खण्ड 45 संख्या 3 जुलाई से सितम्बर 2022 आई.एस.एस.एन.0253–6803
Volume 45 Number 3 July-September 2022 ISSN- 0253-6803

स्वास्थ्य एवं जनसंख्या : परिप्रेक्ष्य एवं मुद्दे

Health and Population: Perspectives and Issues

आरोग्यम् सुखसम्पदा

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HEALTH AND POPULATION: PERSPECTIVES AND ISSUES

(INCORPORATING NIHAE BULLETIN (EST.1968) AND THE JOURNAL OF POPULATION RESEARCH (ESTD. 1974)

VOLUME: 45	NUMBER 3	July-September 2022

Health and Population:
Perspectives and Issues, 45 (3) 128-141 / July-September 2022

Unit Cost for Output Indicators and Per Capita Expenditure of Various Programmes at PHC Level in Medak District

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Abstract

Studies on unit cost and per capita expenditure are critical to promote efficiency and arrive at the right decisions about priorities in health budgeting and planning of various programmes. This paper examines the distribution of the expenditure and resource components of the programmes, calculate the unit costs and per capita expenditure of various programmes at the Primary Health Centre (PHC) level on different services like Family Planning (FP), Maternal and Child Health (MCH), Curative services. Communicable Disease Control (CDC) and Environment Sanitation (ENV). The study is based on primary and secondary data, and nine PHCs were selected purposively from Medak District for data collection. The cost accounting method is used. The analysis of programme specific expenditure on different functions indicates that of the total resources, 25.1 per cent was spent for FP, followed by 22.1 for illness, 21.6 for MCH, 18.5 for CDC and 12.3 per cent for ENVT. The unit cost of the FP programme is the highest, i.e., Rs.3895, followed by MCH (Rs.828), CDC (Rs.494), and illness (Rs.29). On average, one PHC had spent Rs.85.5 lakhs for the year 2013-14 and also, a PHC had spent the highest amount of Rs.21.9 lakhs for FP followed by MCH, CDC and illness in that order. It was found that Kanukunta had the highest per capita expenditure of Rs.370, and Bhanoor had the lowest of Rs.90. For better and efficient functioning of the PHCs, the salary component has to be 50 to 60 per cent. Recurring (operational and maintenance) and the cost component of medicines must be raised to at least up to 30 per cent for the services to be efficient. The expenditure of all programmes for PHCs is not in proportion to their population size, suggesting that the allocation of funds to PHCs has to be done based on the size of the population.

Key words: Unit cost, Per capita expenditure, Primary health centre, Public health, Allocation of resources

Introduction

In India, the demand and the cost for health care facilities have been rapidly growing over time. However, the resources are limited, hence a need to utilize available resources efficiently to meet the growing demand for health services. In order to promote efficiency and arrive at the right decisions about priorities, studies on the cost of various programmes are needed. Direct costing of services can provide detailed estimates of allocation of resources for comparing programme and planning priorities. Information on total and unit cost of services is required to assess the financial requirement of programme maintenance or expansion at various levels of facilities. In this paper, unit costs and per capita expenditure of major programmes at the Primary Health Center (PHC) level were calculated. PHC, along with its sub-centres,

provide five major services: (i) Curative care (Illness), (ii) Family Planning (FP), (iii) Maternal and Child Health (MCH), (iv) Communicable Diseases Control (CDC) and (v) Environmental Sanitation (ENV).

Dey and Padhy have examined the distribution of PHC expenditure among four Direct Programmes: Curative care, FP, MCH and other programmes in 8 PHCs and 145 sub-centers from four states Uttar Pradesh, Odisha, Gujarat and Maharashtra during 1989-90[1]. They found that the average annual expenditure per PHC was Rs.1.673 million. Of this, the FP programme accounted for 34 per cent, followed by the MCH programme (30 per cent), Curative care and other programmes accounted for 18 per cent each. Analysis of resource-specific expenditure shows that salary accounted for 71 per cent of the total expenditure, followed by drugs (7%) and incentives (6%). Thus, salary had taken a major share in all the four programmes.

Alexander et al.[2] have examined the costs incurred for five major functions of PHCs: i) Medical Relief including all care of illness (MR) ii) MCH including personal preventive services which were on a very small scale, iii) FP, iv) Communicable Disease Control (CDC) and v) ENV from four blocks- two from Punjab and two from Mysore in 1968-'69. They found that the total annual cost of operating a PHC was about Rs. 1,59,750 in Punjab and Rs.83 400 in Mysore. In Punjab, the salary scales were higher, but the size of the staff was more.

Dileep Mavalankar[3] compared the allocation of budget on medicines at the PHC level and government employees in some organizations in two relatively well-developed states and three under-developed states in India. They found that the allocation for medicines in PHC was ranging from Rs.0.17 to Rs.3.2 per capita in various states. In comparison, government organizations have spent between Rs.62 to 1000 per capita per year on medicines for their employees in economically well-developed states.

Objectives

In India, much analysis was not done on the allocation of the resources (both manpower and material) at the PHC level on different services. Also, a detailed analysis of components of total expenditure is not done. However, such analysis from time to time can be helpful for proper planning and effective management of limited resources available for the PHCs. The primary objectives of this paper are to:

I. examine the distribution of the expenditure of the PHCs by various programmes and components,
II. examine the time allocation by the staff members in PHCs across programmes,
III. calculate the unit cost of various programmes at the PHC level, and
IV. calculate the per-capita costs for different programmes.

Methodology

For calculating the unit costs of output indicators of various programmes, information on costs and output indicators of various programmes of PHCs is needed. Costs of a programme are calculated based on the use of resources such as salary component (time of staff members), medicines, capital and recurring, etc., by each patient. The cost accounting method is used to collect secondary data on costs. Except for the salary component, data on others was collected from PHC and Directorate of Medical and Health Organisation records. To get the salary component of the PHC staff members, time allocation data of the staff members for the following five major programmes were collected to get the salary component of the

staff members: 1) Illness care (ILL), 2) MCH, 3) FP, 4) Communicable Disease Control (CDC), and 5) Environmental sanitation (ENV) of nine PHCs for 2013-14.

The benefits are measured as the output measures of different programmes at the PHC and sub-centre levels. Then the unit cost for each programme of the PHC was calculated by dividing the total costs with the output indicator of that programme. Further, the per capita expenditure of each PHC during 2013-14 was calculated by dividing the total expenditure of the PHC by the population of that PHC.

Sample Selection: Nine PHCs and 85 Sub-Centers (SCs) from Medak district were selected for the study purposively. Data was collected from secondary and primary sources from October 2013 to Feb 2014. Secondary data was collected from the District Medical and Health Office (DMHO), Sangareddy, PHCs and SCs. Cost data were collected from the work statements, account books, list of medicines and equipment, attendance registers of all the 9 PHCs for 2011-12, 2012-13 and 2013-14 through a questionnaire. Data on medical supplies were collected from the records of DMHO.

Data Collection: Primary data was collected through personal observation and an informal discussion with the staff members. Secondary data was also collected from the records of the PHCs. Five major services are provided at the PHCs and sub-centres. They are:

1. Illness care (ILL): Total number of outpatients at the OPD of PHC/SCs
2. Maternal Child Health (MCH): Activities under it were categorized into two groups:
    a. MCH care (excluding Immunization service): Ante-Natal Care (ANC) Post-Natal Care, Deliveries conducted, baby checkups, etc.
    b. Immunization services: TT to pregnant women, BCG, DPT, and TT, Polio given to children. The indicator for the immunization was the number of injections/doses administered in the accounting year.
3. Family Planning (FP): This was measured in two ways: (i) the total number of beneficiaries of various FP methods and (ii) sterilization equivalents.
4. Communicable Disease Control (CDC): All activities related to mass communicable disease control, and
5. Environmental sanitation (ENV): All activities related to Community Environmental Sanitation.

Each of these five services is further divided into two categories: (1) Direct delivery of services and (2) Administrative or Supportive Activities.

Allocation of Time for different activities by the PHC Staff

To calculate the time spent by the PHC staff members on different activities, a special time use form was used for the doctors, supervisors, and workers to record their daily activities and time spent on each activity. The researcher filled up these schedules by observing their activities every day at the PHC for a couple of days. The data was collected from the personnel of all PHCs and SCs. Thus, each worker reported about the place of work, activities carried out for a) Activities for delivering direct services on Illness Care, FP, MCH, CDC, and ENV, b) Administrative and support services such as writing records and reports, preparation of supplies, maintenance and cleaning, liaison with health and community officials, travel, transit and waiting, routine administrative discussions; ill-defined technical work related to specific services; and staff communication, supervision, and education.

The total number of hours of allocation of time per week was filled and converted into total monthly working hours spent by each personnel member for each activity. For estimating the time devoted to different activities, the units of time spent for different activities were summed up. Then proportional allocation of time for each activity by each category of personnel was calculated. Table 1 gives the allocation of percentage distribution of time devoted to direct services and administrative and support services by the PHC staff members to various programmes.

In Jinnaram, Gummadidala, Kanukunta, Kondapur and Athmakur, where there was no Assistant Para-Medical Officer (APMO), the figures for monthly time spent was based on the figures for those PHCs, where such positions were occupied. Medical officers were in overall control of the PHCs. Besides the medical duties, they attended activities like 'Others' (monthly *taluk* meetings, many visits to *Gram Saba*, training programmes, etc.). Overall, the staff members of PHCs devoted maximum time to FP services. All the PHCs have given illness and MCH almost equal importance. This suggests that PHCs were paying much attention to both preventive and curative care. The allocation of salary cost component of the staff into different programmes was done based on the proportion of time spent by them on various programmes in a month.

Table 1

Staff Position and Time Allocation for Each Programme in One Month 2013-'14

Sl. No	Staff/Category	Availability of staff members in 9 PHCS									Monthly time Spent for Each programme (in Hours)						Monthly Hours
		1.Jinnaram	2.Gummadiala	3.Kanukunta	4. RC Puram	5.Bhanoor	6.Munipally	7. Kandi	8.Kondapur	9.Athmakur	ILL	MCH	FP	CDC	ENV	Others	
1	Medical Officer	2	1	1	1	1	2	1	2	2	46	29	41	16	18	56	206
2	APMO	0	0	0	1	1	1	1	0	0	34	34	43	43	24	28	206
3	MPHEO	1	1	-	-	1	-	1	-	1	23	36	46	31	21	49	206
4	CHO	-	-	-	1	1	1	-	1	_	81	56	69	0	0	0	206
5	PHN	1	_	_	1	_	1	1	1	1	19	66	44	14	12	49	206
6	MPHS(F)	3	1	1	3	4	2	2	3	3	26	51	40	15	14	61	206
7	MPHS(M)	1	1	_	1	2	1	1	1	2	39	39	29	39	39	21	206
8	Staff Nurse	2	2	1	3	1	2	1	2	2	34	61	49	11	9	42	206
9	Sr. Assistant	1	1	1	1	1	1	1	1	1	24	24	27	17	19	96	206
10	Jr. Assistant	1	-	-	-	-	-	-	-	-	26	24	26	19	16	96	206
11	Lab-Tech	1	1	1	1	1	1	1	1	1	53	37	27	23	8	58	206
1	Pharmaci	1	1	1	1	_	1	1	1	1	57	3	3	3	0	46	206

2	st											5	6	1			
13	MNO	1	-	-	-	-	-	-	-	-	0	0	26	60	60	60	206
14	FNO	1	-	-	-	-	-	-	-	-	0	0	26	60	60	60	206
15	MPHA(F)	6	6	2	13	20	4	6	9	10	29	34	45	27	16	55	206
16	MPHA(M)	2	3	2	2	6	2	2	2	1	13	17	39	47	39	51	206
17	2nd ANM	6	5	2	5	10	7	11	7	10	61	54	54	6	5	26	206
	Total	35	27	13	37	51	31	31	36	41							

Source: Calculated by the author

Relative Attention Paid by Various Functionaries on Different Programmes

Different staff members of the PHCs perform different types of duties. Thus, while a medical officer may be the overall in-charge of the PHC, supervising all the activities of the PHCs, personnel like the laboratory technician and pharmacist attend to specific duties which may not be related to all the services performed by the PHC. So, individual programme specific time use is calculated. The formula is as follows:

Individual programme spe = time use (in per cent) — No. of time units (hours) of direct services for the programme by a functionary in a month x 100/ No. of total units of time units (hours) of direct services for all programmes by the functionary in a month

Data in Table 2 show that while the Medical officers devoted maximum time to 'Others', followed by ILL, FP and MCH, ENV and CDC. The Multipurpose Health Education Officer (MPHEO), on the other hand, devoted maximum time to FP followed by ILL and MCH in that order. CDC and ENV figured relatively low in their time allocation. The Multi-Purpose Health Supervisor (MPHS) male and female attended ILL, MCH, FP, CDC and ENV equally. The Multi-Purpose Health Assistants (MPHAs) male and female were attending more to 'Others' followed by CDC, ENV, FP, MCH and ILL, in that order. The staff nurse was attending to ILL, followed by FP and MCH, in that order. The pharmacist and laboratory technician were attending to ILL, MCH, FP and CDC. Public Health Nurse (PHN) devoted maximum time to MCH and FP. The senior assistant was attending to 'Others'. The 2nd and 3rd ANMs have devoted maximum time to ILL, MCH and FP.

Table 2

Individual Programme Specific Time Use during 2013-14 (%)

Sl. No	Staff/Category	ILL	MCH	FP	CDC	ENV	Others	TOTAL
1	Medical Officer	22.57	13.89	19.97	7.81	8.68	27.08	100
2	MPHEO	20.83	20.83	26.04	13.54	8.33	10.42	100
3	MPHS(F)	18.75	18.75	18.75	18.75	18.75	6.25	100
4	MPHS(M)	18.75	18.75	18.75	18.75	18.75	6.25	100
5	MPHA(M)	6.25	8.33	18.75	22.92	18.75	25.00	100
6	MPHA(F)	6.25	8.33	18.75	22.92	18.75	25.00	100
7	Staff Nurse	31.25	27.08	29.17	0.00	0.00	12.50	100
8	Pharmacist	31.25	18.75	18.75	18.75	0.00	12.50	100
9	Lab-Tech	31.25	18.75	18.75	18.75	0.00	12.50	100
10	O. Subordinate	31.21	27.05	29.13	0.00	0.00	12.62	100

11	APMO	16.67	16.67	20.83	20.83	11.46	13.54	100
12	CHO	39.58	27.08	33.33	0.00	0.00	0.00	100
13	PHN	0.00	45.83	41.67	0.00	0.00	12.50	100
14	Sr. Asst.	8.33	6.25	10.42	6.25	6.25	62.50	100
15	2nd ANM	31.25	27.08	29.17	0.00	0.00	12.50	100
16	3rd ANM	31.25	27.08	29.17	0.00	0.00	12.50	100
17	Sweeper	18.75	18.75	18.75	20.83	20.83	2.08	100
18	Contingency Worker	18.75	18.75	18.75	20.83	20.83	2.08	100

Programme Specific Time Use

Total service time of all health functionaries in a PHC and its SCs spent on a specific activity is termed programme specific time use. Programme specific time use is calculated by adding the time spent by all functionaries on a programme. It is calculated as:

Programme specific time use in a PHC and sub centres (in %) = No. of time units (hours) of direct and administrative services for a particular programme by all functionaries in a month x 100/ No. of total units of time (hours) of direct and administrative services for all programmes by all functionaries in a month

From the data presented in Table 3, it was noticed that all the PHCs devoted more time to FP services and least time to ENV. All the PHCs gave CDC, Illness and MCH almost equal time. However, one cannot ignore the noticeable presence of 'Others' (supervision, travel time, waiting time, record keeping and meetings) ranging from 15-20 per cent for the PHCs.

Table 3

Distribution of Time Allocated for Different Programmes during 2013-'14 (%)

Name of PHC	Programmes						
	ILL	MCH	FP	CDC	ENV	OTHERS	TOTAL
1.Jinnaram	17.87	17.24	21.61	13.54	11.36	18.39	100
2.Gummadidala	19.05	17.18	21.84	13.75	10.82	17.36	100
3.Kanukunta	19.20	16.13	20.61	14.06	9.96	20.03	100
4.RC Puram	17.22	16.99	22.16	14.40	11.47	17.76	100
5.Bhanoor	15.84	15.22	21.53	15.61	12.85	18.93	100
6.Munipally	21.40	20.01	23.38	11.17	8.97	15.07	100
7.Kandi	20.36	19.39	23.41	10.99	8.46	17.38	100
8.Kondapur	19.08	18.25	22.52	13.05	10.78	16.32	100
9.Athmakur	19.80	18.97	22.90	12.25	10.13	15.96	100

Measurement of Costs

Cost refers to the resources which are spent on all activities for providing health services. Data on costs were collected mainly through secondary sources such as documents like work statements, account books, list of medicines and equipment, attendance registers and medical supplies from 9 selected PHCs from

Medak district for the accounting years 2011-12, 2012-13 and 2013-14 during October 2013 to Feb 2014. Personal observation and informal discussions with staff members were done to give authenticity to the data.

