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Regional Disparities in Dual Burden of Malnutrition among Rural Men in India: Evidence from National Family Health Survey

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ABSTRACT

Background: The steadily increase in prevalence of overweight/obesity coexisted with under-nutrition can pose a major public health problem among adult populations in most of developing countries. In India, the prevalence of overweight/obesity is increasing rapidly, particularly among men. So an attempt was made to study the regional disparities in duel burden of malnutrition among rural men aged 15-54 years in India.

Methods: Data from fourth round of National Family Health Survey (NFHS-4, 2015-16) of India was used for this study. Totally, 672,1779 men aged 15-54 years were interviewed from rural areas of India. Multinomial logistic regression analysis was used to quantify the results.

Results: A total of 23% of men aged 15-54 years in rural regions of India were underweight and 15% were overweight or obese. The risk of underweight was highest in central regions followed by west and east regions, in men in younger age and among unmarried subjects. Overweight/obesity was more prevalent in southern regions followed by north and west regions, among men in older age, and in married cases. Educational level, wealth index, and access to media were positively associated with overweight/obesity.

Conclusion: In India, the prevalence of overweight/obesity was shown to be double among men in rural areas; whereas underweight is still prevalent that denotes to an alarming and necessity for an effective policy and program implementations to address this situation.

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Introduction

Good nutrition is the cornerstone for survival, health and development of current and succeeding generations (1). However, many low and middle income countries (LMICs) are now experiencing escalating levels of diet-related chronic conditions; such as overweight, obesity, cardiovascular diseases and diabetes mellitus along with persistent nutritional deficiencies, such as under-nutrition or gaps in key micronutrients, such as iron (2, 3). Improved economical conditions, urbanization, rapid dietary and lifestyle changes coupled with only slow improvements in tackling nutritional deficiencies has left many LMICs facing a "double

burden of malnutrition", overweight/obesity and non-communicable diseases (4, 5).

The 2018 Global Nutrition Report indicates that the problem of malnutrition remains severe. The world is not on track to achieve the targets it has set itself. Malnutrition in all forms still remains unacceptably high across all regions of the world (6). The double malnutrition trap can be particularly dangerous for Asian economies such as India, where urban populations are rising, and where people increasingly face a sedentary lifestyle (7). Latest studies revealed that despite doubling the rate of stunting reduction in the past 10 years from the previous decade, India still has the largest share of the world's undernourished population (5). At the same time, over nutrition is emerging as a silent epidemic in many parts of the country, as the prevalence of overweight and obesity in India is increasing faster than the world average (6). The double burden of malnutrition confers a serious and negative economic impact on individuals and populations. Most of the Indian studies have focused on malnutrition among children, adolescents and women (5). Few studies also examined the malnutrition among adults. However, it is also necessary to examine changing patterns in men's nutritional status in order to understand the impact of modifiable health factors on men. Hence, our present study is an attempt to determine the regional variations in nutritional status among rural men aged 15-54 years in India. The levels and differentials of malnutrition and determinants of nutritional status among rural men aged 15-54 years in various regions in India would be investigated.

Materials and Methods

Data from the fourth round of National Family Health Survey (NFHS-4) India, conducted from 2015 to 2016 has been used for this study. NFHS is a nationally representative large scale cross-sectional survey in representative samples of households throughout India. The survey has been conducted with the support of Ministry of Health and Family Welfare, Government of India and International Institute of Population Sciences, and Mumbai has been designated as the nodal agency for various rounds of NFHS. The survey used stratified two stage sampling method to collect the samples covering 2059 clusters from rural areas. In the first stage, clusters have been chosen using probability proportion to cluster size. In the second stage, 22 household were selected from each cluster with an equal opportunity systematic selection from the household listing. A total of 601,509 household were taken and randomly selected. Totally, 672,1779 men in the age group of 15-54 years were interviewed from rural areas from all states and union territories of India (8). The details about the NFHS-4 designs, tools and protocols are available in the national report of NFHS-4, India (8). The NFHS-4 data set is available in the DHS program website (9). We have divided the country into six regions, viz. north-east, north, central, east, west, and south for regional analysis. The details of the regions classification is given in Table 1.

Data sets are available in IND_2015_DHS_v01_M and DDI Document id: DDI_IND_2015_DHS_v01_M_WB at https://dhsprogram.com/data/dataset/India_Standard-DHS_2015.cfm?flag=0.

