**1585**	**321**	**430**	**69**	**2407**

Table 4

Percentage Distribution of Currently Married Female Adolescents Aged 15-19 by Contraceptive Method Currently Used with Background Characteristics in Bangladesh, 2019-'20

Background Characteristics	Any methods	Any modern methods	Any traditional	Not currently using	Number of adolescents
Age					
15-17	55.6	50.1	05.5	44.4	2,107
18-19	56.4	51.1	05.3	43.6	2,692
Residence					
Urban	56.8	51.0	05.8	43.2	1,111
Rural	55.8	50.6	05.2	44.2	3,688
Region					
Western	63.6	57.9	05.6	36.4	1,959
Central	57.1	51.7	05.3	42.9	1,889
Eastern	38.4	33.7	04.8	61.6	950
Educational attainment					
Primary incomplete	56.8	51.4	05.4	43.2	557
primary complete	53.4	50.2	03.3	46.6	423
secondary incomplete	57.1	51.9	05.2	42.9	2,629
secondary complete or higher	54.2	47.8	06.4	45.8	1,190
Wealth Quantile					
Lowest	56.5	50.9	05.6	43.5	917
secondary	57.3	53.2	04.1	42.7	1,040
Middle	56.5	49.8	06.6	43.5	1,106
Fourth	55.2	50.4	04.7	44.8	1,019
Highest	54.1	48.4	05.8	45.9	715
Total	**56.0**	**50.7**	**05.4**	**44.0**	**4,799**
Note: If more than one methods is used, only the most effective methods is considered in this tabulation.					
includes a few cases with no education.					

Discussion

An analysis of the figures of the Census 2022 shows that the highest number of the population belongs to the age group of 15-19 Years (10.03%)[9]. Fifty-nine per cent of the women age 20–24 years marry before 18 years. Between 2011 and 2014, the percentage declined from 65 per cent to 59 per cent; and has remained stable over the last 3 years. Twenty-eight per cent of the teenagers had initiated child bearing. Teenage childbearing declined slightly between 2014 and 2017 from 31 from 65 per cent to 28 from 65 per cent[10]. This study on the knowledge, attitude and practice of contraception among adolescent in Bangladesh emphasises on describing the family planning method is crucial to impart knowledge of the method among unmarried adolescents. In all the cases, more adolescents reported knowing of the contraceptive method when it was described than those who reported knowing it spontaneously. The most widely reported source of contraceptive methods by unmarried adolescents aged 15-19 years was the private medical sector followed by the public sector. The NGO sector was the least reported source. Over one-in-four (25%) of the married female respondents reported that their husbands stayed elsewhere or were abroad; so they did not require to use a method. More than one-in-five (20%) did not use any contraceptive method due to other reasons. There was no clear association of overall contraceptive use (any or modern methods) with education but injectables and male condom use were associated with education. For example, injectables use sharply declined with education and in contrast, male condom uses sharply increased with education.

Conclusion

The study highlights that knowledge and awareness do not always lead to a positive attitude towards the use of contraceptives. Although in the present study, the actual number of sexually active unmarried male and female were not known, there appears to be a need for continuing education about sexuality and contraception. Also there is a need to motivate the youth for effective and appropriate use of contraceptives, and arrest the trend towards unwanted pregnancy and increase in population. Most married female adolescents who used a contraceptive method, obtained it from a pharmacy. Obtaining methods from pharmacies or from friends and relatives limits the range and quality of FP information and counseling that can be provided; and potentially limits the methods choices. Ensuring access to adolescent-friendly services and comprehensive information on FP options will enable adolescents making a fully informed choice to meet their fertility preferences in ways tailored to their life stages and circumstances. The National Plan of Action for Adolescent Health Strategy 2017-2030 aims at promoting age-appropriate comprehensive sexuality education. This should include comprehensive education on contraceptive methods and where to obtain them in order to address the current knowledge gaps, and further recommendations for platforms to reach adolescents, both married and unmarried, with complete information on FP.

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A Systematic Review of Screen Time and Adolescent Mental Health in India during the COVID-19 Pandemic

[1]Athira O S and [2]Nithyanandan

[1]Ph.D. Research Scholar, E-mail: athiraos96@gmail.com; [2]Assistant Professor,
Department of Psychology, Periyar University, Salem, Tamil Nadu, India.

Abstract

The COVID-19 pandemic and resulting lockdowns have had a significant impact on global mental health, accompanied by an increased screen time on electronic devices. In India, where a large adolescent population exists, approximately 75 per cent of the internet-using teenagers had experienced excessive screen time due to the pandemic. Thus, it is vital to examine the effects of prolonged screen time on the mental well-being of Indian adolescents during the COVID-19 restrictions. This comprehensive review analyses the various studies conducted on Indian adolescents, following a systematic approach that searches electronic databases for relevant studies published between March 2020 and August 2022. The findings demonstrate a growing trend of screen time amongst the Indian adolescents, leading to potential health issues such as depression, anxiety, gaming addiction, decreased quality of life, physical and sleep problems, increased risk of myopia, social connectedness, emotional wellness, social isolation, and cognitive impairment. To fully comprehend the impact of excessive screen time on their mental health, it is essential to consider additional COVID-19-related factors like cyberbullying, domestic violence, sexual harassment, and work-from-home arrangements. Further, quantitative research is necessary to enhance the understanding of the influence of these variables on mental health during the pandemic.