Costs were grouped into two types - capital and recurring. (1) Capital Costs: Physical infrastructure: (major repair/maintenance work), patch work, furniture, and equipment and (2) Recurrent costs: included (a) operational and maintenance and repair costs, (b) salaries and allowances of the staff, (c) food for the patients (d) medicines, vaccines, contraceptives, (e) stationery, electricity, water, telephone charges, cleaning, and general administrative expenses, and (f) IEC activities like film shows, cultural shows, etc.

Allocation of Costs to Different Programmes

The data on costs includes salary, capital, recurring, and medicines for 2013-14. The component of salary of PHC staff members was apportioned for different programmes in the same proportion as the time allocation for Direct Services and administrative services to these programmes by the staff members. Data on expenditure on capital recurring for each function was obtained from PHC records. The expenditure data for Medicines was collected from DMHO records for 9 selected PHCs. The expenditure on medicines was not available programme wise at the PHC level but was available under four sub-heads - general, antibiotics, fluids and surgical. Based on the activities and output indicators of PHCs, the expenditure of medicines was allocated as Illness -50 per cent, CDC -20 per cent, and MCH and FP -15 per cent each. The total expenditure for each programme includes salary, capital (excluding building, vehicles, and large equipment), recurring and expenditure on medicines.

Programme Specific Expenditure

Data from Tables 4 and 5 reveal that of the total expenditure of the nine PHCs, 88.5 per cent is spent on salaries of the staff members, 3.5 per cent on medicines, 1.3 per cent on capital expenditure and 6.5 per cent is spent on recurring expenditure, indicating that the salary is the major component of the expenditure. The pattern is the same for all programmes.

Table 4

Programme Specific Expenditure of all 9 PHCs combined during 2013-14 (In Rs.)

	Illness	MCH	FP	CDC	ENV	Total
Salary*	15250839	15056639	18973002	12243664	9823780	71347924
Medicines	1411914	423574	423574	564765	0	2823827
Capital	405621	319623	232110	93474	73646	1124474
Recurring	795303	1676741	645530	2056937	76590	5251101
Total	17863677	17476577	20274216	14958840	9974016	80547326

*Salary component was apportioned to 5 programmes only. Others not included.

Table 5

Percentage Distribution of Programme Specific Expenditure on Different Resources of All 9 PHCs during 2013-'14

	Illness	**MCH**	**FP**	**CDC**	**ENV**	**Total**
Salary	85.3	86.1	93.5	81.8	98.4	88.5
Medicines	7.9	2.4	2.0	3.7	0	3.5
Capital	2.2	1.8	1.1	0.6	0.7	1.3
Recurring	4.4	9.5	3.1	13.7	0.7	6.5
Total	100	100	100	100	100	100

Resource Specific Expenditure

Data from Table 6 and Chart 1 show that the share of salary component was 26.5 per cent for FP followed by MCH (21.1%), Illness (21.3%), CDC (17.1%) and ENV (13.7%). The capital expenditure was highest for Illness (36%), followed by MCH (28.4%), FP (20.6%), CDC (8.3%) and ENV (6.5%). The Recurring expenditure was highest for CDC (39.1%), followed by MCH (31.9%), Illness (15.1%), FP (12.2%) and ENV (1.4%). Of the total resources, 25.1 per cent was spent for FP, followed by illness (22.1), MCH (21.6), CDC (18.5) and ENVT (12.3).

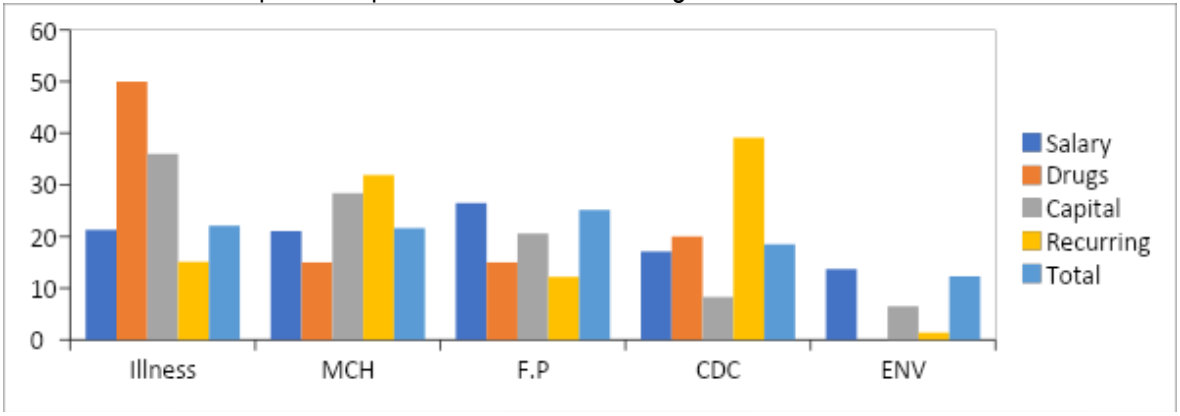
Table 6

Percentage distribution of Resource Specific Expenditure on Different Programmes of All 9 PHCs, 2013-14

Resources	Illness	MCH	F.P	CDC	ENV	Total
Salary	21.3	21.1	26.5	17.1	13.7	100
Medicines	50	15	15	20	0	100
Capital	36	28.4	20.6	8.3	6.5	100
Recurring	15.1	31.9	12.2	39.1	1.4	100
Total	22.1	21.6	25.1	18.5	12.3	100

Chart 1

Resource Specific Expenditure on Different Programmes of All 9 PHCs 2013-'14



Unit Costs per Output of Various Programmes

To calculate the unit cost for different services provided at the PHC level, cost data of various services and the output indicators of the services were needed. The total cost of each function is divided by the output measure of each programme to get the unit cost. Output measures are available for each function at the PHC level. The output indicators are available for 6 months only (April 2013- September 2013) for the selected PHCs. So, for calculating unit costs, expenditure data was taken for six months only.

Data given in Table 7 and Chart 2 show that the total expenditure was the highest for Bhanoor, followed by Athmakur, Kondapur, and RC Puram in that order while the lowest expenditure is for Kanukunta PHC.

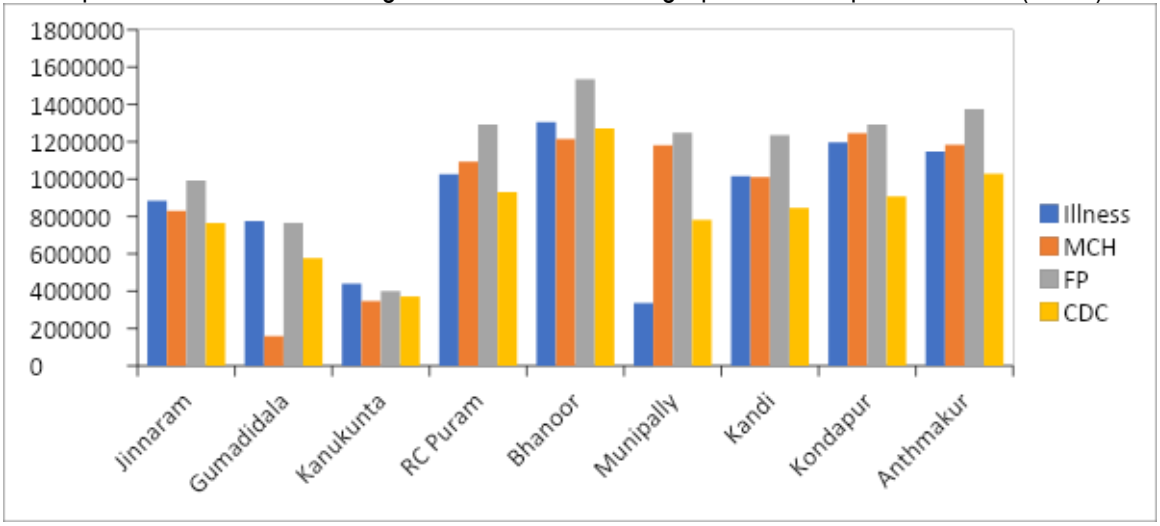
Table 7

Expenditure on Different Programmes of PHCs, April 2013- September 2013 (in Rs.)

PHC	Illness	MCH	FP	CDC	Total
Jinnaram	883821	829911	993872	764906	3472509
Gumadidala	775252	159131	765615	576762	2276759
Kanukunta	439981	346812	400202	371509	1558505
RC Puram	1025412	1093270	1291151	931064	4340896
Bhanoor	1306457	1215042	1535077	1271133	5327709
Munipally	336253	1180437	1248161	781745	3546596
Kandi	1014594	1010158	1236732	845602	4107087
Kondapur	1196407	1244644	1292303	907096	4640450
Anthmakur	1147173	1183205	1373996	1029603	4733976
Total	8125351	8262609	10137108	7479420	34004487

Chart 2

Expenditure on Different Programmes of PHCs during April 2013- September 2013 (in Rs.)



Measurement of Output indicators

For output indicators, only four programmes were considered, i.e., Illness (curative care), MCH, FP and CDC, because for ENV, data on output indicators was not available at the PHC level. For illness, the outcome variables are inpatients at the PHC level, and outpatients (new cases) and old cases at the PHC level and outpatients at the sub-centre level. The weighted outcome indicator for MCH is obtained by giving weights as ANC (0.2), institutional delivery (0.6), and PNC (0.2), and number of fully immunized children (1.0). For Family Planning, Sterilization equivalents are calculated by converting 3 IUDs = 1 Sterilization, 9 Oral Pills = 1 Sterilization, and 18 Condoms = 1 Sterilization.

Under the CDC programme, mainly the activities are collection of blood samples for checking Malaria, Venereal diseases (VD) and Sexually Transmitted Diseases (STD), and collection of sputum samples for Tuberculosis (TB). A composite index for CDC was calculated by giving weights of 0.7 for Malaria, 0.1 each for Tuberculosis, VD and STD.

The data in Table 8 show that an output indicator for illness was highest for Kandi PHC, followed by Athmakur. For FP, Munipally and MCH, Kandi has the highest output indicator. For CDC, Gummadidala has the highest, and RC Puram has the lowest indicator. Kanukunta has the lowest output indicators except for CDC compared to all other PHCs.

Table 8

Output Indicators of Different Programmes in PHCs, April-September 2013

PHC name	Illness	MCH	FP	CDC
Jinnaram	36036	643	150	2281
Gumadidala	15087	879	115	6482
Kanukunta	8197	394	104	870
RC Puram	25073	1689	322	719
Bhanoor	75525	1665	324	3207
Munipally	20166	842	991	2400
Kandi	106246	1907	463	1670
Kondapur	35344	1264	586	1501
Athmakur	91646	1462	452	2218

The expenditure of each programme was divided by the combined output indicator of that programme to get the unit cost. Data of Table 9 and Chart 3 indicate that the average unit cost of producing an outcome indicator by a PHC for FP is Rs.3895, followed by MCH outcome indicator (Rs.828), CDC (Rs.494), illness indicator (Rs.29). It was found that the unit cost of producing an output indicator for illness is the highest for Kanukunta PHC because of the lowest outcome indicator, and for MCH, it was highest for Munipally PHC. For FP, it was highest for Gummadidala and for CDC, it was highest for RC Puram PHC.

Table 9

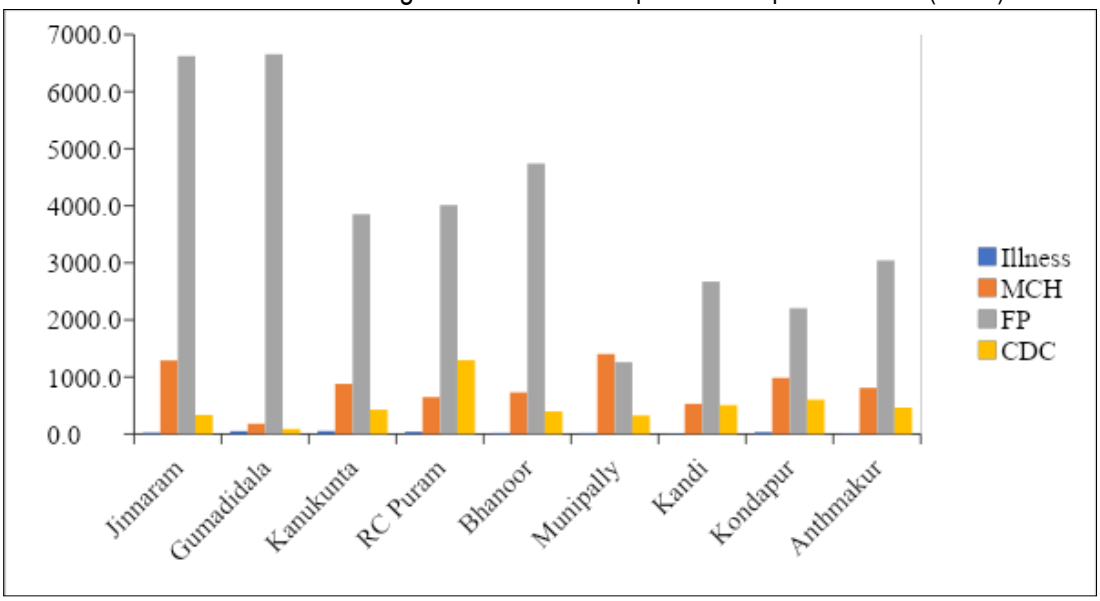
Unit Costs for Different Programmes, April-September 2013 (in Rs.)

PHC name	Illness*	MCH	FP	CDC
Jinnaram	24.5	1290.7	6625.8	335.3
Gumadidala	51.4	181.0	6657.5	89.0
Kanukunta	53.7	880.2	3848.1	427.0
RC Puram	40.9	647.3	4009.8	1294.9
Bhanoor	17.3	729.8	4737.9	396.4
Munipally	16.7	1401.9	1259.5	325.7
Kandi	9.5	529.7	2671.1	506.3
Kondapur	33.9	984.7	2205.3	604.3
Anthmakur	12.5	809.3	3039.8	464.2
Total	260.4	7454.6	35054.8	4443.3
Average	28.9	828.3	3895.0	493.7

*It includes inpatients and outpatients.

Chart 3

Unit Costs of Different Programmes in PHCs April 2013- September 2013 (in Rs.)



Expenditures of PHCs

Expenditure for Different Programmes

The total expenditure for each programme includes salary, capital and recurrent expenditure. It excludes expenditure on medicines. Table 10 shows that Bhanoor had the highest total expenditure and Kanukunta the lowest expenditure. On average, one PHC had spent Rs 85.5 lakhs for the year 2013-14 and also, on average, a PHC had spent highest for FP followed by MCH and illness in that order.

Table 10

Expenditure by PHCs for Different Programmes, 2013-14 (in Rs.)

PHCs	ILL	MCH	FP	CDC	ENV	Total
Jinnaram	1646674	1623530	1951454	1481424	1145923	7849005
Gumadidala	1451616	1239955	1501564	1113968	763291	6070394
Kanukunta	825497	677286	784065	721233	312771	3320852
RC Puram	1896826	2140339	2536102	1800529	1371543	9745339
Bhanoor	2242129	2121696	2922162	2231129	1852799	11369915
Munipally	2045671	2288931	2424378	1467566	919471	9146017
Kandi	1876391	1974476	2427625	1630086	999041	8907619
Kondapur	2165488	2421091	2516409	1723263	1220313	10046564
Athmakur	2128026	2316514	2698095	1992678	1356575	10491888
Total	16278318	16803818	19761854	14161876	9941727	76947593
Average	1808702	1867091	2195762	1573542	1104636	8549733

Note: Expenditure includes Salary, Capital and Recurring expenditure of PHCs and sub-centers.

Per Capita Expenditure for Different Programmes

Per capita expenditure was calculated for each programme by dividing the total expenditure by the population of the PHC. Data from Table 11 show that the per capita expenditure of PHCs was negatively related to its population size. For instance, Kanukunta, serving a population of only 8969, had the highest per capita expenditure of Rs.92.04 for illness and Bhanoor PHC serving a population of 125819 had the lowest per capita expenditure of Rs.17.82 on curative care. In the case of Family planning, Kanukunta PHC had the highest per capita expenditure of Rs.87.42, and Bhanoor had the lowest with Rs.23.23. A similar pattern was observed for the other three programmes. When the per capita expenditure of all programmes was combined, it was found that Kanukunta had a per capita expenditure of Rs370, which is the highest and Bhanoor, with Rs. 90 has the least. The above analysis indicates that the expenditure of all functions for PHCs is not in proportion to their population. Therefore, allocation of funds to the PHC has to be done based on the size of the population.