The NFHS-4 collected anthropometric data on the height and weight of men age 15-54 years. Nutritional status among males has been assessed using the body mass index (BMI), which is defined as weight in kilograms divided by height in meters squared (kg/m^2) and classified according to WHO cut-off values. A BMI below 18.5 indicated the chronic energy deficiency or undernutrition or underweight. Adults with a BMI of 25 or higher were considered to be overweight or obese.

In this study, we considered several social and demographic variables such as age, education (no education, primary, secondary and higher), religion (Hindu, Muslim, Christian, etc.), caste (Scheduled caste, Scheduled tribe, Other Backward classes and others), wealth index (poorest, poorer, middle, richer and richest), marital status (never married, currently married and widowed/divorce/separate), household structure (nuclear family and non-nuclear family), working status (currently working and not working), access to mass media (reading newspaper, watching TV, listening radio), and finally the region.

Table 1: Regional classification of states in India.

No.	Regions	States/UTs
1	North-East	Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura
2	North	Chandigarh, Delhi, Haryana, Himachal Pradesh, J&K, Punjab, Rajasthan, Uttarakhand
3	Central	Chhattisgarh, Madhya Pradesh, Uttar Pradesh
4	East	Bihar, Jharkhand, Odisha, West Bengal
5	West	Dadra and Nagar Haveli, Daman and Diu, Goa, Gujarat, Maharashtra
6	South	Andaman and Nicobar Islands, Andhra Pradesh, Karnataka, Kerala, Lakshadweep, Puducherry, Tamil Nadu, Telangana

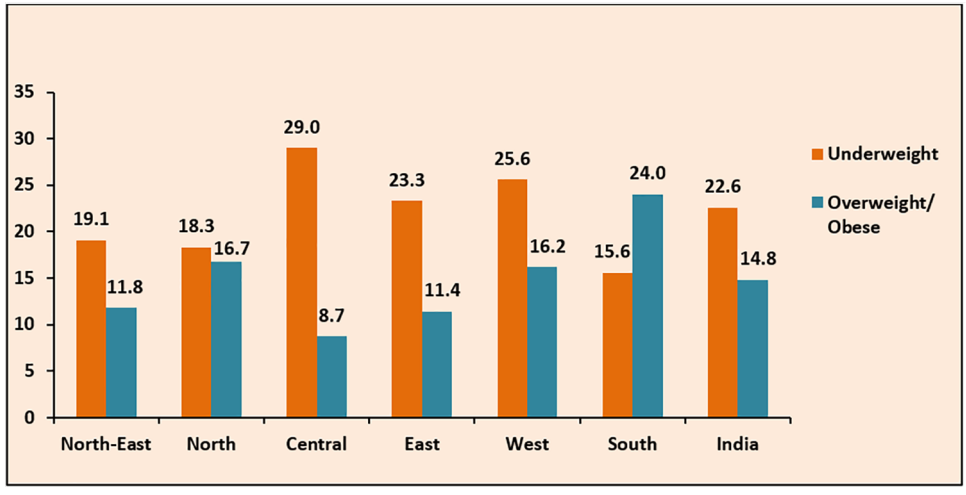

Figure 1: Regional disparities in nutritional status of rural men aged 15-54 years in India (NFHS-IV, 2015-16).

In order to examine the levels and differentials of nutritional status (underweight and overweight/obese) among rural adult males, bivariate analysis has been used. To find out the determinants of underweight and overweight/obese multinomial logistic regression has been performed. Odds ratios (OR) are accustomed to interpret the results of the predictor variables for each of the outcome variable. The 95 percent confidence interval (CI) for the odds ratio is also presented to establish the precision of the estimates and $p<0.05$ has been considered as statistically significant. The data has been analyzed using IBM SPSS Statistics (Version 20, Chicago, Il, USA).

Results

The regional disparities in nutritional status (underweight and overweight/obese) among rural men has been shown in Figure 1, which shows that 23 percent of men age 15-54 years were underweight and 15 percent of men were overweight or obese in rural India. The risk of underweight was highest in Central region (29%) followed by West (25.6%) and East (23.3%) regions; whereas overweight/obesity was more prevalent in Southern region (24%) followed by North (16.7%) and West (16.2%) regions.