Key words: COVID-19, Adolescent, Mental health, Digital technology, Screen time, Quality life

Introduction

The COVID-19 pandemic, declared a public health emergency by the World Health Organization (WHO) in January 2020, has had widespread impacts on physical and mental health globally[1]. In India, with over 1.34 billion people, the government imposed a 55-day lockdown beginning on 25 March 2020, to manage spread of the virus[2].

The pandemic and associated vulnerabilities, including lockdowns and financial crises, are expected to increase mental health issues and self-destructive behavior[3]. Studies conducted during the previous pandemics such as the 2014 Ebola outbreak and the 2009 H1N1 outbreak, found that the general population reported an increased anxiety and depression[4,5]. Similarly, during the COVID-19 pandemic, many studies reported poor self-rated health, poor sleep quality, higher perceived stress load, previous distressful life events, lack of psychological preparedness,

and severe health issues like pneumonia, all of which increase the risk of depression and anxiety[6-12].

The pandemic's impact is not limited to adults only as children and adolescents have also been affected directly or indirectly by the pandemic's measures such as lockdowns[13]. Expanded screen time, stressed family relations, or inactive life at home present additional challenges to adolescents' emotional wellness. Moreover, prolonged exposure to screens can cause mechanical eye strain, myopia, and obesity, and is related to poor sleep and mental disorders[14-18].

While some studies have reported positive or no relationship between screen time and mental well-being among the adolescents[18], excessive screen time is associated with a range of adverse mental health outcomes such as psychological problems, low emotional stability, and greater risk for depression or anxiety. Moreover, excessive time spent on online activities can lead to addictive behaviours and certain mental disorders.

In conclusion, the COVID-19 pandemic has had significant impacts on physical and mental health globally. While the pandemic's impact on mental health is expected to continue for years, it is essential to consider the impact on children and adolescents who are also affected by prolonged screen time, disrupted social relationships, and other challenges. The current study is important for investigating the impact of increased screen time on the mental health of adolescents during the pandemic. Therefore, it is important to investigate the relationship between screen time and adolescent mental health during the pandemic. The study is particularly relevant in the Indian context where the pandemic has had a significant impact on adolescent mental health. India is one of the world's most populous countries, and it has experienced a rapid increase in internet penetration and smartphone use in the recent years, making it an ideal setting to investigate the relationship between screen time and mental health among the adolescents. Overall, the study aims at providing important insights into the relationship between screen time and adolescent mental health during the pandemic in India which could be used for framing and formulating public health policies and interventions to mitigate the negative effects of the pandemic on their mental health.

Methodology

This systematic review was conducted based on the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement[20]. It helped collect and analyze data from the past studies and evaluate the results. The protocol of this systematic review was registered in the prospective international register of systematic reviews (PROSPERO) database (ID: CRD42022306125).

Eligibility criteria: The following section describes the inclusion and exclusion criteria:

Population: Adolescents ranging from 18 to 21 years old. (Late adolescence is the transition between childhood and adulthood, the time to test boundaries, break dependency ties, and build new identities) were included in the study. It also included those adolescents who were exposed to COVID-19 lockdown in India.

Interventions/exposures: All the studies that reported screen time usage during COVID-19 or studies that reported associations between any mental and physical health outcomes (psychological impact, mental impact, physical health, screen time/technological impact, behavioural impacts) and screen time during COVID-19 in India.

Review of literatures: Articles published between march 2020 to August 2022 were reviewed. Studies exploring mental or physical health outcomes using screen time and its consequences in the context of COVID-19 amongst the adolescents were reoffered.

Outcomes: The earlier studies had reported the mean screen time (in either hours or minutes/week) before and during the COVID-19 pandemic; associations between any mental health outcome or both physical and mental health outcomes, and screen time during the COVID-19 pandemic.

Exclusion criteria: The review of literatures excluded the conference proceedings and abstracts; studies those included adolescents <18 and >21 or those which adolescents who were not exposed to COVID-19 lockdown; and the studies that focussed only on physical health outcomes of the adolescents.

Search strategy: To find the past researches for this review article, the authors searched individual studies with original data including grey literatures like editorials, academic databases including Scopus, PubMed, Science Direct, CINAHL, Cochrane, Google Scholar, Scielo, and ProQuest for previous studies published between March 2020 and August 2022 (major lockdown period). A systematic search was conducted by the two authors. Titles and abstracts of the remaining studies were independently screened for inclusion. They used the combinations of the following search terms: screen time, social media, technology, connectedness, belonging, loneliness, in India, Adolescent, physical activity, psychosocial wellbeing, identity, self-concept, adolescence, Twitter, Instagram, and Facebook.