Table 11

Per Capita Expenditure of PHCs for Different Programmes, 2013-14 (in Rs.)

PHCs	ILL	MCH	FP	CDC	ENV	Total
Jinnaram	33.81	33.34	40.07	30.42	23.53	161.18
Gumadidala	48.05	41.05	49.71	36.88	25.27	200.95
Kanukunta	92.04	75.51	87.42	80.41	34.87	370.26
RC Puram	23.05	26.01	30.81	21.88	16.66	118.41
Bhanoor	17.82	16.86	23.23	17.73	14.73	90.37
Munipally	52.04	58.23	61.67	37.33	23.39	232.67
Kandi	30.12	31.69	38.97	26.17	16.04	142.98
Kondapur	50.33	56.27	58.49	40.05	28.36	233.50
Athmakur	42.75	46.54	54.20	40.03	27.25	210.77
Total	33.19	34.26	40.30	28.88	20.27	156.90

Expenditure on Medicines

Table 12

Per Capita Expenditure on Medicines for 9 PHCs, 2011-2014 (in Rs.)

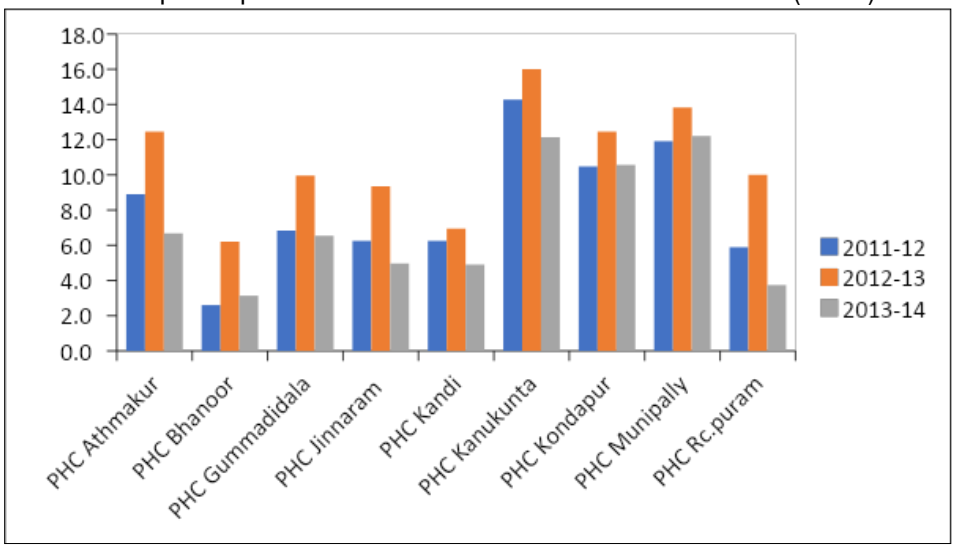
PHCs	Population	Expenditure 2011-12	PCE	Expenditure 2012-13	PCE	Expenditure 2013-14	PCE
Athmakur	49780	442764	8.9	620052	12.5	332639	6.7
Bhanoor	125819	327640	2.6	781429	6.2	394684	3.1
Gummadidala	30209	206319	6.8	301011	10	197775	6.5
Jinnaram	48698	303969	6.2	456028	9.4	241937	5
Kandi	62300	388976	6.2	433130	7	305594	4.9
Kanukunta	8969	128138	14.3	143643	16	108929	12.1
Kondapur	43026	451228	10.5	536120	12.5	454651	10.6
Munipally	39309	468643	11.9	543940	13.8	479624	12.2
R.C.Puram	82301	484027	5.9	824339	10	307996	3.7

The expenditure data for medicines were collected from DMHO records for nine selected PHCs. It was available under four sub-heads, General, antibiotics, fluids and surgical. But programme wise data was not available; hence total expenditure was considered for the analysis.

Table 12 and Chart 6 data indicate that Kanukunta has the highest and Bhanoor PHC has the lowest per capita expenditure and on medicines from 2011-12, 2012-13 to 2013-14 because the former serves the smallest population and the latter the largest population among the PHCs. The per capita expenditure is the highest in 2013-14 for Kanukunta, followed by Munipally, Kondapur, and the least is for Bhanoor PHC. The allocation for medicines should be based on the size of the population of the PHC and also on disease profiles.

Chart 6

Per Capita Expenditure on Medicines for 9 PHCs in 2011-'14 (in Rs.)



Conclusion

The analysis of data at the PHC level in this paper brought out several useful conclusions for the policy. The programme specific expenditure on different resources of all PHCs indicates that 88.5 per cent is spent on salaries of the staff members. For better and efficient functioning of the PHCs, the salary component has to be 50 to 60 per cent, and the components of recurring and medicines have to be raised at least up to 30 per cent. Salaries of staff members were regularly updated and adjusted for inflation but not the budgets for medicines, which is a crucial supply input for better functioning of a PHC.

The analysis of resource specific expenditure on different programmes indicates that of the total resources, 25.1 per cent was spent for FP followed by illness 22.1 per cent, MCH 21.6 per cent, CDC 18.5 per cent and ENVT 12.3 per cent. Budget allocation for CDC has to be increased.

The unit cost of producing an FP outcome indicator is the highest, i.e., Rs.3895 for FP, followed by MCH outcome indicator (Rs.828), CDC (Rs.494), and illness indicator (Rs.29). It was found that the unit cost of

producing an output indicator for illness is the highest for Kanukunta PHC because of the lowest outcome indicator, and for MCH, it was highest for Munipally PHC. For FP, it was highest for Gummadidala and for CDC, it was highest for RC Puram PHC.

Bhanoor had the highest total expenditure and largest population, and Kanukunta the lowest expenditure and the least population. The allocation can be less for Kanukunta PHC, and also, the staff members of the PHC can be shared by the nearest PHC for two days in a week for some activates to increase the efficiency of the nearby PHC. On average, one PHC had spent Rs.85.5 lakhs for the year 2013-14 and also, on average, a PHC had spent the highest amount of Rs.21.9 lakhs for FP followed by MCH, CDC and illness in that order.

When the per capita expenditure of all programmes combined, it was found that Kanukunta had the highest per capita expenditure of Rs.370, and Bhanoor had the lowest per capita of Rs.90. Thus, the above analysis indicates that the expenditure of all programmes for PHCs is not in proportion to their population. One policy suggestion could be that the allocation of funds to PHCs has to be done based on the size of the population and disease profiles.

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Health and Population:
Perspectives and Issues, 45 (3):142- 146/ July-September 2022

Importance of Oxygen Concentrators and Its Effective Distribution in Various Hospital Areas to Avoid Casualties due to Sudden Oxygen Crisis amidst Pandemic

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Abstract

While liquid oxygen and cylinders are the most popular oxygen sources in hospitals, the pandemic situation and increasing load of cases worldwide led to the quest for alternate and extra oxygen sources in the form of oxygen concentrators. They have been used in medicine for decades, especially in resource-limited situations, but their value is re-emerging in epidemic times. They are approved for long-term home usage for people with Chronic Obstructive Pulmonary Disease. Their admonition came back in the latest pandemic, notably at the second peak's nadir when the nation ran out of medical oxygen. This is when hospitals started using newer versions of old technology to save lives. Nonetheless, distributing OC evenly throughout ICUs and HDUs is a difficult task that takes hours to days. Here we highlight critical management procedures required in a life-threatening case of oxygen scarcity in the middle of a pandemic that afflicted the entire country. However, micromanagement at the hospital level within available resources is noteworthy for both the administration and medical community. This paper tries to address effective distribution of oxygen concentrators to avoid tragedy in an oxygen supply breakdown.

Key words: COVID pneumonia, Pandemic, Hospital Preparedness, Oxygen Concentrator, Oxygen shortage

While liquid oxygen and cylinders are the most common forms of oxygen source in any hospital, the pandemic situation and increasing burden of cases worldwide led to a search for alternative and additional sources of oxygen in the form of oxygen concentrators. to compensate for the already precarious amount of liquid oxygen and cylinders. Oxygen concentrators (OC) are not entirely new and have been in medical use for decades, especially in resource-limited settings, but their importance is realized again in pandemic times. They are accepted means of oxygen supply for long-term domiciliary use in patients suffering from chronic obstructive pulmonary disease. [1-3] Their indication was revisited in the recent pandemic, especially at the nadir of the second peak when the whole nation ran out of medical oxygen. This was when hospitals turned their attention towards this old technology in a newer form to save lives. Nevertheless, uniform distribution of OC amongst intensive care units (ICUs) and high dependency units (HDUs) is an arduous task in a short span of hours to days. Here we discuss some of the key steps required from a management perspective in a life-threatening situation of oxygen shortage in the middle of a pandemic that affected not only a district or a state but the whole country. But micromanagement done at an individual hospital level within the available resources is worth mentioning, which could benefit the administration wing and medical community.

Working of Oxygen Concentrators

Oxygen concentrators are different from oxygen plants in a way, they do not use any chemical reaction, and therefore, no new oxygen molecule is generated. Nitrogen molecules are removed from air (78% N2 and 21% O2) to increase the concentration of oxygen molecules, hence the name. It is done by either of the following two mechanisms:

- Pressure swing adsorption: Air is passed through a Zeolite sieve with a large surface area, which adsorbs nitrogen and allows oxygen to pass through.
- Membrane separation: A semipermeable membrane is used, which allows different compounds to move across it, at different rates.

Advantages of Oxygen Concentrators

- Portability: They are relatively small in size and can be used at home also.
- Safety: They are less dangerous than cylinders which are pressurized and can burst. Therefore, they are especially useful in military and disaster conditions.
- Economical: They are not very costly given their safety and portability.

Types of Oxygen Concentrators

Two types of oxygen concentrators are available for medical use:

- Portable oxygen concentrators (POC): They can be carried along with the patient outside the home and have rechargeable batteries. They provide a pulse mode of oxygen.
- Stationary: They are placed on the floor and provide continuous flow of oxygen. They are further available in different capacities varying from less than 5 litres per minute to up to 10 litres per minute. Some of them also have an in-built extendable wire pulse oximeter.

Oxygen Concentration

The oxygen concentrator needs to be able to produce a continuous flow of oxygen with a concentration that is higher than 82 percent. The term "oxygen purity" can also be used interchangeably with "oxygen concentration." When they are used in accordance with the manufacturer's guidelines, the vast majority of concentrators that are now on the market generate an oxygen concentration that lies between 82 and 96 percent by volume fraction.

In any set up, one need to demarcate areas according to category of patients, as mild, moderate and severe COVID pneumonia case, as Intensive care units with ventilators and monitors on each bed, High Dependency units with oxygen facility on every bed and lastly non-oxygen beds.

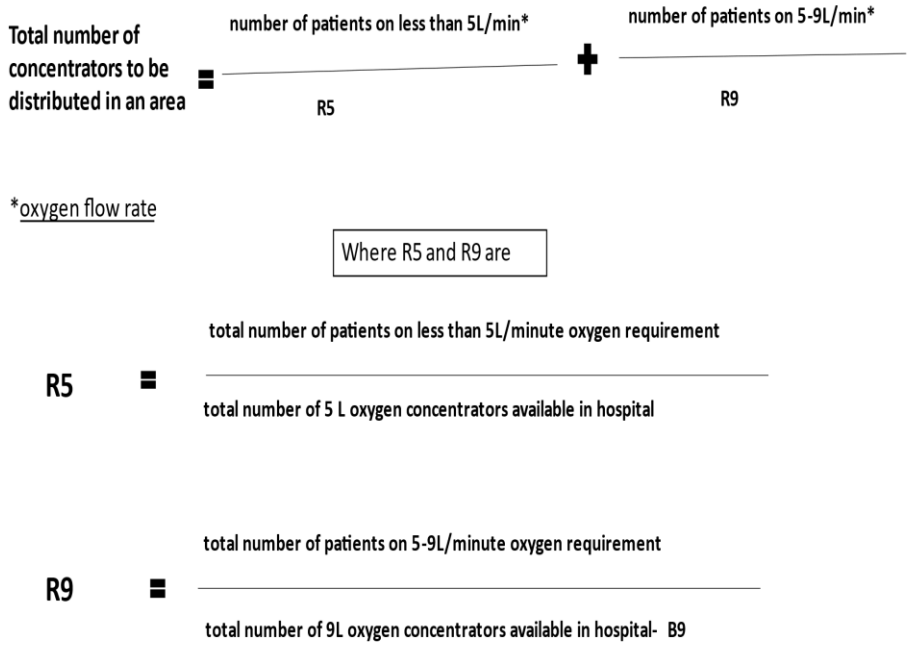
Methodology

The crucial points on how to distribute oxygen concentrators to avoid any casualty due to sudden interruption in oxygen supply are:

- Oxygen concentrators should be reserved for mild to moderate cases of COVID infection and those patients who required oxygen at the rate of 1-9 l/minute.
- One should exclude patients who had severe COVID pneumonia and oxygen requirement more than 9 litre/minute, or on mechanical ventilation.
- One should sub categorise areas into following subcategories – total patients in respective areas, categorising patients into mild, moderate and severe COVID 19 infection, requirement of oxygen per patient and categorising further into patients maintaining peripheral oxygen saturation on room air, requiring flow of oxygen <5L/min, 5-9 L/min and more than 9 L/min oxygen flow requirement or on ventilator support.
- Distribution of oxygen concentrators to various areas should be calculated as below-[Fig 1]-
    - Please note we have given formulae for 5l and 9l oxygen concentrators, which are most commonly in use.
    - Ratio 5 (R5) and ratio 9 R9 denotes the number of patients on less than 5 and 9 litre oxygen requirement for each 5 and 9 Litre Oxygen concentrator available respectively. Backup 9 (B9) denotes number of patients (not on ventilators) with more than 9 L oxygen requirement without a backup cylinder in case central supply runs out. With this formula, we can distribute an adequate number of OC in all areas according to availability (can be micromanaged later on according to changing need) thus avoiding any crisis in case the hospital runs out of oxygen. 9 L OC are distributed after keeping cylinders and concentrators reserve for ICUs having patients on more than 9 L requirements, including ventilated ones.

Figure 1

Total Number of Oxygen Concentrators in an Area Can be



A few of the key efforts that were made could be summarized as (a) educating end users regarding usage and maintenance of oxygen concentrators; (b) re-training biomedical engineering personnel regarding their maintenance and functioning; (c) performing online video training once concentrators are mounted in the wards; high dependency areas and (d) strategic planning for distribution according to their capacity and oxygen requirement in various areas; and (e) follow up and troubleshooting.

Discussion

OC have demonstrated to be a "blessing" for people who are moderately affected by COVID-19 and are trying to recover during these troubled times. Though OC is inferior to Liquid Medical Oxygen (LMO), which is 99 percent pure and a safe therapy, and can only supply 5-10 L of oxygen per minute when critically ill patients require 40-45 L, it can be useful for a short time if LMO supply is interrupted or cylinders are depleted. On the other hand, OC are the best alternatives to cylinders, which are difficult to transport or store and must be refilled, and can produce oxygen for up to five years or longer using only ambient air and a power supply. Since the majority of COVID19 patients have minor symptoms and may not need ventilator requirements, OC breathing therapy aids in the patient's health stabilization in a precarious situation.

Significant Changes

The key improvements to note: (1) the inclusion of an alternative easily accessible source of oxygen (2) the education of electrical engineering and health staff in the use, maintenance, and repair of oxygen concentrators; and 3) a reduction in the total load of an already precarious oxygen supply.

Oxygen Concentrators have demonstrated to be a "blessing" for people who are moderately affected by COVID-19 and are trying to recover during these troubled times. An oxygen concentrator is a medical device that works by concentrating oxygen from the surrounding air and making it easier for the patient to breathe. According to experts, oxygen concentrators are inferior to Liquid Medical Oxygen (LMO), which is 99 percent pure and a safe therapy for providing oxygen for mild to moderate COVID-19 patients with an oxygen saturation level of 90% or higher. These are the best alternatives to cylinder and LMO, latter are difficult to transport or store. Furthermore, cylinders must be refilled, while concentrators can produce oxygen using only ambient air and a power source for up to five years or longer. The concentrators' only disadvantage is that they can only deliver 5-10 litres of oxygen per minute, while critical patients can need 40-45 litres. Since the majority of patients have minor symptoms and may not need ventilator treatment, oxygen concentrator breathing therapy aids in the patient's health stabilisation.

A purchaser is tasked with the responsibility of ensuring that each oxygen concentrator device specification is accurate, detailed, transparent, and consistent. This is one of the more significant roles of a purchaser. The purchaser should review the WHO specifications in order to gain a comprehensive understanding of the various levels of requirements and to determine which requirements can be modified by the purchaser to address specific programme needs and which requirements must be left unaltered so as not to compromise the product's integrity and quality.