The region-wise prevalence of underweight and overweight/obese among rural men aged 15-54 years by various background characteristics have been shown in Table 2. Table 2 illustrates that prevalence of underweight among rural men was highest among those who were 15-24 years, less educated, never married, belonging to poorest wealth quintile, living in nuclear family and those who had no access to media as compared to their counterparts. The table also shows that the prevalence of overweight/obesity was more prevalent among men in older age group of 40-54 years, those who were high school educated and above, belonged to richest wealth quintile, those who were currently married, lived in joint family and who had access to media almost every day. Similar kind of pattern has been observed in each region. In contrast, underweight was more prevalent among men who were not currently working. The prevalence of overweight/obese was higher among those who currently were working. This pattern was similar for all regions.

The factors affecting underweight and overweight/obese status among rural men by various background characteristics has been shown in Table 3 revealing that the likelihood of underweight decreased as age increased and the likelihood of overweight/obesity tended to increase with age among rural men. Men aged 40-54 years were about 2.4 times more likely to be overweight/obese (OR=2.44, $p<0.000$) than men aged 15-24 years. Educational level had a negative association with the prevalence of underweight, while having a positive association with the prevalence of overweight/obesity (High school and above, OR=1.5, $p<0.000$). Hindu men were more likely to be underweight compared to men belonged to other religious groups and Hindu men were less likely to be overweight compared to men belong to Muslim and others. Regarding caste, scheduled tribe (ST) men and men from other castes were least likely to be under-weight compared to scheduled caste (SC) men, whereas scheduled tribe men were also less likely to be overweight/obese compared to men from SC category (OR=0.84, $p<0.000$).

Men belonged to less wealthy quintile were more likely underweight compared to other higher wealthy groups and men with a higher wealth index were more likely overweight/obese compared to less wealthy men (Richer, OR=4.73, $p<0.000$). Furthermore, regarding marital status, currently married men were least likely to be underweight (OR=0.75, $p<0.000$), and the likelihood of being overweight/obesity was much higher among currently married men than in

Table 2: Prevalence of underweight and overweight/obese among rural men by various background characteristics in different regions of India (NFHS-IV, 2015-16).