Selection process: The researchers reviewed the titles and abstracts of the articles and excluded those who did not meet the eligibility criteria, involve mentoring, and the search terms that were not in the scope of the review. Then, the researchers independently screened the titles and abstracts of all articles retrieved, and they compared their choice of articles. In case of disagreement, consensus on which articles to screen the full text was reached by discussion. Again in any case of disagreement, they had consensus on inclusion or exclusion by discussion; and, if necessary, thee consulted a third expert reviewer.

Data collection process: Data from each study were extracted in a standardized form including characteristics of the subjects, and the study findings. Study sources included the name of the first author's year of publication. Meanwhile, the characteristics of each study referred to study design, population type, age of the sample, sample size, and location of the study. Every article was carefully read and two review authors extracted data independently recorded on an Excel sheet.

Table 1

Keywords Used in Each Search Engine

Search engine	Keywords
Scopus	*(adolescent) OR (late-adolescent) AND (screentime OR digital AND media OR digital AND technology) AND (mental AND health) AND (covid*) AND (India) AND (LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020)) AND (LIMIT-TO (SUBJAREA , "PSYC")) AND (LIMIT-TO (AFFILCOUNTRY , "India"))*
Pub med	*((((((covid 19) AND (mental health)) OR (wellbeing)) AND (screen time)) OR (digital technology)) AND (adolescent) OR (college students)) AND (India)*
Web of Science	*((TI= (covid*mental health screen time adolescent* India)) AND AB= (covid*mental health screen time late adolescent* India)) AND PY=(2020-2021)*
Google Scholar	*screen time OR digital technology AND mental health OR well-being AND adolescent OR late adolescent OR college students AND covid 19 AND India*
Science Direct	

Study Risk of Bias Assessment

The Newcastle-Ottawa Scale (NOS)[21] was used to assess the quality of the studies included. This tool was modified for cohort and case-control studies and adapted for cross-sectional studies. The unclear design studies were assessed according to the prospective cohort NOS. To enhance the validity of this review, the authors only comprised primary studies with the acceptable display quality. The reviewers independently rated all the components of the studies, and results were corroborated, with discrepancies resolved through discussion. The three dimensions of this scale are selection, comparability, and outcome. With a maximum of five stars to be given, the selection domain has four criteria that evaluate the sample's representativeness, sample size, the number of non-respondents, and the indications of the exposure. One category in the comparability domain, with a maximum rating of two stars, evaluates whether confounding factors are considered. With a maximum rating of three stars, the final domain of outcomes has two categories that evaluate the result and the appropriate use of statistical tests. Except for the evaluation of exposure and assessment of the result which both have a maximum score of two stars, all categories are eligible for only one star.

Table 2

Quality Assessment of the Included Studies Using the Newcastle Ottawa scale

Study	Sample representativeness	Sample size	Non-response rate	Exposure definition	Adjustment for confounders	Assessment of the outcome	Statistical test	Score (0-10)
Majumdar et al., 2020	1	1	1	2	0	2	1	8
Akulwar-Tajane et al., 2021	1	0	1	1	0	1	2	6
Arora et al., 2021	1	1	1	2	0	1	1	7
Akulwar-Tajane et al., 2021	1	1	0	2	0	2	1	7
Pandya & Lodha, 2021	1	1	1	1	0	2	1	7
Singh & Balhara, 2021	0	1	1	2	2	1	1	8
Gupta et al., 2021	1	1	1	2	0	1	1	7
Kattula et al., 2021	1	1	1	2	1	1	1	8
Balhara et al., 2022	1	1	0	2	2	2	1	9
Ganesh et al., 2022	1	1	0	2	1	1	1	7

Findings

The literature search was done using the key-words listed in Table 1. The authors found 1556 records in the database search. After the removal of duplicates, a total of 983 records were excluded at the full-text screening stage; 42 full-text documents were reviewed; and finally, 10 articles met the criteria for inclusion[22-31]. Later, they searched the documents that cited any of the originally included databases, and the references of the initiative included studies. However, no extra article that fulfilled the inclusion criteria was found in these searches. According to the PRISMA statement, the flow of our study selection is presented in Fig. 1.[20]