Lessons Learned: A concentrator-based oxygen system can be implemented in a low-income region. The supply of oxygen necessitates the use of qualified personnel as well as the required equipment and supplies. Regular maintenance and supervision is needed to ensure optimum utilization.

Limitation: It is an observational study and reflects author's experiences in using and manging the distribution of Oxygen concentrators amidst COVID19 pandemic situation.

To conclude, OC has several advantages and aid in the battle against the coronavirus. They are portable, cost-effective, uncomplicated, suitable to be used at households and in health facilities, and are significantly a boon in a crisis. The supply of oxygen necessitates the use of qualified personnel as well as the required equipment and supplies. Meticulous planning, maintenance, and supervision are needed to ensure optimum utilization.

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Health and Population:
Perspectives and Issues, 45 (3) :147- 160 / July-September 2022

Socio-Demographic Correlates of Under Weight, Overweight and Obesity among Currently Married Women in Eag States of India

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Abstract

The health and nutritional status of women of reproductive age and that of children are very important, underweight, overweight/obesity can have significant adverse health effects and obesity is associated with non-communicable illnesses among women as well. In such a context, some important findings and suggestions of this study using the fourth-round data set of the NFHS are noted. The higher prevalence of both underweight and overweight/obesity among currently married women now coexists in the EAG states. But the prevalence of underweight is less than the prevalence of overweight/obesity. The prevalence of underweight among currently married women in EAG states is more than double as of the global prevalence of underweight women. Using Multinomial Regression analysis, risk factors for overweight/obesity are identified as middle-aged, higher education and higher economic status, higher parity and urban residence of the women. The study found that the problem of overweight and obesity is more in urban areas and positively associated with the economic status of women. There is an urgent need for the timely intervention of the government of EAG states in activities like the promotion of nutritious foods and proper physical exercise for good health behaviour that will reduce the burden of much chronic morbidity among women. Resetting the provision of micro nutrient-rich foods through government facilities like ICDS centres in fixed days and time, food and iron supplementation programmes through outreach platforms are also needed. It is also important for systematically monitoring the coverage of the consumption of micro nutrient-rich foods, the quality of the nutritional food supplied and imparting health counseling for mothers, to maintain a healthy lifestyle among women.

Key words: Underweight, Overweight/Obesity, BMI, Reproductive age, Prevalence.

Introduction

Malnutrition and over-nutrition are factors that significantly affect public health, especially women in the reproductive ages and children. According to the definition of the World Health Organization overweight and obesity are the accumulation of abnormal or excess fat in the body that may impair health[1]. Overweight and obesity are the fifth leading risk for global deaths. Obesity that affects virtually all ages and socio-economic groups has serious social and psychological implications. The higher prevalence of overweight/obesity has been found among women than men[2].

Previously, overweight/obesity was considered as a problem for high-income countries, but today it has become a concern for low-middle-income countries, especially in urban areas. The sharp rise in

overweight/obesity in low-middle-income countries has attracted global attention in recent decades[3]. The causes and co-morbidities of obesity are wide and have been linked to a variety of non-communicable diseases, including high blood pressure, diabetes, cancer, and heart disease.

The main risk factors in obese women are infertility and gestational complications such as hypertensive disorders, gestational diabetes, hemorrhage, and caesarean delivery. Moreover they have increased risks of foetal and infant death, neural tube defects, and newborn macrosomia[4]. The maternal obesity increases the risk of obesity in their children during childhood and early adulthood and raises the risks of diabetes and cardiovascular disease in future life[5]. On the contrary, Razak et al.[6] revealed that underweight is inversely associated with reduced fertility and adverse pregnancy complications including low birth weight, preterm birth, low duration of gestational age, and neonatal death.

In the context of over one billion population, India is being stepped up in the prevalence of rising obesity and overweight[7]. The Lancet[8] has found that even when India continues to be in the list of the largest number of underweight people in the world, it has also bushed into the top five in terms of obesity. India leads the world in being home to over 40 per cent of the global underweight population. The presence of underweight coexisting with a rising prevalence of overweight/obesity is a dual burden of a country like India. In such a scenario, the study of the underweight, overweight/obesity in the population of Empowered Action Group (EAG) states, the backward states of a country like India, is very important. Given that EAG states are contributing more to the size of national population, the eight EAG states and their performances are the main focus of the present study. Also, the studies which investigated the prevalence and correlates of underweight and overweight/obesity among women in EAG states of India are rare. Therefore, the present study is aimed at the trends, socio-demographic and correlates of underweight and overweight/obesity among currently married women in EAG states of India.

Objectives

- To analyse the trends of underweight, overweight/obesity among currently married women in EAG states of India
- To analyse the prevalence of underweight, overweight/obesity among currently married women in EAG states of India
- To find out the possible determinants of underweight and overweight/obesity among currently married women in EAG states of India.

Methodology

Data Source and Sample: The required data for the study is taken from National family Health Survey (NFHS-2015-16) Round-4. The present study focused on underweight, overweight and obese currently married women in the reproductive age group (15-49) as per Asian BMI criteria. For this purpose, the data has been extracted from the women details collected from EAG states by the NFHS-4 survey, with a sample of 254333 currently married women in the (15-49) age group. For the analysis purpose, pregnant women, delivered within the last two months, and data with missing information were excluded. Finally, 233384 women were selected for this study.

Variables Selected

Dependent/ Outcome variable: Body weight categories are usually expressed by body mass index (BMI), i.e.BMI=Weight in Kilogram (kg)Height inmeter squared (m2).The WHO endorsed cut-off points for BMI categories in Asian populations as follows: underweight (<18.5 kg/m^2), normal weight (18.5 kg/m^2 to 23 kg/m^2), overweight (23 kg/m^2 to 27.5 kg/m^2) and /obese (≥27.5 kg/m^2) [22].

For the analysis purpose, the dependent variable BMI was categorized as per Asian cutoff by using the anthropometric measures (weight and height) provided in the NFHS-4 data set.

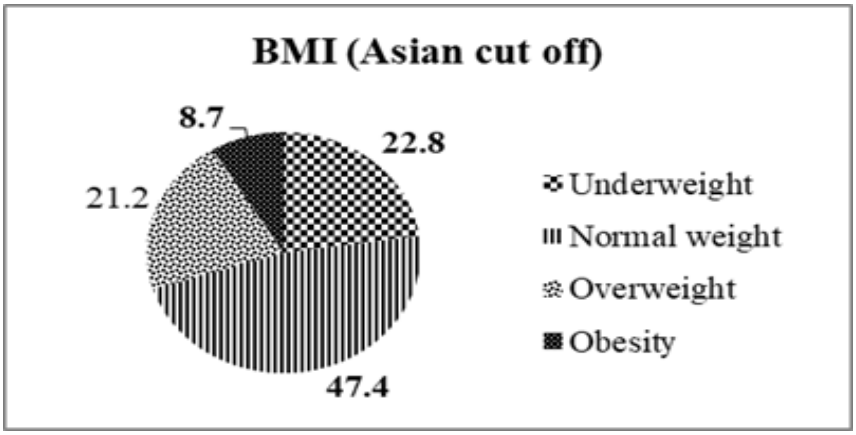
Predicted/ Independent Variable: Socio economic and demographic variables such as age, residence, marital status, education, religion, caste, wealth index, parity and current use of contraceptives were used as predicted variables. In this analysis the selection of the variables was mainly dependent on the availability of the variables in the data set.

Statistical Method Used: The statistical tool used for the analysis was SPSS 26. Univariate, bivariate and multivariate analyses were performed to interpret the data. Chi-square test was used to identify the association between BMI categories and socio- demographic variables. To assess the possible determinants of underweight and overweight/obesity among currently married women in the age group (15-49 years) in EAG states of India, multinomial logistic regression model was used. Adjusted odds ratios with corresponding 95 per cent confidence intervals (CIs) were estimated. *P*-value of 1 per cent, and 5 per cent level showed statistical significance.

Findings

As per the Asian cut off, the median BMI is 20.90 kg/m^2 (IQR: 23.7-18.7=5) among the currently married women in EAG states of India who have a median age 32 years (IQR: 40.0-26.0=14). Figure 1 shows overall 22.8 per cent, 47.4 per cent, 21.2 per cent and 8.7 per cent of the currently married women were underweight, normal weight, overweight and obese respectively.

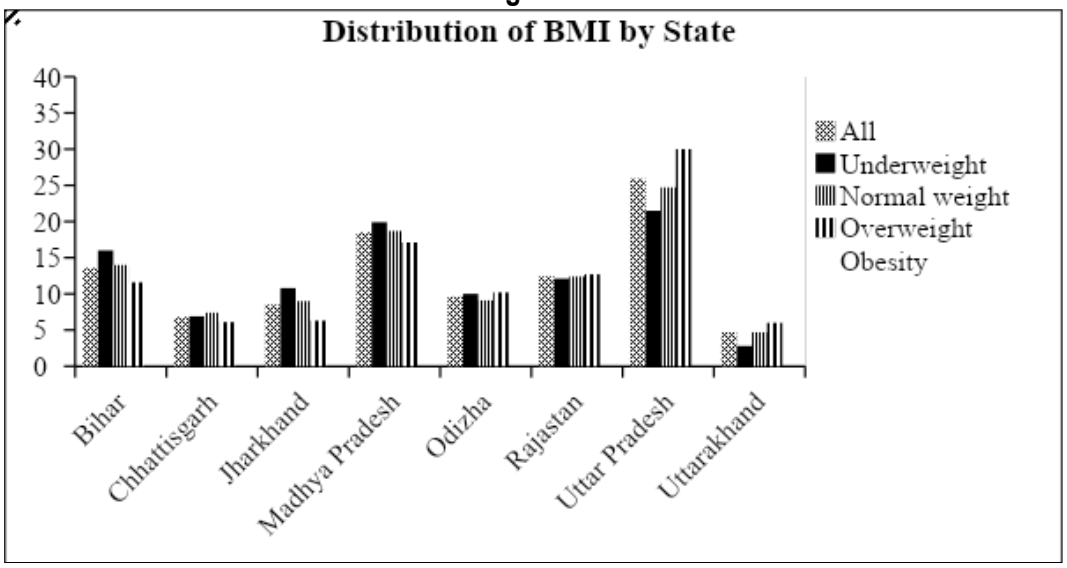
Figure 1



Distribution of BMI Status of Currently Married Women in EAG Sates by State

Considering the different states from EAG (Figure 2), it is seen that 25.9 per cent of women belong to Uttar Pradesh which is the highest proportion, followed by Madhya Pradesh (18.5 %) Bihar (13.6 %). The women from Uttarakhand are very less. With slight variations, women with normal, underweight, overweight and obesity are seen highest in Uttar Pradesh followed by Madhya Pradesh and Bihar. Among the women with underweight, the share of Uttarakhand is only 2.8 per cent, and the share of women from Uttarakhand for overweight and obese women is 6.0 and 6.9 per cent respectively.

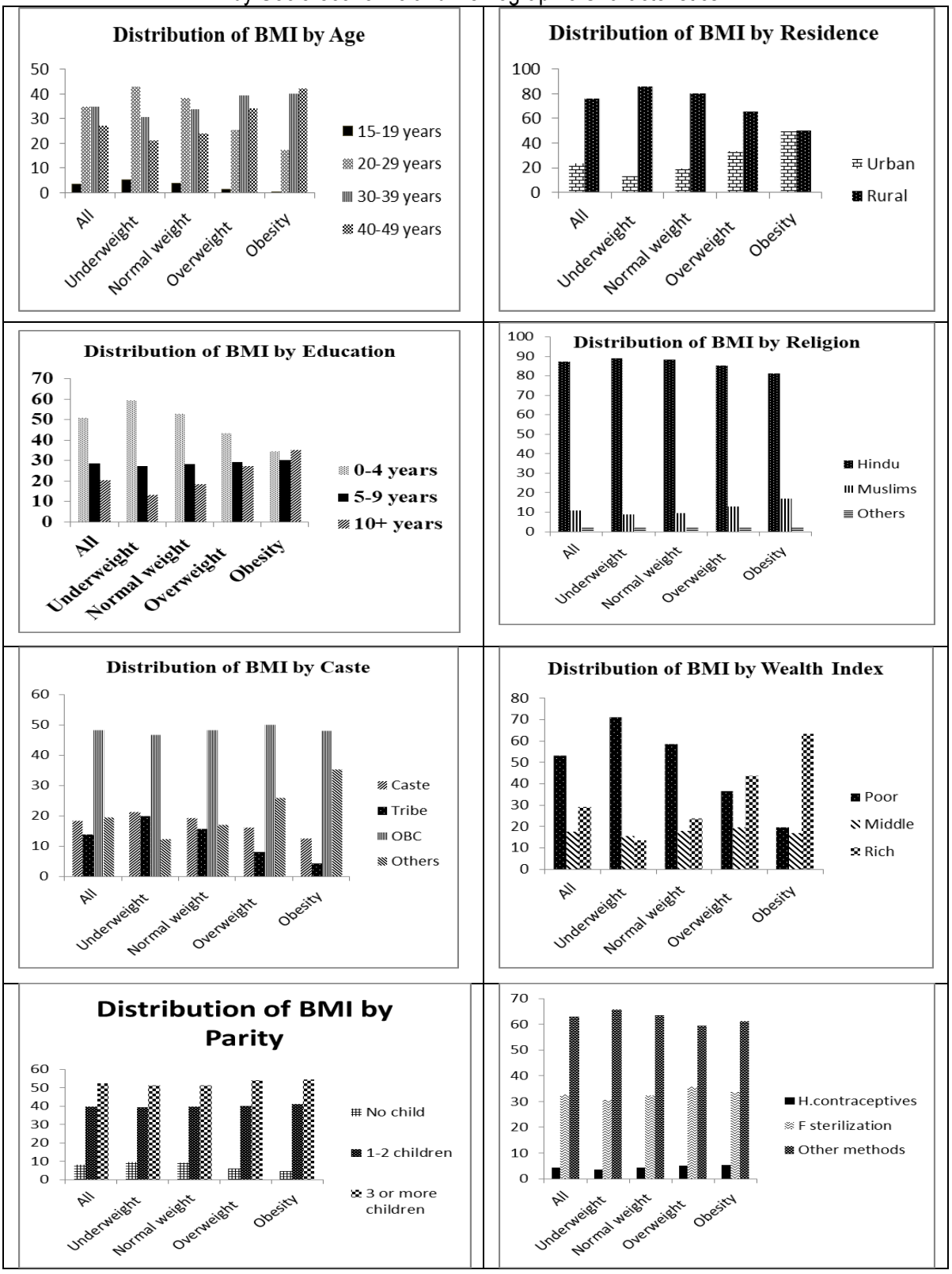
Figure 2



According to the age-wise classification, women in the age groups 20-29 and 30-39 are constituted by about 35 per cent each (Figure 3). Women in the uppermost and bottom age groups are formed by 3.3 per cent and about 27 per cent respectively. As per the Asian cut off, the women with normal (38.3 %) and underweight (43.1 %) are more in 20-29 years. The highest percentage of overweight women is seen in 30-39 years (39.3 %) while obese women are highest in 40-49 years (42.3 percent) followed by 30-39 years (40.2 %).

Rural residents are more in the sample; consequently, the number of women according to the different BMI status is also higher among women from rural areas compared to that of urban areas. It is seen that more than half of women has an education up to the primary level (50.9 %), 28.5 per cent have 5-9 years of school education and another 20.6 per cent has attained an educational level 10 or more than 10. Women with underweight, normal and overweight distributes in the highest proportions among women who have got the education up to primary level. The share of obese women is almost the same among women who have got the education up to primary level and more than 10 years of school education (34.6 % and 35.3 % respectively).

Figure 3 : Distribution of BMI Status of Currently Married Women in EAG States by Socio-economic and Demographic Characteristics

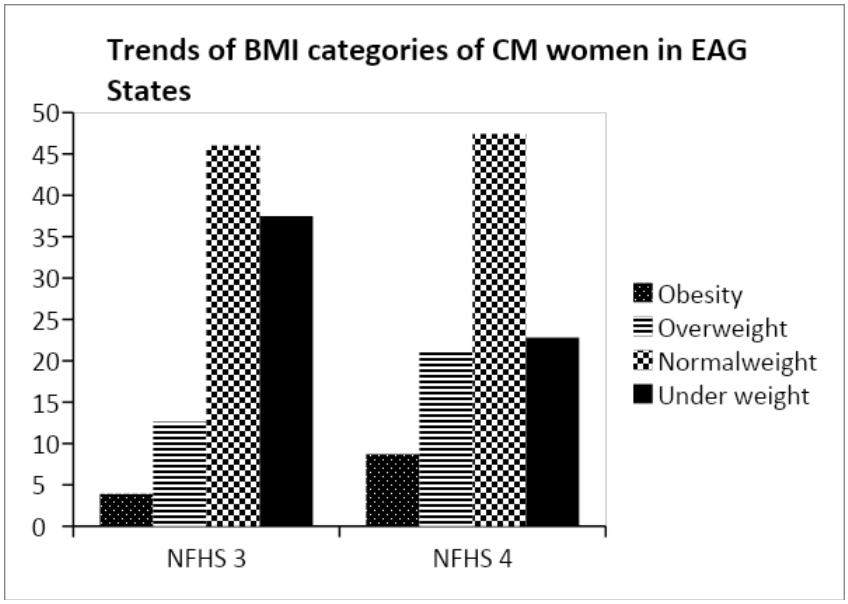


It is seen that a majority of women belong to Hindus (87.1 %), around 11 per cent belong to Muslims and only 2.3 per cent belong to other religions. The highest proportion of overweight and obesity are found among women who belong to Hindus followed by Muslims. According to the caste wise classification, 48.2 percent belong to OBC, which is similar to the cases of women with normal and obesity. But in the case of underweight and obese women, 46.6 per cent and 49.9 per cent respectively belong to OBC.