Variable	Underweight							Overweight						
	North-East	North	Central	East	West	South	India	North-East	North	Central	East	West	South	India
Age-group (years)														
15-24	26.3	30.9	41.1	37.3	43.7	32.1	37.0	5.8	6.7	3.1	4.3	6.4	9.7	5.6
25-39	15.9	11.5	21.4	16.6	18.3	9.2	15.6	13.9	19.6	11.1	13.9	18.2	28.5	17.8
40-54	16.5	12.2	22.8	17.5	16.6	10.2	16.2	14.6	25.4	13.0	15.7	24.1	30.2	20.9
Education														
No education	23.6	18.8	28.4	24.7	25.8	16.5	23.4	7.5	12.9	5.4	6.8	11.2	22.6	10.8
Primary	21.3	18.7	30.3	23.6	26.2	11.6	22.8	7.4	17.6	7.3	10.6	17.0	26.2	14.0
Secondary	18.4	19.8	31.0	24.8	27.1	17.7	24.3	12.6	16.2	8.6	11.7	15.8	22.6	14.5
High school or above	10.3	10.9	18.0	10.9	17.4	11.0	13.5	24.4	21.8	16.0	21.7	21.1	28.5	22.3
Religion														
Hindu	19.9	19.9	29.1	23.5	25.8	16.0	23.2	12.8	15.1	8.4	11.4	16.1	23.4	14.4
Muslim	23.0	16.7	28.0	22.3	21.4	13.6	21.4	8.4	14.8	10.6	12.5	19.8	27.9	14.7
Christian	9.5	24.3	21.6	22.1	20.3	11.6	13.3	11.2	7.6	2.6	4.9	24.5	29.6	20.3
Others	10.9	10.7	25.5	23.7	27.8	17.8	17.0	22.8	28.6	22.0	7.5	14.1	33.5	21.8
Caste														
Scheduled caste	23.7	19.4	30.4	25.4	28.7	17.0	24.2	10.0	14.8	6.6	8.7	15.0	21.3	12.6
Scheduled tribe	7.6	30.2	28.4	22.9	33.4	21.6	25.7	13.5	8.5	4.2	6.9	9.5	15.1	8.5
Other backward class	24.2	19.2	29.5	24.7	25.4	15.1	23.1	12.1	15.2	9.1	12.4	17.8	25.4	15.8
Others	20.6	13.2	25.1	20.3	19.8	12.5	18.7	12.8	23.9	14.4	14.3	18.7	28.2	18.9
Wealth quintile														
Poorest	28.2	32.7	34.5	29.5	37.8	23.3	31.9	5.3	5.6	3.9	4.8	6.2	10.1	4.9
Poorer	20.5	25.0	30.4	22.7	32.1	22.1	26.1	8.0	8.1	6.5	10.3	9.4	16.1	9.7
Middle	13.8	18.5	26.0	17.3	24.1	16.2	19.8	15.3	13.4	10.1	18.6	15.2	23.0	16.9
Richer	10.0	15.0	21.3	11.3	20.7	12.0	15.7	25.9	19.1	17.1	26.9	22.1	28.5	23.4
Richest	7.9	10.3	16.1	14.0	13.4	8.1	11.4	33.8	28.5	24.1	32.4	32.6	36.5	30.6
Marital status														
Never married	22.6	28.9	40.7	35.5	40.0	27.5	34.3	7.9	7.9	3.4	4.9	7.6	12.5	7.0
Currently married	17.0	12.1	22.4	17.8	18.4	9.6	16.5	14.1	21.8	11.7	14.4	20.5	29.9	18.8
Widowed/ Divorced/ Separated	26.2	22.0	31.6	19.1	34.7	18.2	26.5	3.9	16.4	4.8	10.4	13.3	25.1	12.2
Household structure														
Nuclear	20.4	20.5	31.1	25.6	27.3	17.2	24.3	11.0	15.4	7.2	9.9	15.1	22.6	13.6
Non-nuclear	17.3	16.5	27.1	21.2	24.5	13.7	21.1	12.9	17.8	10.0	12.8	17.1	25.8	15.8
Currently working														
No	25.1	29.5	39.2	34.2	45.8	30.4	35.1	9.1	9.1	6.1	8.3	8.1	14.4	8.9
Yes	17.7	13.8	25.2	19.4	21.5	11.9	18.7	12.4	19.8	9.6	12.5	17.9	26.5	16.6
Access to media														
Not at all	23.4	29.5	36.4	275	35.6	21.5	30.9	7.0	7.6	4.1	6.2	10.4	15.3	6.7
Less than once a week	23.9	21.1	31.6	25.3	30.6	12.8	27.4	7.5	11.0	6.0	8.4	12.6	22.1	8.6