Figure 1

PRISMA 2020 Flow Diagram Describing the Study Selection Process

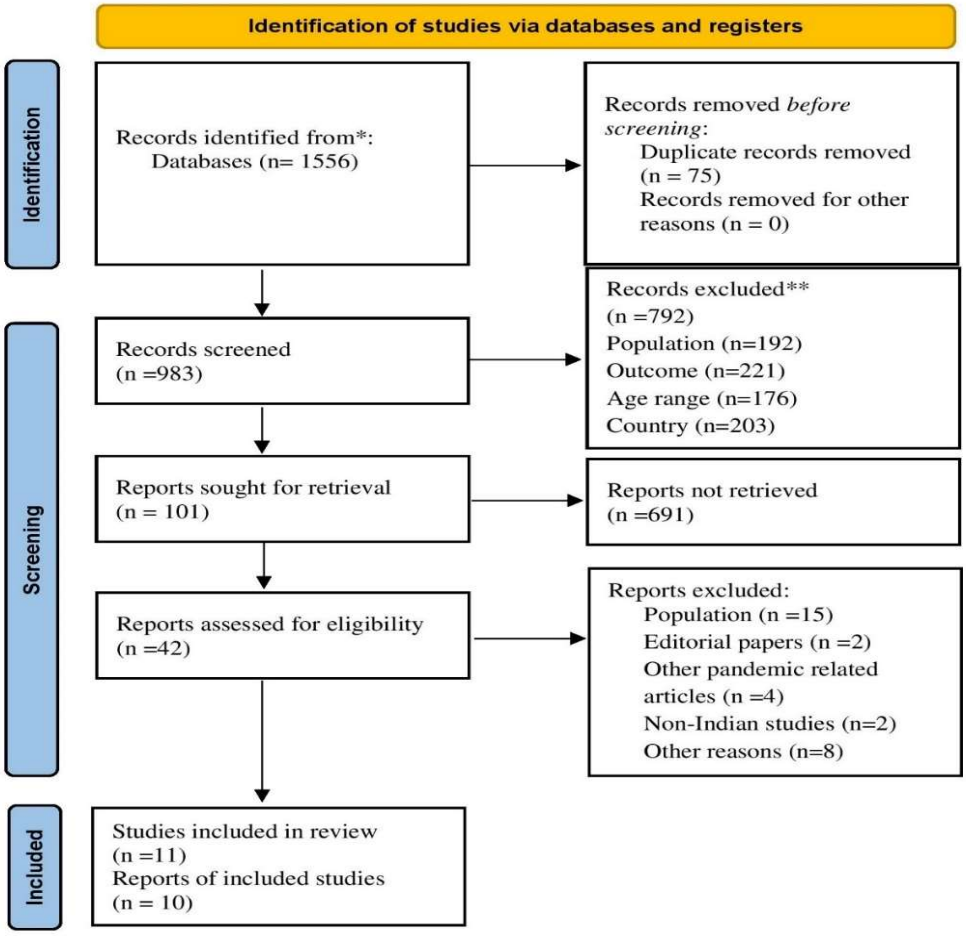

Table 3

Summary of Baseline Characteristics and Findings of Studies Included

Lead Author (Year)	Study design	Population, Age	Sample size	Aims and objectives	Findings
Majumdar, 2020	Qualitative design	University undergraduate students, 18-21	325	To explore the impact of the lockdown – home confinement and social distancing – caused by the COVID-19 pandemic on well-being and lifestyle behaviours, particularly mental and physical health, depressive status, sleep quality, somatic complaints, and digital use.	The study of 325 undergraduate and postgraduate university students confirms, students spent a significantly ($p < .001$) greater duration of time on their cell phone both before (3.04 hours/day) and during (5.23 hours/day) the lockdown and drastically as compared to desktop/laptop or television use. The study showed an interesting association; increased cell phones use among students was negatively correlated with sleep duration ($r = -0.60$); Increased total screen time among the respondents was associated with higher depressive symptomatology; CES-D score was found to be positively associated with screen time among students ($r = 0.26$). The study revealed that Excessive screen time appears to have had a detrimental effect on health by severely affecting sleep patterns and duration.
Akulwar-Tajane, 2021	Cross-sectional qualitative study	Students, 18-21	150	To identify technology use in regards to the person's screen time and its impact on sleep and the mediating effect of physical exercise.	A total number of 150 psychotherapy students completed forms were analysed. 94.7% students' screen time use had increased during the lockdown. 43.3% of student participants spent more than 6 hours on digital devices on a daily basis.73.3% of the population agreed that screen time did affect their sleeping pattern during the lockdown. The study revealed that screen time has increased during the lockdown and to ha affected students' sleep patterns and sleep quality along with a new occurrence of sleep problems in lockdown. Also, mental and physical health issues have been reported. Along with changes in circadian rhythm, lifestyle influences from increasing access.
Kumar Arora, 2021	Cross-sectional, explanatory, online survey study	College students, 18-21	500	To assess the impact of screen time and physical activity on the level of cognitive loss in college students in India.	The highest percentage of college students (43%) had more than six hours of screen time. Subjects having more screen time also revealed a higher cognitive failure questionnaire score (56.19+20.07). Subjects who completed exercises for more than 29 minutes per day were found to have the lowest cognitive failure score (44.31+22.34). A decrease in physical activity also