Wealth Index of women shows that 53.2 per cent of women are in poor class, while 17.7 per cent and 29.1 per cent are in middle and rich classes respectively. Higher proportions of overweight women and obese women are found among those with rich wealth index (43.7 % and 63.1 % respectively). Parity wise distribution of women shows that women with three or more children form the highest proportion (52.2 %) followed by those with 1-2 children (39.6 %) and 8.1 per cent of women have no child. Women according to the different BMI categories are found more among those with three or more children.

While analysing the methods used for the current contraception, it is seen that 32.7 per cent of the currently married women adopt sterilization, 4.4 per cent adopts hormonal contraceptives and another 62.9 per cent adopts the other type of temporary methods which forms the major share. More than sixty percent of the currently married women according to the different BMI status are those among the users of methods other than hormonal contraceptives and sterilization.

Figure 4



Source: NFHS3 & NFHS 4

Figure 4 displays the trend of underweight, normal weight, overweight and obesity among currently married women of EAG states in the age group of 15-49 years according to the NFHS III and IV data. In NFHS IV, the prevalence of underweight was 22.8 per cent, which is lower compared to that of NFHS III (37.5 %). The prevalence of overweight and obesity in NFHS IV is 21.2 per cent and 8.7 per cent respectively and the corresponding figures in NFHS III were 12.6 percent and 3.9 percent respectively. An increase in overweight and obesity is seen from NFHS III to NFHS IV. Further, the prevalence of normal weight

increased from NFHS III to NFHS IV, but the variation is very less (46.0 per cent in NFHS III and 47.0 per cent in NFHS IV) compared to the other BMI status.

The prevalence of different BMI status among women shows that majority of women are normal weight, varies from 38.6 per cent to 56.2 per cent (Table 1), according to their various background characteristics and significant proportions of women are under weight and overweight.

The prevalence of BMI status and age of the currently married women among 15-49 shows that underweight and normal weight declines with the increase of age while the overweight and obesity show the opposite trend.

Table 1

Prevalence of Underweight, Overweight and Obesity by Socio-economic and Demographic Characteristics of Women in EAG states (NFHS 4)

Variables	Underweight (<18.5)	N_weight (18.5-22.9)	Overweight (23.0-27.4)	Obesity (27.5+)	P-value
Age					<0.001
15-19 years	35.9	56.2	7.1	0.9	
20-29 years	28.2	52.1	15.4	4.3	
30-39 years	20.1	46.1	23.9	10.0	
40-49 years	17.7	42.0	26.7	13.6	
Residence					<0.001
Urban	13.0	38.9	30.0	18.1	
Rural	25.8	50.1	18.4	5.7	
Education					
0-4 years	26.7	49.4	18.0	5.9	
5-9 years	21.8	47.2	21.9	9.2	
10 and above)	14.5	42.8	27.9	14.9	
State					<0.001
Bihar	26.7	48.9	18.1	6.3	
Chhattisgarh	23.1	51.5	18.9	6.5	
Jharkhand	28.9	50.0	15.6	5.5	
Madhya Pradesh	24.5	48.0	19.6	7.9	
Odizha	23.7	44.6	22.5	9.2	
Rajastan	22.3	47.6	21.7	8.4	
Uttar Pradesh	18.9	45.3	24.5	11.3	
Uttarakhand	13.5	47.1	26.7	12.7	
Religion					<0.001
Hindu	23.2	48.0	20.7	8.1	
Muslims	18.8	42.0	25.5	13.7	
Others	23.5	50.1	18.4	8.0	
Caste/ Tribe					

Caste	26.3	49.3	18.5	5.9	<0.001
Tribe	32.3	52.9	12.1	2.7	
OBC	22.0	47.4	21.9	8.6	
Others	14.4	41.6	28.3	15.8	
Wealth Index					<0.001
Poor	30.3	52.0	14.5	3.2	
Middle	19.9	48.1	23.6	8.4	
Rich	10.7	38.6	31.8	18.8	
Parity					<0.001
no child	26.5	53.1	15.4	5.0	
1-2 children	22.5	47.2	21.3	9.0	
3 or more children	22.4	46.6	21.9	9.0	
Contraception					<0.001
H. contraception	18.9	45.8	24.9	10.4	
F. Sterilization	21.3	46.9	22.9	8.9	
Other Methods	23.8	47.8	20.0	8.4	
Total	**22.8**	**47.4**	**21.2**	**8.7**	

Obviously, the highest percent of women with overweight and obese women is found among 40-49 age group (26.7 % and 13.6 % respectively). The proportion of obese and overweight women is more among urban residents compared to their rural counterparts whereas the underweight and normal weight is among the rural residents.

It is found that education also shows variation in the BMI status of currently married women. The prevalence of overweight and obesity among women is found increasing with the increase in their education while the prevalence of underweight and normal weight decreases with the increase in education. The prevalence of obesity among women who have an education of more than ten years of school education is 14.9 per cent while that of over weight is 27.9 per cent. The table exhibits the State wise variation in different BMI status. The highest percent of underweight women are in Jharkhand (28.9 %) and this varies to 13.5 percent in Uttarakhand. Also, the prevalence of overweight and obesity is found highest in Uttarakhand (26.7 % and 12.7 % respectively) and the prevalence of lowest overweight and obesity is in Jharkhand (15.6 percent and 5.5 percent respectively). The highest percent of normal weight women are in Chhattisgarh (51.5 %) followed by Jharkhand (50.0 %) and the lowest are in Odisha (44.6 %).

The prevalence of different BMI status according to religion shows that the lowest prevalence of underweight women is seen among Muslims (18.8 percent) and the highest prevalence of overweight and obesity is also among Muslims (24.5 % and 13.7 % respectively). Among the currently married women of Scheduled Tribes, more than 32 per cent are underweight, 12.1 percent over weight and 2.7 per cent are obese. The table shows that the proportion of scheduled tribe women are more in the case of underweight but in the case of overweight and obesity they are the least when compared to the women of other categories of castes.

Wealth index shows a positive association with overweight and obesity of women as it is evident from the table that the proportion of overweight and obese women increases from poor to rich category of wealth index. Among the women of poor wealth index, 14.5 per cent and 3.2 per cent respectively are overweight and obese while the corresponding figures for rich wealth index are 31.8 percent and 18.8 per cent respectively.

The proportion of underweight women is 26.5 per cent among those women who have no child which is higher compared to that of women with children and the corresponding figure for women having 1-2 children and having three or more children is 22.5 per cent and 22.4 per cent respectively. Reversibly, the prevalence of overweight and obesity is found increasing with the increase of number of children women have.

Table 1 shows that the use of current contraception significantly affects the weight of currently married women. The prevalence of underweight is the lowest (18.9 %) among women who use hormonal contraceptives, likewise the prevalence of overweight and obesity is the lowest among women (20.0 %and 8.4 % respectively) who use methods other than hormonal contraception and sterilization. Among the women who adopt sterilization, 21.3 per cent are under weight, 22.9 per cent over weight and 8.9 per cent are obese women.

A Multinomial logistic regression is applied to analyse the factors associated for being underweight, overweight or obese among currently married women in EAG states of India in which the dependent variable is coded as '0' for normal weight , '1' for underweight and '2' for overweight/obesity. The independent variables which are found significant in the chi- square test are included in this regression. The effect of selected demographic and socioeconomic covariates on the risk of being overweight and obese among women in EAG states is presented in Table 2.

Table 2

Determinants of BMI among Currently Married Women in EAG States

Socio- economic and Demographic Variables	Under-weight (<18.5kg/m2) AOR (95% CI)	Over-weight/Obesity (≥23 kg/m2) AOR (95% CI)
Age		
15-24 years	1.59 (1.54-1.65) ***	0.24 (0.23-0.25)***
25-34 years	1.22(1.19-1.25) ***	0.56 (0.54-0.57)***
35 and above years®		
State		
Uttarakhand	0.71 (0.66-0.75) ***	1.04 (0.99-1.09)
Bihar	0.97 (0.93-1.01)	1.15 (1.11-1.20)***
Chhattisgarh	0.87 (0.83-0.91) ***	0.93 (0.88-0.97)***
Jharkhand	1.07 (1.02-1.11) ***	0.86 (0.82-0.90)***
Odizha	1.01 (0.97-1.05)	1.50 (1.41-1.53)***
Rajasthan	0.97 (0.93-1.01)	1.02 (0.98-1.06)
Uttar Pradesh	0.84 (0.81-0.86) ***	1.33 (1.29-1.37)***
Madhya Pradesh®		
Residence		

Urban	0.91 (0.88-0.94) ***	1.39 (1.36-1.43)***
Rural®		
Education		
0-4 years	1.31 (1.26-1.36) ***	0.68 (0.66-0.70) ***
5-9 years	1.15 (1.11-1.19) ***	0.88 (0.85-0.91) ***
10 and above®		
Religion		
Hindus	1.04 (1.00-1.07) **	0.78 (0.76-0.81) ***
others®		
Cate/Tribe		
Scheduled Caste	1.18 (1.14-1.23) ***	0.79 (0.77-0.82)***
Scheduled Tribe	1.21 (1.16-1.26) ***	0.58 (0.55-0.60)***
OBC	1.10 (1.06-1.13) ***	0.87 (0.85-0.89)***
Others®		
Wealth Index		
Poor	1.27 (1.23-1.31) ***	0.61 (0.59-0.62) ***
Rich	0.76 (0.73-0.79) ***	1.55 (1.50-1.60) ***
Middle®		
Parity		
no child	0.86 (0.83-0.90) ***	0.96 (0.92-1.01)
1-2 children	0.96 (0.94-0.99) **	0.99 (0.96-1.01)
3 or more children®		
Current FP methods		
Hormonal contraceptive	0.87 (0.82 -0.92) ***	1.07(1.02-1.13)**
Female sterilization	0.93 (0.91 -0.96) ***	1.03 (1.01-1.06)**
Other Methods®		

***1 % level,**5% level

Women in decreasing age groups are more likely to become underweight women compared to their higher age group counterparts. Women in the age group 15-24 years and 25-34 are more likely to be underweight [1.59 times with CI (1.54-1.65) and 1.22 times with CI (1.19-1.25) respectively] than women from 35+ years. It is 76 percent lesser odds for women in 15-24 years and 44 percent lesser odds for 25-34 for the risk of being overweight/ obesity than normal weight compared to the women at later ages (35+ years). Table shows that the residing states of women are also influential factors for their BMI status. When Madhya Pradesh was selected for the reference category, it is seen that currently married women from Jharkhand (1.07 times) and Odisha (1.01 times) have little more chances to become underweight women than women from Madhaya Pradesh.

At the same time, women from Uttarakhand (29 % lesser odds), Chhattisgarh (13 % lesser odds) and Uttar Pradesh (16 % lesser odds) have lesser chances to be under weight than that of Madhya Pradesh. The chance for being overweight/obesity than normal weight is more for women in the states of Odisha [1.50 times with CI 1.41-1.53 and Uttar Pradesh 1.33 times with 1.29-1.37] compared to the women from Madhaya Pradesh. It is seen that women from urban areas are less likely to be underweight than normal weight, but they are at more risk of being overweight/obesity than normal weight comparing to their rural

counterparts. Education is found to be a significant factor for the BMI status of women in EAG states. There is a decreasing odd for being underweight among women with the increase in their educational attainment while an opposite trend is found with the risk of being overweight/obesity. In the case of underweight of women in EAG states, religion is not found prominent because it is only 1.04 times more for Hindus than the women from the other religions. Further, there is 22 per cent lesser chances for women belonging to Hindus for being overweight/obesity than normal weight compared to women from the other religions. Caste of women exerts influence on the BMI status of women in such a way that women belonging to Scheduled caste, scheduled Tribe and OBC are more likely to be underweight than normal weight against the women from other castes. But according to the caste, an opposite trend is found with the risk of being overweight/ obesity among women. Comparing the women with middle wealth index category, women with poor wealth index show a higher chance to become underweight [1.27 times with CI 1.23-1.31 while women with rich wealth index (0.76 (0.73-0.79)] show a lesser chance to be underweight than normal weight and vice versa in the case of overweight/obesity [0.61 with CI 0.59-0.62 and 1.55 with CI 1.50-1.60 for poor and rich wealth index respectively]. In both cases of underweight and overweight/obesity than normal weight, women with higher parity are more likely to be underweight or over weight/ obese compared to women with lesser parity or childlessness. It is seen that the current users of hormonal contraceptives and adopters of sterilization are less likely to be underweight than normal weight while they are more likely to be overweight/obesity when compared to the women who are the users of methods other than hormonal contraceptives and sterilization.

Discussion

The findings of the study provide evidence that a larger proportion of currently married women in EAG states come under the BMI categories such as underweight and overweight. It also evidenced the socio-economic determinants are significantly associated with underweight and overweight. These determinants are age, place of residence, education, state of residence, religion, caste, wealth Index, parity and current use of contraception. Among these factors, some of them have a significant positive correlation with the prevalence and odds of underweight and the remaining had a significant reverse (negative) correlation with overweight/obesity.

According to Asian cutoffs, the proportion of overweight women is much higher. The trend analysis by using the NFHS-3 and NFHS-4 showed that the underweight decreased from 37.5 per cent to 22.8 per cent while overweight/obesity increased from 16.5 to 29.9 per cent. Similar results showed in some state-wise studies in India[9,10]. The burden of underweight among currently married women has dropped a lot when compared to the previous period. However the prevalence of underweight among women in reproductive age remains high in EAG states as well as in Asian countries[11]. The higher prevalence of both underweight and overweight/obesity among currently married women now coexists in the EAG states. But the prevalence of underweight is less than the prevalence of overweight/obesity. The prevalence of underweight among currently married women in EAG states is more than double as of the global prevalence of underweight women (10 %)[11,12].

Among different age groups studied, the prevalence of underweight declined with the increase of age while overweight and obesity showed the opposite trend, which is consistent with earlier studies in India[10,13]. Disparities in underweight and overweight/obesity among women in the reproductive age-group have been noted by earlier research studies in India and in other developing countries[14,15]. This study found an

association between lower education, lower economic status, residing in rural areas and religion/schedule tribe groups with underweight, which is consistent with previous studies[16,17]. Global evidence indicates that higher educational attainment is associated with the better health status of the community, due to the improvement in socioeconomic status[18]. Low socio-economic status may be related to limited food intake and combined with stressful physical/manual work may lead to net negative energy intake[17].

In consistent with previous studies, this study found that older age, higher education, greater wealth, urban residence and other groups in the classification of caste were associated with having overweight or obesity[16,17]. Studies indicated that rural women are found more engaged in high physical activities than their urban counterparts[19].

Women with higher parity are more likely to be overweight/obesity compared to women with lesser parity or childlessness. Age, parity and overweight/obesity are correlated with each other[20] which are in agreement with the findings of an earlier study. Women who were using hormonal contraceptives and adopters of female sterilization during the survey period had a positive association with overweight/obesity[19].

Conclusion and Recommendations

The total sample included 2, 33,384 currently married women with a median BMI 20.9 and with median age 32.0 years. It can be seen that the sample women, and by their BMI status also, are distributed unevenly over the various socio-economic and demographic characteristics. An increase in overweight and obesity is seen from NFHS III to NFHS IV but there is a decline of underweight.

Age of the women is found to have a negative association with underweight while it is positively associated with overweight or obesity. Similar case of education can also be observed. The prevalence of overweight and obesity is found increasing with the increase in the number of children women have. The other socio-economic variables of currently married women selected for the analysis also showed more or less variations with respect to the different BMI status. The multinomial regression analysis showed that the selected background variables are found significant predictors in explaining the BMI status of currently married women in EAG states of India.