					accompanies the increased screen usage thereby impacting the mental health of college students leading to cognitive failure.
Akulwar-Tajane, 2021	Cross-sectional qualitative study	Physiotherapy students, 18-21	150	To explore how access to screens, such as smartphones, tablets, and computers, can act as a distraction potential and play a role in studying experiences. Taking into consideration the mediating effect of sleep patterns and mental health of students on learning abilities.	For 94.7% students' screen time use had increased during the lockdown, the extent of the increase being moderate (51-75%) or high (>75%) for nearly two-thirds of the population. 43.3% of student participants spent more than 6 hours on digital devices daily. 56.7% of the students opined that smartphone use was problematic as screen usage has affected their academic performance. The study revealed that distracting students from study-related tasks and excessive hours spent in front of the screen also have a major effect on one's sleep and can affect one's physical and mental well-being.
Pandya, 2021	Systematic review	Children, Youth, 18-21	-	To comprehend the virtual social connectedness, excessive use of digital technology, and its consequences and suggest strategies to maintain healthy use of digital technology.	Screen time has increased drastically during COVID-19. Overall digital device usage increased by 5 h, giving a plunge to screen time up to 17.5 h per day for heavy users and an average of 30 h per week for non-heavy users. The study reported 8.8 h of screen time among younger adults and 5.2 h among the elderly (>65 years old), presenting concerns among these. However, there are mixed consequences of prolonged screen time use and blurred understanding between healthy and unhealthy social connectedness over digital media. A large number of original studies indicate excessive screen time has adverse health effects in long run such as physical health symptoms like eye strain, sleep disturbance, carpal tunnel syndrome, and neck pain as well as mental health problems ranging from difficulties in concentration and obsession to diagnosable mental illness such as anxiety, depression, and attention-deficit hyperactivity disorder.
Singh, 2021	Review study	Adolescent 18-21	-	To rethink the concept of "screen time" in the context of the COVID-19 situation.	The concerns about excessive screen time among children and adolescents pertain to two main health domains. First, an increase in screen time can harm physical health, cause sleep problems and increase the risk of myopia. Second, excessive screen time can also lead to adverse psychological consequences. Using screens while gaming, accessing social media, and watching online streaming services can be associated with behavioural addictions such as gaming disorder.

Gupta, 2021	Cross-sectional survey	College students 18-21	210	To determine the impact of increased screen usage on psychological and physical health during COVID-19 among Indian Students.	A statistically significant difference in time duration spent on screen before and during COVID was observed (t= 19.96; p<0.01). The bulk of them was spending more than 3 hours on screen for study purposes during COVID. The physical health issue which was faced the most due to increased screen usage during COVID, the majority of people reported neck pain (63.3%), eye problems (59.04%), headaches (56.19 %), and backache (29.52 %). 69.9% responded they felt anxious due to over-screen usage whereas 48.8 % responded lack of confidence as a major issue faced by them followed by panic disorder (24.8 %), depression (23.3 %), while 5.2 % responded to other problems which included lack of concentration, feeling agitated, and irritated due to over screen usage.
Kattula, 2021	Cross-sectional study	College students 18-20	232	The study aimed to assess OTT platform use among college students and its associations with increased screen time, mental well-being, COVID-19 related anxiety and personality traits.	Around 80% of the participants reported streaming videos for entertainment was an important reason for the increase in screen time. The change in screen time following the COVID-19 pandemic was a median increase of 240 (120-300) minutes per day. The study found students with high OTT platform use had scored significantly lower on the scale score representing the trait of conscientiousness. Further, those with problematic OTT platform use had poorer mental well-being. The psychological effects of binge-watching reported a significantly greater level of depressive symptoms in those who binge-watched videos. Also, watching videos is a way to reduce or cope with symptoms of anxiety and depression rather than a source of causing or perpetuating emotional difficulties in them.
Balhara, 2022	Descriptive cross-sectional study	College students 18-21	128	The study aimed to assess the gaming behaviour of college students and its association with stress due to the COVID-19 pandemic and the situation consequent to the public health measures instituted.	About half (50.8%) of the participants reported that their gaming behavior had increased, whereas 14.6% reported a decrease in their gaming during the lockdown period. Those with increased gaming had significantly greater chances of experiencing moderate-or-severe anxiety as compared to those who did not increase gaming. In binary logistic regression analysis, hours of gaming per day (OR 1.75 [1.29–2.36]), an increase in gaming due to examination-related stress (OR 4.96 [1.12–21.98]), and belief that gaming helped manage stress (OR 4.27 [1.65–11.04]), were found to be independently associated with gaming behaviour during the lockdown period. An increase in the amount of time spent on gaming would likely reduce the time available for

					other life activities such as personal care, exercise, and communication with others. This pattern of gaming could be detrimental to their physical and mental well-being.
Ganesh, 2022	Cross-sectional study	Medical and engineering students 18-21	731	The current study aimed to assess the relationship between screen time and mental well-being among students. also, attempted to explore the impact of educational and recreational screen time on the mental well-being of students.	The daily total screen time across different devices among the study participants was 540 min (median value, Interquartile range (IQR) = 390.0–720.0) and 540 min (median value, IQR = 420.0–720.0) for weekdays and weekends, respectively. Overall, the students who participated in the study reported a median score of 52 (IQR: 36–68) on the WHO well-being index. About 46.8% (n = 342) of participants scored less than 50% cut-off score on the WHO-5 well-being index (i.e., suggestive of poor mental well-being). During the COVID-19 pandemic, physical inactivity was found to have an association with mental health problems such as anxiety and depression in participants. Increased screen time use predominantly to access social media for non-communication purposes was associated with a higher risk of poor mental well-being.

Of the 10 studies, three were qualitative studies[22,29,30]. Five were cross-sectional studies[23,24,25,28,31] and two were review studies[26,27]. The overview of the baseline study characteristics is given in Table 3.

The researchers used the Newcastle-Ottawa Scale (NOS) to assess the risk of bias for each incorporated study. They considered the high quality of the articles based on each NOS score (moderate and high). An overview of these assessments is depicted in Table 2.

A study by Majumdar et al.[22] uncovered an interesting association that increased cell phone use among students was negatively correlated with sleep duration (r = −0.60) whereas among the office workers, increased use of desktop/laptops was negatively correlated with sleep duration (r = −0.90). Increased screen time among the respondents was associated with higher depressive symptomatology; CES-D (The Center for Epidemiological Studies-Depression Scale) score was entirely associated with screen time among students (r = 0.26) and office time workers. This is also consistent with the discovery that healthy sleeping habits, timing, and patterns are associated with improved mental health and a lower depression score.

Akulwar-Tajane et al.[23] showed that the screen-based digital devices and media use have significantly increased during the COVID-19 pandemic lockdown amongst the Physiotherapy students and provided scientific evidence for its negative impact on sleep. From the study, 94.7 per cent of the students' screen time use had increased during the lockdown. 43.3 per cent of the student participants spent more than 6 hours on digital devices daily. 73.3 per cent of the population agreed that screen time did affect their sleeping pattern during the lockdown. 64 per cent of the students encountered sleeping problems. 52 per cent of the people admitted that excessive screen use had affected their sleep quality. 65.3 per cent of the students were found participating in physical exercises regularly, out of which 65.27 per cent reported decreased sleeping complaints. The study revealed that using screens can have a severe impact on one's mental and physical health, in addition to disrupting the sleep cycle. These mental health conditions (20%) also include a lack of motivation and academic pressures (6%).

The Akulwar-Tajane et al.[25] study also revealed that 84.7 per cent of students could not perform study-related activities optimally as per their academic capacity. 56.7% of the population also agreed that excessive screen time hindered their ability to perform academically well. The study found that excessive screen use keeps students from completing their academic work and negatively impacts their sleep and overall physical and mental health.

Kumar Arora et al.[24] found that the highest percentage of college students (43%) had more than six hours of screen time. Subjects having a higher screen time also demonstrated a higher cognitive failure questionnaire score (56.19+20.07). Subjects who performed exercises for more than 29 minutes per day were found to have the lowest cognitive failure score (44.31+22.34). Along with increased screen time comes a decline in physical exercise, which affects college students' mental health and impairs their ability to think clearly.

Pandya and Lodha[26] showed the virtual social connectedness, excessive use of digital technology, and its consequences and suggested strategies to maintain healthy use of digital technology. Results reveal that screen time has increased drastically during COVID-19. However,

there are mixed consequences of prolonged screen time use and blurred understanding between healthy and unhealthy social connectedness over the digital media. According to a wide number of original studies, excessive screen time has negative health impacts over the long term including physical symptoms like eye strain, sleep disturbance, carpal tunnel syndrome, and neck discomfort as well as mental health issues including memory problems, obsessions, and diagnosable mental illnesses like anxiety, depression, and attention-deficit hyperactivity disorder. The suggestions for negative implications on (physical and) mental health warrant a strict need for inculcating healthy digital habits, especially knowing that digital technology is here to stay and grow with time.

According to Singh & Balhara[27], concerns regarding excessive screen time among children and adolescents are related to two essential health categories. The first way that increasing screen time might impair physical health is through sleep issues and an increased chance of myopia. Second, excessive screen time can also lead to adverse psychological consequences. They were using screens while gaming, accessing social media, and watching online streaming services can be associated with behavioural addictions such as gaming disorder.

Gupta et al.[28] showed a statistically significant disparity between the screen time spent before and during COVID-19 ($t= 19.96$; $p<0.01$). Similarly, a statistically significant positive correlation was found between screen usage time during the COVID-19 pandemic with backache (0.62), neck pain (0.71), headache (0.50), weight gain (0.52), and mental health (0.40). 69.9 per cent of the respondents said they felt anxious because of excessive screen time while 48.8 per cent cited lack of confidence as a critical concern, followed by panic disorder (24.8%) and depression (23.3%), and 5.2 per cent mentioned additional issues like inability to concentrate, feeling upset, and angered. The study found a positive association between screen time and physical and psychological health during COVID-19 among the Indian students.

Kattula et al.[29] found that most of the participants (n=216, 93%) regularly used OTT platforms. Approximately 80 per cent of the participants stated that watching streaming videos for fun was a significant factor in their increased screen usage. The Problematic Over the Top Platform Use Item list (POTTPUI) score was positively connected with the COVID-19-related anxiety scale score ($r=0.148$, $p=0.024$) and significantly inversely correlated with the WHO well-being index score ($r=-0.314$, p0.001). The study discovered that problematic OTT use was connected with paid OTT platform subscriptions and poor mental health, whereas conscientiousness's personality characteristic appeared to protect against problematic OTT use.