Risk factors for overweight/obesity can be identified as middle-aged, higher education and higher economic status, higher parity and urban residence of the women. There is an urgent need for the timely intervention of the government of EAG states in the activities like the promotion of nutritious foods and proper physical exercise for good health behaviour that will reduce the burden of much chronic morbidities among women. It is thus important to arrange routine field assessment of maternal nutritional status. Resetting the provision of micronutrient-rich foods through government facility like ICDS centres in fixed days and time, food and iron supplementation programmes through outreach are also needed. It is also important for systematically monitoring the coverage of the consumption of micronutrient-rich foods, the quality of the nutritional food supplied and imparting health counselling for mothers, to maintain a healthy lifestyle among women.

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Health and Population:
Perspectives and Issues, 45 (3) 161-170 / July-September 2022

Occupational Morbidity and Health Risk among Brick Kiln Workers in Azamgarh District, India

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Abstract

Brick kiln industries in India are among most under covered yet prominent employer to most of the migrant workers. The kiln workers are mostly stressed out due to heavy work load, long working hour, substandard quality of work environment have an undoubtedly adverse effect on their health. The objective of the study was to examine the morbidity status of workers by their type of work in Azamgarh district. A structured interview and in-depth interviews were used as tools to collect data. Data entry was done in SPSS version 23. Data were analyzed using STATA version 15. Major morbidity identified among brick kiln workers were musculoskeletal disorder (82.7%), respiratory (53.8%), skin (31.1%), eye (28.7%) and injury/accidents (20.7%). The extent of multi-morbidity was highest among molders (80.7%) followed by loader (77.3%) and fireman (74.7%). Prevalence of tobacco consumption among workers were found to be 99.6 per cent while smoking and drinking alcohol was found to be 96.4 per cent and 92.7 per cent respectively. Occupational morbidities and health risks among brick kiln workers are high. The living standard of workers was severely affected by poor living and work environment, induced injuries and diseases. Brick kilns needs to be monitored properly by government and schemes should be implemented properly.

Key words: Brick kiln, occupational morbidity, labour.

Introduction

Occupational morbidity forms an unhealthy condition of employee/labor those who works in a specific situation which led them to expose themselves to hazardous conditions which ultimately results in serious health problems. International Labor Organization (ILO) and World Health Organization share a common definition for occupational health (1950) and define it as "the highest degree of physical, mental and social well-being of workers in all occupations[1]." Occupational health not only deals with all aspects of health but also the safety of workers at workplace by taking steps to primary preventions from hazardous condition on priority basis. The health condition of workers are determined by various aspects like workers' expose to vulnerable condition to cancer, respiratory diseases, accidents, musculoskeletal diseases, hearing loss, circulatory diseases, stress, communicable diseases and many others. Earlier studies have shown evidences that biological, physical, chemical and social variables associated with occupation have higher chances of affecting workers physical and psychological wellbeing. Occupational health hazard is counted on several parameters of working culture *i.e.* occupational hygiene, occupational toxicology, occupational

physiology, and occupational psychology etc. If work tasks and equipment do not include ergonomic principles in their design, workers may have exposure to undue physical stress, strain, and overexertion, including vibration, awkward postures, forceful exertions, repetitive motion, and heavy lifting.

Study conducted by Nigam et al.[2] found that workers' safety has to be the utmost priority from employer side in order to have a smooth functioning and proper growth of an industry. Of the total three billion workers in the world, more than 80 per cent work and live without having access to Basic Occupational Health Services[3]. The introduction of the concept of Basic Occupational Health Services (BOHS) has its roots in the WHO Alma Ata Declaration from the year 1978 which spells in article VI: "Primary health care is essential health care based on practical, scientifically sound and socially acceptable methods.....It is the first level of contact of individuals, the family and community with the national health system bringing health care as close as possible to where people live and work.....". This in spite of the fact that several authoritative bodies, including the International Labor Organization (ILO), the World Health Organization (WHO) and numerous professional organizations and the organizations of workers have, already for several decades, emphasized the need for services[3]. Workers exposed into wider range of occupational hazards and risk which includes chemical, physical and biological factors (WHO, 2005). Due to work-related issues about two million people die, 160 million people affected and 270 million fatal and non-fatal accidents occur every year particularly mortality due to dust accounts for 2,43,000 cases (WHO, 2005). These accidents and diseases have effect on work productivity and social wellbeing of workers and that result in depletion of household asset and income. It is estimated that unsafe work conditions are one of the leading causes of death and disability in India among working population. These deaths are needless and preventable. Unlike growth rates and GDP figures that flaunted every quarter, the figures of dying and ailing workers who make this growth possible are never recorded or spoken about. According to the ILO estimates, every year over 2.3 million women and men die at work from an occupational injury or disease. Over 350,000 deaths are due to fatal accidents and almost 2 million deaths are due to fatal work-related diseases. In addition, over 313 million workers are involved in non-fatal occupational accidents causing serious injuries and absences from work. The ILO also estimates that 160 million cases of non-fatal work-related diseases occur annually. These estimates imply that that every day approximately 6,400 people die from occupational accidents or diseases and that 860,000 people are injured on the job (Global Trends on Occupational Accidents and Diseases, ILO, 2015).

In this era, infrastructure acts as the most basic and important component of growth and development. The high pace of building infrastructure needs to be coordinated with the basic elements of construction. Brick is the most basic component of construction. As the volume of construction is growing day by day in both urban as well as rural areas, the demand for the brick has drastically increased. The workers working in brick kilns are among one of the most tiring and fatal employment. Laborers associated with the brick kiln industry are vulnerable for accident/injuries, respiratory disease, skin, eye infection and musculoskeletal disorders with compared to the general population. The ample amount of research studies the relationship of brick kiln workers and the type of morbidities they are exposed to. Most of the studies have restricted only exploring their migration traits and child labor which are prevalent among them. There are paucity of researches about the occupational morbidity among brick kiln workers. Minimal amount of studies has been found exploring household status of brick kiln workers and their motivation of working specifically as brick kiln laborers. The main objective of the present study is to examine the labourers working in the various segments of brick production and their occupational morbidities.

Methodology

In the present research, the methodology is designed as sample selection of the study area and population, sampling techniques and sample size survey instrument, the construction of the questionnaire data collection procedure, data processing and analysis are further stated.

Selection of the Study Area and Population: Brick making industry is one of the fastest growing industries in India which has estimated annual production of approximately 250-300 billion bricks per annum. It is estimated to have around 100,000 brick kilns in India which makes the country the second largest global producer of clay fired bricks and accounts for the 10 percent of the global production. There are about more than 18000 recorded brick kiln in Uttar Pradesh (Uttar Pradesh Pollution Control Board, 2017). In the present study, Azamgarh district had been identified as the study area comprising 647 brick kilns, the highest in a district in whole country.

Sampling Techniques and Sample Size: Sample size was determined systematically after the exhaustive list of workers from each occupational category was prepared. Fifteen respondents from each of the occupational category were selected *viz.* molder, loader and fireman. Therefore, 45 respondents were selected from each kiln, 15 each from molders, loaders and fireman. Thus 450 respondents were selected from 10 brick kilns. Ten brick kilns will be selected systematically based on Probability Proportional to Size (PPS).

Survey Instruments: Interview schedule were used as the tool for data collection which included a number of questions reviewing personal details, family details and education and at last number of enquiries reviewing the aforesaid issues *viz.* their health conditions, occupational morbidity, treatment seeking behavior, health expenditure and substance use.

Construction of Questionnaire: Total of 450 questionnaires was prepared to find out the occupational morbidity, health risk and present health condition of brick kiln worker in the study area. The data were drafted considering limitations from workers' side on priority and were finalized after pilot survey. While designing questionnaire worker's socio-economic and educational background were also took into consideration in order to provide them better and clear understanding about the questions asked. Questionnaire also consists of statistical and operational factors with a view point to provide the data a strong base. All questionnaires were filled through face to face interview.

Data Collection Procedures: In-depth interviews were conducted with workers of kiln to get the specific information about their job and associated morbidity. Data collection was conducted from November 2019 to March 2020 in ten different brick kilns in Azamgarh district of Uttar Pradesh. Data were collected best in the early morning before 8 a.m. or after 5 p.m. as workers were not allowed to be interviewed by the owners/managers in working hours.

Data Processing and Analysis: Data were analyzed using SPSS (Version 23) and STATA (Version 15). Descriptive statistics were used to summarize the data. Cross-tabulations were done to get the frequency and percentages of the subcategories.

Findings

Basic Characteristics of Brick Kiln Workers

Results shows (Table 1) that highest percentage of labors are found working in the age group of 36-50 irrespective of their job profile being Molder, Loader or Firemen. From Table 1, it has been observed that most of the labourers working in the kiln belong to Scheduled caste followed by other backward caste and scheduled tribe. Workers in the kiln are 80 per cent Hindus and 20 per cent are Muslims, wherein, Muslims works specifically as loaders. Maximum labors in the kilns are illiterate those who can't even read or write. Firemen (67%) shows the highest percentage of education received compared to Molders (44%) and Loader (46%). Workers interviewed are found to be working in the kiln at least for 3 years and maximum for 33 years of experience.

Table 1

Percentage Distribution of Workers by Background Characteristics for Any Disease

Characteristics	Molder	Loader	Fireman	Total
Age				
24-35	53.3	12.8	21.4	28.5
36-50	46.7	64.2	52.4	54.7
51-65	0.0	23.0	26.2	16.8
Years of Working				
0-10	81.5	60.8	63.5	68.2
11-20	16.3	32.4	33.1	27.6
21-33	2.2	6.8	3.5	4.2
Years of Schooling				
0-4	55.6	53.4	32.4	47.0
5-8	40.0	43.9	56.6	47.0
9-10	4.4	2.7	11.0	6.1
Marital Status				
Currently Married	100.0	100.0	100.0	100.0
Religion				
Hindu	100.0	39.9	100.0	79.2
Muslim	0.0	60.1	0.0	20.8
Caste				
Scheduled caste	97.0	38.5	58.6	63.8
Scheduled tribe	0.0	1.4	0.7	0.7
Other backward class	3.0	60.1	40.7	35.5
Total	100.0	100.0	100.0	100.0

Consequences of Brick Kiln Jobs on Brick Kiln Workers

Results from Table 2 shows that musculoskeletal disorders (82%) are most prevalent among the workers followed by Respiratory diseases (54%) and Skin diseases (31%). Molders are the most vulnerable group

of workers in the kiln those who encounter musculoskeletal disorder, Tuberculosis and skin diseases whereas Fireman are found to be the most vulnerable experiencing eye-related (vision) problems (46%), Accidents/Injuries (27%) and Respiratory diseases (56%) the most. Table 4 shows Molders experiences the highest percentage of respondents confronting multiple morbidity (81%) whereas, Firemen where found to have highest percentage of respondents suffering from single morbidity (23%) and Loaders had highest percentage of respondents suffering from no morbidity (5%). From Table 4, it can clearly be observed that molders show the highest percentage suffering from multiple morbidities followed by loaders and firemen. From Table 5, it can be clearly observed that for the subcategories of musculoskeletal disorder molders are suffering the most from neck problems (27.13), shoulder problems (18.40), wrist (20.80) and lower back pain (21.60) compared to loader and firemen. Whereas, loaders are most affected from elbow (10.69) and hip/ankle disorder (37.88) compared to molders and firemen. Disability (57.55) is found to be highest among fireman for hip/ankle disorders compared to other category of workers.

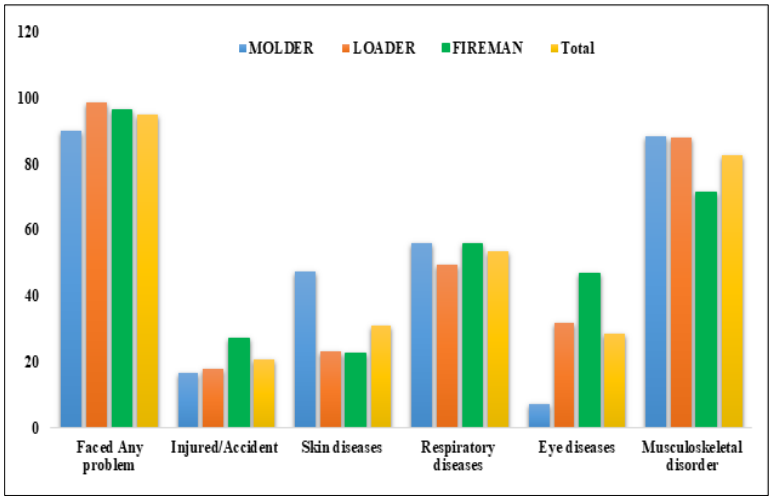
Table 2

Percentage-wise of Workers Suffering from Diseases

Disease	Workers (%)
Tuberculosis	8.7
Injury	20.7
Skin Disease	31.1
Respiratory Disease	53.8
Eye Disease	28.7
Musculoskeletal Disorder	82.7

Figure 1

Percentage-wise Workers Suffering From Different Diseases



Long working hours, non-ergonomic job structure, out skirt location of workplace and delay in treatment seeking among brick kiln workers were some of the key factors associated with their occupational morbidity. Laborers working as loaders in the kiln were more likely to suffer from occupational morbidity. The chi-square statistics (Table 3) showed a significant relationship between workers and different

occupational morbidity *i.e.* Tuberculosis (Chi-square = 15.3; *p*-value = 0.000), Skin disease (chi-square = 27.7; *p*-value = 0.000), Eye disease (chi-square = 58.0; *p*-value = 0.000) and musculoskeletal disorder (chi-square = 20.2; *p*-value = 0.000). The years of education shows a positive relationship between workers and their morbidity. The higher education level shows lower prevalence of diseases (Table 1). Scheduled caste workers (63.8) experienced the highest percentage of occupational morbidity followed by other backward caste (35.5) and scheduled tribe workers (0.7) (Table 1).

Table 3
Association between Type of Brick Kiln Workers and Occurring Occupational Morbidity

Disease		Specific Job of Worker in the Kiln			
		MOLDER	LOADER	FIREMAN	Chi (p)
		N (%)	N (%)	N (%)	
Faced Any Problem	**Yes**	135 (90.0)	148 (98.7)	145 (96.7)	13.3 (0.001)
	No	15 (10.0)	2 (1.3)	5 (3.3)	
Tuberculosis	**Yes**	22 (14.7)	3 (2.0)	14 (9.3)	15.3 (0.000)
	No	128 (85.3)	147 (98.0)	136 (90.7)	
Injury/Accident	**Yes**	25 (16.7)	27 (18.0)	41 (27.3)	6.2 (0.045)
	No	125 (83.3)	123 (82.0)	109 (72.7)	
Skin Disease	**Yes**	71 (47.3)	35 (23.3)	34 (22.7)	27.7 (0.000)
	No	79 (52.7)	115 (76.7)	116 (77.3)	
Respiratory Disease	**Yes**	84 (56.0)	74 (49.3)	84 (56.0)	1.8 (0.409)
	No	66 (44.0)	76 (50.7)	66 (44.0)	
Eye Disease	**Yes**	11 (7.3)	48 (32.0)	70 (46.7)	58.0 (0.000)
	No	139 (92.7)	102 (68.0)	80 (53.3)	
Musculoskeletal Disorder	**Yes**	133 (88.7)	132 (88.0)	107 (71.3)	20.2 (0.000)
	No	17 (11.3)	18 (12.0)	43 (28.7)	

Table 4
Work-specific Morbidity Status

Specific Job of worker in the kiln	Morbidity Status			
	Molder	**Loader**	**Fireman**	**Total**
No morbidity	1.3	4.7	2.7	2.9
Any 1 morbidity	18.0	18.0	22.7	19.6
Multiple Morbidity	80.7	77.3	74.7	77.6

Figure 2
Percentage-wise Workers Suffering from Different MSD's

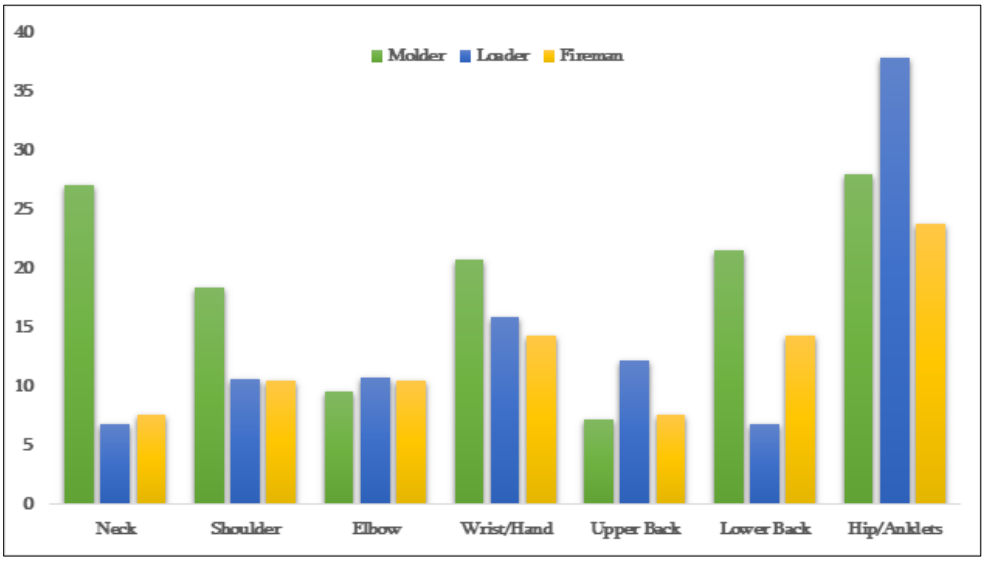


Table 5
Percentage of Prevalence of Sub-categories of Musculoskeletal Disorder (MSDs) among Brick Kiln Workers in Past 12 Months and Disability in 7 Days