Balhara et al.[30] explored the changes in gaming habits among college students within the COVID-19 context. Half of the participants (50.8%) claimed that their gaming activity had grown, while 14.6 per cent claimed it had decreased during the lockdown. The time available for other daily activities like self-care, exercise, and social interaction would presumably decrease as game time increased. Their physical and emotional health may suffer from their gaming habits. This study does not prove that higher gaming during lockdown is associated with mild, moderate, or severe depression. They also expressed a more substantial agreement than students who did not enhance their gaming habit with the notion that gaming assisted in reducing stress due to the COVID-19 pandemic and the associated public health measures such as lockdown, quarantine, and social isolation.

Ganesh et al.[31] found that total screen time was noticeably more significant for students with poor mental health. On the WHO well-being measure, the students who participated in the study reported a median score of 52 (IQR: 36-68). On the WHO-5 well-being index, 46.8 per cent of the participants (n = 342) scored below the 50 per cent cut-off which suggests poor mental well-being. Physical inactivity was linked to mental health issues like anxiety and depression during the COVID-19 pandemic. An increased risk of poor mental health was linked to increased screen usage, mainly when it was used to access social media for non-communicational purposes.

Discussion

The digital age has brought about a sea change in the lives of children and adolescents. It has provided an avenue for further educational opportunities and easy access to information, knowledge, and communication. At the same span, there are concerns about the harms caused by the excessive use of digital technology. With the rise of the novel coronavirus (COVID-19) pandemic crisis, the world has been facing unprecedented times[32]. The beginning of December 2019 gripped the world as a whole, causing the pandemic situation[33] COVID-19-generated lockdown introduced the concept of a "new normal" as a measure of prevention and protection, necessitating children and adolescents to stay at home for educational and recreational purposes. Digitalization impacted children's play, learning, the construction of social relationships, and overall development. Although several studies have tried to elucidate how screen time affects mental health, the extent of how far adolescents' mental health is concerned is unknown. This systematic review included studies showing that screen time and COVID-19 impact adolescents' mental health.

The systematic review mainly collected pieces of evidence from the Indian adolescent population. According to research, increased screen time has been shown to affect both physical and mental health negatively. According to our research, the most frequent effects were sleep difficulties, decreased physical activity, anxiety, and depression. Adolescents' symptoms of depression and anxiety increased noticeably and significantly throughout the lockout compared to rates seen before the lockdown.[22,26,28,29] Cognitive failures, decreased academic performance, lack of concentration, gaming disorder, and poor well-being are additional outcomes that appear to be linked to the COVID-19 lockdown associated with screen time[24-27,31] The literature on screen time reflects both the pros and cons of screen time on (mental) health.

Screen time in excess appears to have negatively impacted sleep quality and duration which in turn, seems to have harmed health. Restrictions on access and isolation in the house resulted in less physical activity and more screen time, which may have significantly contributed to the disruption of sleep patterns. According to a study, the respondents' mid-sleep time curve flattened and shifted toward the right, indicating that more people went to bed later and woke up later during lockdown than they did before lockdown.[22] Furthermore, another study adds to the expanding body of literature emphasizing the connections between screen use and various outcomes, including sleep. The study clarifies that physical activity may be a modifying factor affecting sleep patterns. Most of the exercising participants reportedly felt positive effects due to their physical activity.[23] Also, using a phone or other screen right before bed will prevent you from getting enough rest. Inducing psychophysiological arousal and disrupting sleep might result from gazing at a bright screen while also consuming emotionally upsetting violent, or fast-paced

content in the form of movies or video games. It has been demonstrated that exposure to blue light or electromagnetic radiation after dark from various digital screens such as smartphones, can retard or inhibit the pineal gland's generation of melatonin and lead to sleep disorders owing to disruptions in circadian rhythm. These sleep abnormalities, in turn, have been related to physical health concerns and poor psychosocial functioning, including reduced academic achievement.[27]

According to a study, screen use, sleep quality, and academic achievement are all negatively correlated. The study found that during the COVID-19 lockdown, 84.7 per cent of the students could not complete academic tasks to their fullest potential.

They mentioned the following issues in addition to those covered below: lack of focus and concentration (60.7%), lack of motivation to study, etc. 56.7 per cent of the students felt that using a smartphone was problematic because using a screen had a negative impact on their academic performance.[25] One of the studies revealed that students who spent more time on screens had higher CFQ (cognitive failure questionnaire) scores which indicated a higher likelihood of cognitive failure. The subjects with the longest screen time- more than 6 hours a day, had the highest CFQ scores, whereas those with the shortest- between one and three hours a day, had the lowest CFQ scores.[24] In contrast, it was discovered that a longer exercise period was directly connected to a decline in cognitive failure.

The lowest CFQ scores were found in those who regularly exercised for longer than 29 minutes, indicating a lower chance of cognitive failure.[24] The literature on screen time reflects both the advantages and disadvantages of screen time for (mental) health. If COVID-19 had only been around for a short time, perhaps digital technology would have a positive impact on day-to-day life. However, the prolonged pandemic has made using digital technology a threat to people's physical and mental health.[26] Excessive screen time has negative long-term health effects, including physical symptoms like eye problems, sleep disturbance, carpal tunnel syndrome, and neck pain, as well as mental health problems like concentration issues, obsessions, and diagnosable mental illnesses like anxiety, depression, and attention-deficit hyperactivity disorder.[26-28] Sleep issues and a higher incidence of myopia are the two main detrimental effects of screen time on children's and adolescents' physical health.[27,30] According to a study's findings, spending more time in front of a screen significantly negatively influences one's physical and mental health. Students frequently have backache, neck pain, and headaches, among other physical health issues. However, students report anxiety as the most common mental health problem[28] Poor mental health was linked to using screens more frequently overall. Different sorts of screen time might relate differently to adolescents' mental health. An increased risk of poor mental health was linked to increased screen usage, particularly when it was used to access social media for non-communicational purposes.

Additionally, it was shown that people's lack of physical activity was linked to mental health issues like anxiety and depression during the COVID-19 pandemic.[28,31] A study found that those who used OTT platforms problematically had worse mental health. The psychological consequences of binge-watching revealed noticeably higher depressive symptoms in those who did so.[29] In that study, the OTT consumption behaviour was not linked to COVID-19-related anxiety. We have a similar observation in a study that revealed anxiety associated with COVID-19 was unrelated to

an increase in gaming behaviour.[30] This study fills a gap in the body of knowledge regarding how the COVID-19 pandemic affected gaming habits. During the COVID-19, the majority of college students increased their gaming activity. It was linked to test-related stress and the notion that gaming reduces stress.[30]

Studies revealed that screen time is mediative, with both positive and negative effects on mental health. Perhaps, digital technology offered a forum to deal with psychological reactions fuelled by COVID-19 if it were for a shorter period. However, the protracted period of the pandemic has led the use of digital technology to the pinnacle of a hazard to people's physical and mental health. Literacy about digital practices and parental supervision of children's digital practices needs attention. The pathological use of digital games among youth is disturbing. Critical to note is that digital patterns must be balanced with non-connected activities. It is essential to be aware of the absolutes where one can depend on digital devices for comfort and betterment versus where one needs to pause and disconnect.

Conclusion

Prolonged screen time has been linked to various adverse effects on health including mental health, as suggested by numerous studies. In India, it is essential to re-examine the recommendations on screen time for children and adolescents. However, screen time is a complex concept, and simply limiting the total time spent looking at screens may not be enough. It is advisable to consider other factors when making changes such as the type of screen time, the potential for behavioural problems, and privacy-related concerns like cyberbullying.

Future studies should focus on exploring optimal cut-offs for screen time and delve deeper into the contents and contexts of screen-time use among the children and adolescents at different developmental stages. While digitalization is the future, individuals must be empowered to make informed decisions based on scientific information to mitigate the negative impacts of prolonged screen time. Encouraging healthy digital habits is crucial in the light of the global trend towards digitalization. To promote healthy habits, we can aim at educating students on the negative effects of excessive screen time and encourage better bedtime routines. Additionally, we will limit screen use for academic purposes, providing alternative sources and solutions. We will also educate students on the importance of physical activity, especially during lockdowns which is crucial for maintaining good health and wellbeing. The present research contributes valuable scientific knowledge to the impact of long-term lockdowns on health and wellbeing as well as to the development of effective preventive measures. With the insights gained from this study, we strive to create a healthier digital environment and promote well-being among children and adolescents.

Recommendations

Based on the findings of this study, there are several implications for practice that can promote healthier digital habits and reduce the negative effects of prolonged screen time on children and adolescents. Firstly, educators and parents must be made aware of the adverse effects of prolonged screen time; and they must be educated on strategies to limit and monitor children's screen time. This could include setting guidelines and restrictions on screen time, encouraging

alternative activities like outdoor play or reading, and monitoring children's screen use. Secondly, there is a need to incorporate other attributes besides total screen time spent while making recommendations on screen time. These attributes could include the type of screen time, contents and contexts of screen use, and privacy-related issues like cyberbullying. Thirdly, physical activity should be promoted amongst the children and adolescents, especially during lockdowns. This could include encouraging outdoor activities, setting up virtual exercise classes, and providing opportunities for physical activity during remote learning. Fourthly, educators and parents should promote healthy bedtime routines to ensure that children get enough sleep, which is crucial for their physical and mental well-being. Finally, there is a need for ongoing research to explore the optimal cut-offs for screen time based on the type of screen time, the rise of behavioural problems, and privacy-related issues like cyberbullying. This will ensure that future recommendations on screen time are evidence-based and effective in promoting healthy digital habits among children and adolescents.

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