Major Morbidities (sub-categories)	Type of workers			
	Molder	Loader	Fireman	Total
Sprain				
MSDs	5.4	8.3	15.1	9.2
Disabled	4.8	9.9	7.6	7.4
Past 7 days	1.6	0.0	5.7	2.2
Neck				
MSDs	37.3	18.0	34.7	30.0
Disabled	22.4	3.8	5.7	10.8
Past 7 days	18.4	6.8	6.6	10.8
Shoulder				
MSDs	27.9	18.2	14.2	20.4
Disabled	18.4	10.6	10.5	13.2
Past 7 days	16.0	8.3	8.5	11.0
Elbow				
MSDs	27.1	10.6	17.0	18.2
Disabled	9.6	10.7	10.5	10.2
Past 7 days	7.2	8.3	14.2	9.7

Wrist/Hand				
MSDs	36.4	17.4	19.8	24.8
Disabled	20.8	15.9	14.3	17.1
Past 7 days	7.2	8.3	14.2	16.5
Upper Back				
MSDs	20.2	16.7	20.8	19.1
Disabled	7.2	12.1	7.6	9.1
Past 7 days	18.4	12.1	20.8	16.8
Lower Back				
MSDs	41.9	25.8	37.7	34.8
Disabled	21.6	6.8	14.3	14.1
Past 7 days	22.4	17.4	26.4	21.8
Hip/Thigh/Knee/Anklets/Feet				
MSDs	61.2	53.8	57.6	57.5
Disabled	28.0	37.9	23.8	30.4
Past 7 days	51.2	41.7	44.3	45.8

Discussion

The present study was designed to examine the association between the type of work and incidence of diseases among the brick kiln workers. Male workers were found to be more in numbers during the survey. In, these study females were also observed as workers in the field, in-spite of that it was not an easy task to interview them with prevailing social and administrative obligations. Moreover, males are preferred over females as the environment and pattern of work in brick kiln is more strength oriented. The majority of brick kiln workers belonged to the age group 36-50 years (N=247, 55%). Brick kiln jobs are completely field oriented jobs which requires long hours of exposure to dust, pollution, sun and thermal heat where males are found to be more suitable. Riding loaded carts, preparing soil dough, carrying heavy stacks of bricks, putting them in furnace and removing baked bricks are more suitable jobs for males considering socioeconomic and traditional norms in Indian context.

The large segment of workers is found to be dropouts at their early age of schooling. In present study majority of workers are found to be less educated which also act as one of the key reason for them to opt this job. The key reason for low education level among the workers is that, they keep moving with their family from one kiln to other in search of job in every working season. They don't have enough money to afford educational expenses which instigate them to start working in order to fulfill their family expenses.

The study has witnessed the workers working for more than eight hours to fulfill the mentioned target and earn overtime. The molders and loaders responded that sometimes they have to work double shift as owners need to fulfill the up surging demand of bricks, whereas fireman responded to be working continuously day and night in shifts, as it is required by the nature of their work. Workers were not paid monthly, in-stead they are paid every 15 days based on their performances on nearest Friday of 15th day.

Results shows workers are deficient in receiving basic amenities like proper shelter, sanitation and clean drinking water facility. Facing these adverse situations is their compulsion along with working for long hours day and night. Working in scorching heat of sun and near high temperature of furnace makes it more difficult for laborer to work and add to their occupational morbidity. Brick making is process which requires a rigorous physical activity, to prepare green bricks, drying them, carrying them to furnace, baking bricks and finally taking ready bricks out of furnace requires a complete body involvement and hardcore physical strength and stamina. Different segment of workers have been assigned to perform their respective jobs. Molders are the segment of workers those who need to dig out the soil and make clay to form green bricks. In order to from green brick, molders need to sit in squatting position for longer period of time for mixing clay, fitting the clay in the mold and letting it to dry. Prolonged sitting positing of molders leads to the severe back pain in lumbar region, ankles and thighs. Loaders are assigned to carry the dried and molded green bricks from the field to the furnace where they are baked. Due to continuously bending down to lift up bricks from ground and getting up to put bricks in cart and carrying them to the furnace and again unloading them and arranging them in the furnace leads to the very frequent mobility of their body parts. Repercussion of repeating this process throughout the day leads to lower back pain, headaches, shoulder pain, lower body malfunctioning, etc. among the labourers. Firemen have to work continuously for day and night as required by their job. They have to work in scorching heat of sun and even in the nights. This segment of workers has to perform their job standing position and workers have to face severe joint pains in their hip joints, knees, ankle and lower back. Workers working in the kiln also faced eye problems such as dryness and itching. Studies explain the possible reasons for eye disease may be their continuous exposure to high temperature. Skin disease is also found to be prevalent among workers like bruises, scratches and itching. Studies suggests that workers in unorganized sectors are more prone to skin disease because of unhygienic work environment, long exposure to adverse work condition without any safety gears.

Other than facing all these health complications, they also encounters problems like, unavailability of clean drinking water followed by working in extreme temperature, poor sanitation, exposure to heavy dust, unavailability of life insurance, no job security, minimal first-aid kits and salary, and highly risky for workers as many a times bricks fall and injures them while working. It has also been observed in the present study that working for the longer period in extremely high temperature and heavy dusty environment expose them to vulnerable health problems. The type of fuel used in the brick making process is of very substandard quality and the technology is also outdated. Also, most of the time workers are found to be suppressed by the owners/managers of the brick kilns with a belief that, more the workers are suppressed, they are easy to handle. Workers are also deprived of some elementary needs like children's education, clean drinking, water, health facilities, proper housing or shelter. Workers even reported that all workers don't have the accessibility of basic safety kits during their job hours. Regardless of all these adversities, the workers believe that it's their fate to be in this situation because they are poor.

Conclusion

Although brick kiln industries are multi-millionaire industries but due to unbiased management and negligence of government up to some extent, brick kiln workers are disadvantaged of receiving proper income and work balance in their job. The study attempted to find out the type of work done by the workers and the kind of occupational morbidity they are suffering from. The study found that workers functioning in brick kiln are suffering from multiple morbidities occurred due to their working conditions. Workers reported to work under high pressure and strict vigilance. Their job is highly manually oriented and which leads to

major minor accidents very often. As a result, workers suffer from injuries and major health issues which hamper their physical and mental conditions. There is no up to mark arrangements for their basic needs of clean drinking water, proper shelter, healthy food, proper sanitation, job security and safety measures while in work. As it is rightly said “prevention is better than cure,” we need to take these brick kiln workers’ occupational risks into consideration and appropriate steps should be taken to overcome these oppressive practices before it’s too late. There must be proper information channels in place to track these workers at their work places. This system might help government and make it easy for them to reach workers and deliver them the required health aid and better work environment.

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Health and Population:
Perspectives and Issues, 45(3): 171 -182 / July-September 2022

A Case-Controlled Study of the Mental Health of Chess Playing Indians

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Abstract

The main aim of this study is to evaluate the difference in mental health conditions between a chess-playing and non-chess-playing (control) group for determining the positive impacts of the game. 400 participants were selected for the study (cases = 100, controls = 300) during the second wave of Covid-19 in India. An individual with a record of playing chess was included in the case group, while anyone who does not play chess was chosen as the control. This was a voluntary study wherein self-administered Google forms were used as questionnaires to obtain data. The case group constituted 82 per cent males and 17 per cent of females (mean age= 21.92) while the controls group had 51.3 per cent males and 48 per cent females (mean age = 25.74). Internal consistency, inter-correlation between DASS subscales, categorical analysis using Pearson Chi-Square Test at 95 per cent confidence, t-test for the mean difference of DASS scores and odds ratio at 95 per cent confidence intervals were assessed. Internal consistency of the DASS index was high, with Cronbach's alphas of 0.9103 and 0.9443, respectively, for the chess-playing and control groups. Correlation among the DASS subscales was moderate. Categorical analysis revealed that regularity in chess playing status had no association in ameliorating mental health situations. However, Covid-19 was strongly associated with depression (Chi-Square- 15.088, p-Value = 0.005). Increased risk of mental health deterioration was found in the control group (OR=0.3628; 95% CI0.166-0.789). Independent t-tests revealed statistically significant lower DASS scores for the chess-playing group with respect to depression [t=-1.73 (p=0.043)] and total DASS index [t=-1.80 (p=0.037)]. From the results obtained, it can be inferred that chess playing leads to lesser chances of mental breakdown in challenging, unprecedented situations. However, the intensity of association with the game has no significant effect on bettering mental health. This paper calls for further research to understand the extent of this positive outcome. Enough evidence in this regard would appeal to the popularization and extensive coverage of chess.

Key words: Chess, Depression Anxiety Stress Index, Mental Health, Case-controlled study, COVID-19.

Introduction

Introduction about the study: Mental health is a fundamental component of health, including mental well-being, prevention of mental disorders, treatment, and rehabilitation. 197.3 million Indians (about 14.3% of the total population as per 2017 estimates) were suffering from numerous mental disorders. Of these, 45.7 million suffered from depression, and 44.9 million had anxiety disorders[1]. As per approximations, the economic loss resulting from mental health conditions is assumed to be USD 1.03 trillion between 2012-2030[2]. Anxiety disorders and depression are much more impactful than adjustment disorders relating to a

stressful event or change in life[3]. The Depression Anxiety Stress Scales (DASS)[4] is a critical methodology concerning a tripartite model of anxiety, depression and stress[5]. Created by Lovibond, this instrument is used as a subjective assessment for patients suffering from anxiety and depression[6] and figuring out the perceived severity of symptoms associated with depression, anxiety and stress[7]. The DASS index evaluates emotional indications using a 4-point Likert scale with values ranging from 0 to 3. The three sub-scales, namely depression, anxiety and stress, are scored by adding total item scores- the severity of mental burden increasing as the score rises. The original 42-item DASS of Lovibond has been recently modified into a briefer 21-item version[8] to provide a concise self-report measure of the indications. Several studies published worldwide to confirm the reliability and validity of this measure assure that DASS-21 is a well-established instrument in both clinical and non-clinical samples[9-11].

Chess is viewed as a highly multifaceted game demanding cognitive training and expertise[12]. Chess players are often pigeon holed to be exceptionally intelligent or gifted with exceptional skills. Indeed, a few studies have associated the degree of intelligence with the psychometric aspects of chess players[13].

Positive outcomes arising from playing chess have, for a long time, fascinated researchers. Many studies have been conducted relating to the long-lasting impact of chess on memory[14], intelligence[15] and creativity. Chess instruction is believed to uplift the mathematical abilities of primary and middle school students. The "Chess Effect" Hypothesis has received quite much scientific support to withhold the claims mentioned above.

Apart from providing support through cognitive skill-building, chess acts as a valuable treatment to prevent or protect mental illnesses before disease onset. According to scientific research, chess affects specific areas of the human brain, the stimulation of which shifts with the problems faced by players in due course of the game[16]. Researchers have been able to correlate playing chess and reduce the possibility of developing dementia, AD, and other incapacitating mental illnesses. People over 75 indulging in leisure activities such as chess leading to stimulation of the brain are much less likely to develop signs of dementia when compared to people who did not play[17].

Being considered a sport requiring massive levels of psycho-physiological efforts from players exposed to unusually high levels of stress and cognitive load[18], chess is supposed to adapt to cope with hardships. Prior neuropsychological studies have shown the benefits of chess practice in executive functions, facilitating the adaptation to complex, non-routine situations[19]. Hence, chess players show exceptional aptitude for forecasting, self- control, coping and problem-solving domains of life[20].

Objectives

This is a first of its kind study which related mental health of chess players in situations of crisis. The study could capture difference in mental conditions during a pandemic situation. According to existing literature, since mind-stimulating leisure activities like chess have been associated with reducing the development of mental illnesses, it is seen as a protective factor not only for prevention but also after diagnosis. As the COVID-19 pandemic has established itself as a situation of existential crisis, a chess player's personality, which is believed to modulate stress and cognitive relationships[21], is worth studying. In line with these researches, the objectives of this study are to:

- dig deeper into a chess player's mind and investigate their abilities to tackle adverse situations; and
- analyze the effects of confinement and other restrictions due to COVID-19 on the mental state of chess players and compare it with a non-chess playing control group through a self-administered DASS index.

Methodology

Study Design: This study was conducted on Indian residents during the peak of the second wave of the Covid-19 pandemic in May 2021. Then, the country had seen about 4 lakh daily cases, thousands of deaths, and an overwhelmed medical health condition. People were under severe stress due to worrying financial conditions, loss of employment, restrictions on venturing out and threat to life. This study captures the worsening state of mental health experienced by the citizens during times of extreme crisis.

Cases: We have defined a case as any individual who has been exposed to the game of chess at any point in his lifetime and had played tournaments and trained seriously over a substantial period. Chess players from all over India were eligible to participate in this study.

Many individuals had developed a passion for playing chess through online mode, mainly after the lockdown of the country due to the COVID crisis in March 2020. Although not professionals in their lifetime, these players were regularly in touch with the game through playing online tournaments or friendly matches. Such players were also eligible to participate in this study.

Among the 100 individuals who had willingly enrolled for the study, categories on their weekly duration of chess practice were noted. These categories included:

- *I play and prepare each and every day* (professional players)
- *Sometimes* (<4 days a week, but are professional players)
- *I play chess at times, but not regularly*- This includes non-professional players enjoying the game or playing online at times but not at professional tournaments.

Controls: A potential control was any individual residing in India during the second wave of the COVID-19 pandemic. Controls were recruited from a variety of backgrounds, occupations and regions. The total number of individuals in the controls arm was 300.

Cases and controls were purposefully recruited from areas of the high incidence of the SARS-CoV-2 virus where maximum stress related to mental health was likely to occur.

Matching: Cases and controls were matched by the place of residence, i.e., India.

Data Collection: Written informed consent was obtained, and the authors conducted structured interviews using Google forms. Answers from the participants were saved digitally and later analyzed. In particular, the questionnaire asked about gender, age, infection from SARS-CoV2 virus (if any in the last two weeks), chess-playing status (only for the case group) and questions from the DASS-21 index questionnaire.

DASS-21 index is a self-report questionnaire consisting of 21 items consisting of 7 items per sub-scale:

depression, anxiety and stress. Participants were required to score every item on a scale from 0 (did not apply to me at all) to 3 (applied to me very much). Final sum scores were obtained by summing up all the scores per items per (sub) scale. Sum scores for each of the subscales may range from 0 to 21. Cut-off scores of 13, 9 and 16 were considered cut-off points for extremely severe depression, anxiety, and stress. The cut-off scores were derived from severity ratings as suggested by Lovibond and Lovibond [6]. For both cases and the control group, we have relied on the self-reported assessment of their mental state.

Statistical Analysis: Data were analyzed using MINITAB-17, SPSS-26 and MS-Excel.

The data for the 21 items of the DASS 21 were screened for missing values. The DASS-21 scale index was summed up to arrive at a single score for three areas- depression, anxiety and stress, concerning each individual. A chi-square test was performed to examine the association between a qualitative variable with chess playing status and mental health. An odds ratio (OR) at 95 per cent confidence intervals was performed to evaluate the lesser effects of the combined score of depression, anxiety or stress in chess players. We have calculated the OR based on the total DASS score in both groups. Severe to extremely severe states was considered the threshold for this purpose. The t-test was applied to test the significance of the difference in the DASS index between the case and control groups. The test was carried out at a 5 per cent significance level for total index and depression, and a 10 per cent significance level for anxiety and stress subscale.

To ensure the validity of the parametric test, normality was assumed to estimate that the distribution of means across samples is normal. Additionally, a box plot was used to check the presence of outliers. An internal consistency check of both the groups was conducted through the computation of Cronbach alpha.

Findings

Socio-demographic characteristics of the Study Subjects (Table1): Most were men among the group representing chess players (male=82%; females= 17%). The control arm representing non-chess players had a uniform distribution of males and females (males=51.3%; females=48%). The mean (standard deviation) age of chess players was 21.9 (6.7) years (range 7-52 years) for the chess-playing group as against the non-chess playing group whose mean (standard deviation) was found to be 25.7 (11.05) years (range 15-72 years). Considering the pandemic situation in the country at the time of the study, it was found that a total of 34 participants (both groups included) had tested positive for Covid-19 in the past 14 days. The case-positivity rate for this sample group stood at 8.5 per cent.

The majority of chess players reported practising chess each day (46%), followed by 25 per cent of cases sometimes practised (less than four days a week), and 29 per cent played chess but not regularly.

TABLE 1

Proportion (%) of Study Subjects According to Background Characteristics

	Chess Players (n=100)	**Non-Chess Players (n=300)**
Sex (%)		
Male	82.000	51.300
Female	17.000	48.000
Non-Binary	1.000	0.700

Age		
Mean	21.920	25.743
SD	6.743	11.059
Coeff. Variation	30.760	42.960
Range	45.000	57.000
Skewness	1.930	2.580
Kurtosis	6.320	5.840
Covid Status (%)		
Infected	3.000	10.333
Not Infected	97.000	89.667
Chess Playing Status (%)		
Play and prepare each and every day	46.000	-
Sometimes (<4 days a week)	25.000	-
I play chess at times, but not regularly	29.000	-

Quality of Data: A preliminary screening for missing values was performed wherein no such anomalies were found. Table 2 reflects the mean scores for the DASS-21 items list and their distribution parameters for both groups. This table indicates that the distribution of each item showed a positive skewness. The normality of the distributions was assumed at the univariate level.

TABLE 2

Summary Statistics of 21 Questions

		Chess Players			**Non-Chess Players**		
No.	Abbreviated Item	Mean±S.D.	Skewness	Kurtos is	Mean±S.D.	Skewness	Kurtos is
1	Hard to relax	1.35±0.9361	0.07	-0.89	1.4533±1.0155	0.07	-0.89
2	Dryness of my mouth	0.7±0.9705	0.95	-0.41	0.73±0.9662	0.95	-0.41
3	No positive feeling at	1.17±1.035	0.32	-1.12	1.3233±1.0436	0.32	-1.12
4	Breathing difficulty	0.45±0.7571	1.6	1.7	0.4067±0.7853	1.6	1.7
5	No initiative to do things	1.36±1.078	0.17	-1.23	1.4933±1.0927	0.17	-1.23
6	Over-react	1.29±1.008	0.29	-0.97	1.3767±1.0795	0.29	-0.97
7	Trembling (e.g., in the hands)	0.37±0.6913	1.79	2.32	0.53±0.8898	1.79	2.32
8	Nervous energy	1.03±0.9583	0.36	-1.07	1.667±1.1089	0.36	-1.07
9	Panic and make a fool of myself	0.96±1.044	0.68	-0.82	1.18±1.1158	0.68	-0.82
10	Nothing to look forward to	1.02±0.9845	0.41	-1.07	1.06±1.0709	0.41	-1.07
11	Agitated	1.18±0.9886	0.27	-1.04	1.2867±1.0747	0.27	-1.04

12	Difficult to relax	1.26±0.97 05	0.13	-1.04	1.4233±1.11 3	0.13	-1.04
13	Down-hearted and blue	0.97±0.96 88	0.6	-0.72	1.18±1.1068	0.6	-0.72
14	Intolerant	1.01±0.95 87	0.61	-0.59	1.1667±1.03 07	0.61	-0.59
15	Close to panic	0.94±0.94 09	0.72	-0.41	1.05±1.0885	0.72	-0.41
16	Unable to become enthusiastic	1.18±1.07 7	0.42	-1.09	1.4±1.1184	0.42	-1.09
17	Not worth much	0.94±1.05 2	0.76	-0.71	1.15±1.1395	0.76	-0.71
18	Touchy	0.87±0.92 83	0.81	-0.28	1.0533±1.09 6	0.81	-0.28
19	Action of heart	0.77±1.00 4	1.03	-0.19	0.8467±1.07 1	1.03	-0.19
20	Scared without reason	0.87±1.07 9	0.95	-0.45	1.03±1.1195	0.95	-0.45
21	Life meaningless	0.88±1.05 7	0.87	-0.56	1.0333±1.14 74	0.87	-0.56

Box plot of the three primary subscales of DASS- Anxiety, Depression and Stress, was constructed to check for outliers (Figure 1). No outliers were spotted in any of the subscales for both groups.

Internal Consistency Check: The internal consistency of the case and control group was checked with the help of Cronbach Alpha, which is mathematically expressed as:

$$\boldsymbol{\alpha = \frac{N\bar{c}}{\bar{v} + (N-1)\bar{c}}}$$

Here, N is equal to the number of questions of the study in each group, $\bar{c}$ is the average inter-item covariance among the questions and $\bar{v}$ is the average variance. Cronbach alpha is satisfactorily high in both the case and control groups ($\boldsymbol{\alpha_C = 0.9103, \alpha_{NC} = 0.9443}$; α_C signifies Cronbach alpha coefficient of chess players and α_{NC} signifies Cronbach alpha coefficient of the control group).

Correlation: Correlation matrices were constructed for both the case and control groups to understand the association's strength among the DASS-21 index and its subscales- depression, anxiety, and stress (Table-3). All the subscales and the DASS index have a very weak correlation (either positive or negative) with age. However, the association among the three subscales are found to be moderate to strong (p=0.000).

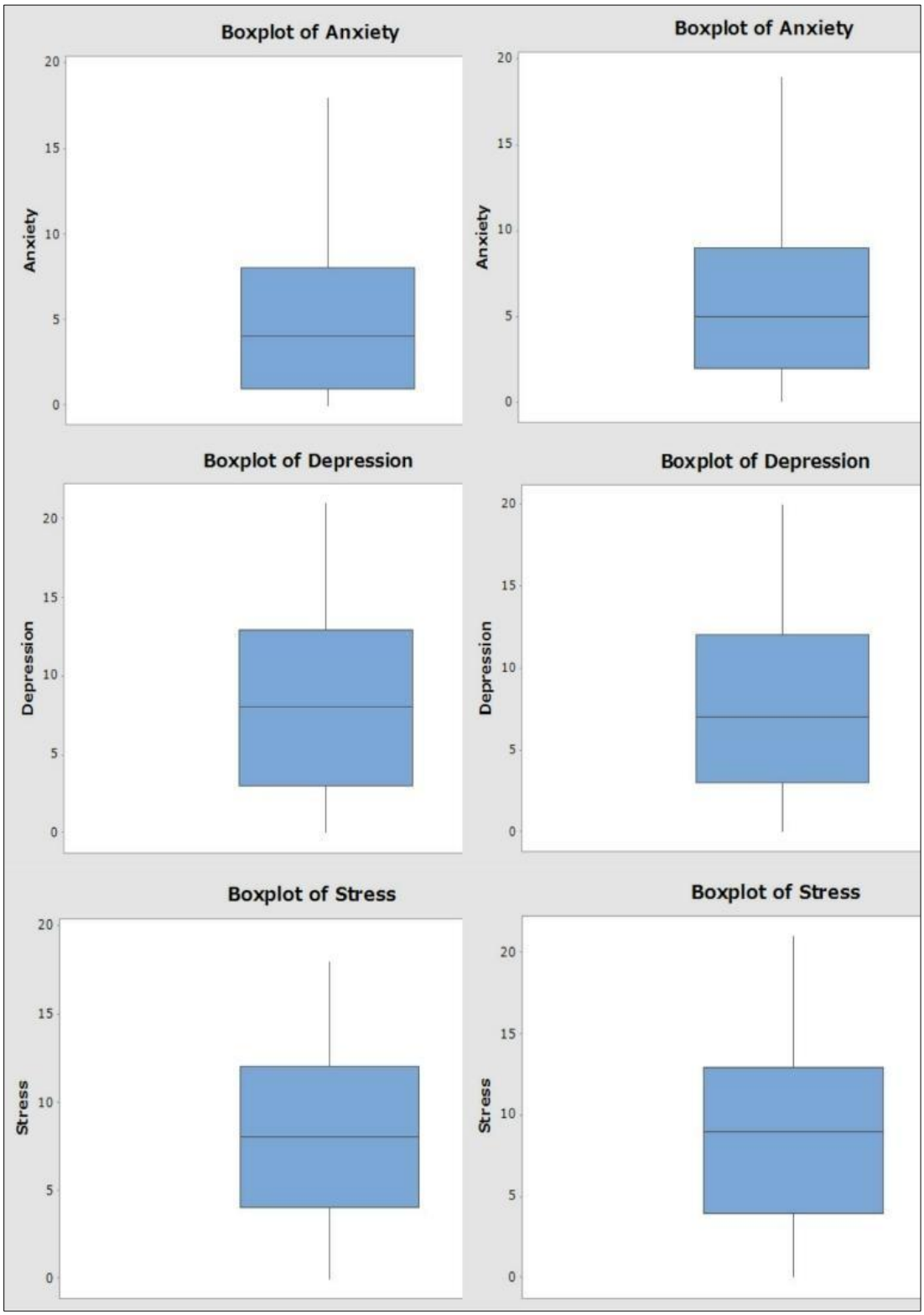

Figure 1: Boxplot of anxiety, stress and depression for chess and non-chess players- Left Side: Chess Players; Right Side: Control Group

TABLE 3

Inter-Correlation among the DASS Indices

Chess Players				
	Age	Depression	Anxiety	Stress
Depression	-0.069			
Anxiety	0.049	0.43 (0.000)		
Stress	0.076	0.622 (0.000)	0.683 (0.000)	
Total DASS-21	0.016	0.833 (0.000)	0.808 (0.000)	0.9 (0.000)
Control Group				
	Age	Depression	Anxiety	Stress
Depression	-0.163			
Anxiety	-0.119	0.696 (0.000)		
Stress	-0.109	0.821 (0.000)	0.8 (0.000)	
Total DASS-21	-0.143	0.922 (0.000)	0.887 (0.000)	0.952 (0.000)

Cell Contents: Pearson correlation (P-Value)

Categorical Analyses: Categorical analysis was performed to understand the effect of the regularity of chess playing status and the impact of Covid-19 on DASS indices. The association of the duration of chess played with depression, anxiety and stress indices has been shown in **Table 4**. As can be seen, none of the P-values is less than 0.05, indicating a non-significant result. Thus, no association has been found between the consistencies of chess practice to any of the DASS indices.

TABLE 4

Categorical Analysis of the effect of Regularity of Chess Playing Status on DASS Indices

Depression Level						
	Mild	Moderate	Normal	Severe	Extremely Severe	All
I play and prepare each and every day	5	11	17	8	5	46
Sometimes (<4 days a week)	1	7	9	2	6	25
I play chess at times, but not regularly	4	5	11	5	4	29
All	10	23	37	15	15	100
Pearson Chi-Square = 5.063, DF = 8, p-Value = 0.751						
Anxiety Level						
	Mild	Moderate	Normal	Severe	Extremely Severe	All
I play and prepare each and every day	1	10	20	3	12	46
Sometimes (<4 days a week)	0	3	16	2	4	25
I play chess at times, but not regularly	4	6	12	3	4	29
All	5	19	48	8	20	100
Pearson Chi-Square = 11.069, DF = 8, p-Value = 0.198						
Stress Level						
	More than Moderate			More than Severe		All
I play and prepare each and every day	35			11		46
Sometimes (<4 days a week)	19			6		25
I play chess at times, but not regularly	25			4		29
All	79			21		100
Pearson Chi-Square = 1.279, DF = 2, p-Value = 0.528						

Satisfactory association is observed between depression level and COVID-19 status (Pearson Chi-Square = 15.088, p-Value = 0.005). However, for anxiety and stress levels, non-significant P-values were obtained (p>0.005 in both cases). This indicated that the effect of Covid-19 had a strong association with depression (Table-5). However, it did not affect stress and anxiety levels whatsoever.

TABLE 5

Categorical Analysis of the Effect of COVID-19 on Mental Health

Depression Level						
	Mild	Moderate	Normal	Severe	Extremely Severe	All
No	40	77	124	44	81	366
Yes	4	4	7	12	7	34
All	44	81	131	56	88	400
Pearson Chi-Square = 15.088, DF = 4, P-Value = 0.005						
Anxiety Level						
	Mild	Moderate	Normal	Severe	Extremely Severe	All
No	25	77	154	36	74	366
Yes	4	9	9	5	7	34
All	29	86	163	41	81	400
Pearson Chi-Square = 4.053, DF = 4, P-Value = 0.399						
Stress Level						
	Mild	Moderate	Normal	Severe	Extremely Severe	All
No	43	68	166	61	28	366
Yes	5	9	9	10	1	34
All	48	77	175	71	29	400
Pearson Chi-Square = 7.568, DF = 4, P-Value = 0.109						

Odds Ratio: Increased incidence of deplorable mental conditions (high scoreof DASS- 21 index) was prominently found in the control group (Table-6); for a severe to extremely severe DASS score, the odds ratio was found to be 0.3628 (95% CI0.166-0.789).

TABLE 6

Contingency Table for Total DASS Index

	Chess Player (Cases)	Control Group	Total
Severe to Extreme Severe DASS	8	58	66
Less than Extreme Severe DASS	92	242	334
Total	100	300	400

Testing: Independent-samples t-tests revealed that chess players obtained significantly lower scores than the control group on the depression subscale and total of the three subscales (p<0.05) (Table-7).Theanxietyandstresssubscaledifferenceachievedstatisticalsignificance at p=0.098 and p=0.053, respectively(p<0.1).

TABLE 7

Summary Statistics of DASS Indices for Two Groups

	Chess Players			Control Group			t(p)
	Mean	SD	Standard Error of Mean	Mean	SD	Standard Error of Mean	
							-1.73
							(0.043)
Depression	7.52	5.44	0.54	8.64	6.09	0.35	
							-1.30
				5.77			(0.098)
Anxiety	5.1	4.41	0.44		4.73	0.27	
							-1.62
							(0.053)
Stress	7.99	4.69	0.47	8.93	5.84	0.34	
							-1.80
Total							(0.037)
Scale	20.6	12.3	1.2	23.3	15.4	0.89	

Discussion

In this study, we have evaluated the long-term effect of chess in upgrading the mental health conditions of individuals while dealing with an unprecedented crisis. DASS score, as a whole, is seen to show better results in the selected chess playing subjects indicating a healthier mental state.

Inter-Correlation among DASS Indices: Inter-correlation between depression, anxiety, and stress in both the chess-playing and control groups is moderate to substantial (Table 3). This suggests that, to some extent, exacerbation of one index triggers the other index. Moreover, the strength of association of these indices was higher in the control group than the chess-playing group. A possible explanation for this may be that deterioration of other index resulting from the worsening condition of one index is slightly less prevalent among chess players. However, a detailed study needs to be done to provide a scientific explanation in this context.

Chess Playing Status: From the categorical analysis, it was found that the regularity status of practising or playing chess did not affect DASS indices whatsoever (Table 4). Thus, since all results obtained in this study points to a positive benefit reaped from the game, it is essential to understand that the intensity of practice or regularity had no specific impact on improving mental healthconditions.

One of the many benefits of the game of chess has been illustrated in this study. The odd's ratio clarifies that a non-chessplaying individual is more likely to suffer from depression, anxiety or stress under extreme, hostile circumstances. From the independent t-tests conducted, it has been found that the moderate depression and total DASS scores were significantly lower ($p<0.05$) for chess players. This suggests any individual who was introduced to the game and had frequent exposure to it were, on average, less likely to experience mental health crises than their non-chess playing counterparts.

Study Limitations: Our study has several limitations. Study participants were asked to report the irmental

health through a self-administered questionnaire. Patients who had suffered from Covid-19 in the past 14 days may not have been able to explain their plummetingmental health conditions during that time leading to a possibility of recallbias.

In our study, a moderate to high inter-correlation between the DASS indices was found. However, the effect of Covid-19 seemed to have a statistically significant impact only on the status of depression. No impact of Covid-19 on stress and anxiety creates a paradoxical situation as there exists moderate association among the DASS indices.

Conclusive Remarks: This study's data and analysis suggested that chess playing has a deterministic positive impact on mental health. To address the validity of this study, further research involving a large sample is called for. A possible and better approach to understanding an effect on mental health would be to perform a randomized controlled trial (RCT) by teaching chess to apprentices and analyzing their mental health conditions before and after the study period.

If more evidence is found, steps to promote the game and popularize it among the masses must be thoroughly considered. Chess education may be made compulsory in schools. More funding and publicity are required to motivate individuals to learn the so-called "boring game", which has several beneficial characteristics.

Limitations

The sample size of this study was small and thus, considering a vast country like India, case-control studies like this need to have a larger sample. More studies in this line are required to properly determine the actual extent of the benefits of the game. There might have been some instances of recall bias, for participants who had been cured of COVID while documenting their mental health conditions.

Data Availability Statement: The data described in this article are available in the open domain: https://doi.org/10.5061/dryad.h70rxwdjv.

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