At least once a week	20.6	19.3	28.9	25.3	26.7	17.3	24.8	8.8	14.3	7.3	10.0	14.9	22.0	11.3
Almost everyday	15.5	16.2	25.4	19.8	23.8	15.3	19.5	16.1	19.4	12.1	15.3	17.6	24.6	18.6
Total	19.1	18.3	29.0	23.3	25.6	15.6	22.6	11.8	16.7	8.7	11.4	16.2	24.0	14.8

Table 3: Odds ratio of underweight and overweight/obese among rural men in India by background characteristics determined through multinomial logistic regression (NFHS-IV, 2015-16).

Variable	Underweight	*p* values	Overweight/Obese	*p* values
Age group (years)				
15-24	1.00 (Reference)		1.00 (Reference)	
25-39	0.492 (0.482-0.502)***	0.000	2.018 (1.960-2.078) ***	0.000
40-54	0.514 (0.501-0.526) ***	0.000	2.444 (2.367-2.524) ***	0.000
Education				
No education	1.00 (Reference)		1.00 (Reference)	
Primary	1.034 (1.011-1.058) **	0.004	1.226 (1.190-1.262) ***	0.000
Secondary	0.917 (0.899-0.936) ***	0.000	1.237 (1.207-1.269) ***	0.000
High school or above	0.500 (0.485-0.515) ***	0.000	1.544 (1.497-1.593) ***	0.000
Religion				
Hindu	1.00 (Reference)		1.00 (Reference)	
Muslim	0.910 (0.889-0.931) ***	0.000	1.153 (1.122-1.185) ***	0.000
Christian	0.695 (0.658-0.734) ***	0.000	0.986 (0.940-1.034)	0.569
Others	0.845 (0.812-0.880) ***	0.000	1.429 (1.375-1.485) ***	0.000
Caste				
Scheduled caste	1.00 (Reference)		1.00 (Reference)	
Scheduled tribe	0.916 (0.896-0.936) ***	0.000	0.841 (0.815-0.868) ***	0.000
Other backward class	1.030 (1.013-1.046) ***	0.000	1.108 (1.086-1.131) ***	0.000
Others	0.910 (0.892-0.929) ***	0.000	1.108 (1.083-1.134) ***	0.000
Wealth quintile				
Poorest	1.00 (Reference)		1.00 (Reference)	
Poorer	0.849 (0.835-0.864) ***	0.000	1.661 (1.610-1.713) ***	0.000
Middle	0.695 (0.681-0.710) ***	0.000	2.522 (2.444-2.603) ***	0.000
Richer	0.585 (0.571-0.600) ***	0.000	3.485 (3.370-3.604) ***	0.000
Richest	0.476 (0.461-0.492) ***	0.000	4.731 (4.558-4.911) ***	0.000
Marital status				
Never married	1.00 (Reference)		1.00 (Reference)	
Currently married	0.749 (0.734-0.764) ***	0.000	1.813 (1.765-1.862) ***	0.000
Widowed/Divorced/Separated	1.132 (1.075-1.191) ***	0.000	1.475 (1.377-1.581) ***	0.000
Household structure				
Non-nuclear	1.00 (Reference)		1.00 (Reference)	
Nuclear	0.919 (0.908-0.931) ***	0.000	1.020 (1.005-1.036) *	0.010
Currently working				
Yes	1.00 (Reference)		1.00 (Reference)	
No	1.573 (1.549-1.597) ***	0.000	1.136 (1.110-1.163) ***	0.000
Access to media				
Not at all	1.00 (Reference)		1.00 (Reference)	
Less than once a week	0.818 (0.798-0.839) ***	0.000	1.206 (1.156-1.258) ***	0.000
At least once a week	0.792 (0.775-0.811) ***	0.000	1.236 (1.191-1.283) ***	0.000
Almost everyday	0.762 (0.745-0.779) ***	0.000	1.314 (1.268-1.362) ***	0.000
Region				
North-East	1.00 (Reference)		1.00 (Reference)	
North	1.209 (1.162-1.259) ***	0.000	0.887 (0.847-0.929) ***	0.000
Central	1.567 (1.510-1.627) ***	0.000	0.745 (0.712-0.780) ***	0.000
East	1.195 (1.151-1.242) ***	0.000	1.041 (0.995-1.089)	0.080
West	1.970 (1.895-2.048) ***	0.000	1.099 (1.050-1.150) ***	0.000
South	1.168 (1.123-1.215) ***	0.000	1.505 (1.441-1.573) ***	0.000

Significance levels: **$p<0.05$, ***$p<0.001$.

never married men (OR=1.81, $p<0.000$). It was also found that the men who had access to media almost every day were less likely to be underweight and more likely to be overweight/obese as compared to those who did not have access to media at all (OR=0.76, $p<0.000$). Compared to North-Eastern region, men in all regions were more likely to be under weight and more likely to be overweight/obese except North and Central regions.

Discussion

This study examined the determinants of underweight and overweight/obesity among the rural adult males (15-54 years) and the regional variations in India using the NFHS-4 data. It was found that 23 percent of men aged 15-54 years were underweight and 15 percent were overweight or obese in rural India. The likelihood of being underweight decreased as age increased, while the likelihood of overweight/obese tended to increase with age among rural men. Similar findings were observed in a previous research conducted in Botswana that reported about 24 percent of the males aged 20-24 years compared to 15.6 percent of those aged 45-49 years were underweight (10). Another study conducted among male workers in Nepal found that age was significantly associated with nutritional status (11) and similar result was also shown by a study conducted in US among the different industrial workers (12).

The other finding was the likelihood of underweight that decreased as the educational level increased, while the likelihood of overweight/ obese increased as educational level increased. Previous studies conducted in India have identified educational level of men as an important factor which can influence body weight (13-15). While a study conducted in Nepal found that education is not associated with overweight/obesity and it was supported by another study conducted in Nigeria too (11, 16). Regarding caste, scheduled tribe members were least likely to underweight and overweight/ obese, whereas men from other backward class were more likely underweight and overweight/obese compared to the reference category scheduled caste members. This result was supported by another Indian study by Dutta *et al.* too (5).

Compared to less wealthy individuals, individuals with higher wealth index were less likely to be underweight and more likely to be overweight/ obese. These results are in line with those of the previous studies conducted in Botswana and India (5, 10). While studies conducted in Nigeria and US were not in agreement with this finding (16, 17). As far as the marital status is concern, compared to never married men, the prevalence among currently married men were less likely to be underweight, while among widowed or divorced was more likely underweight. However, the prevalence of overweight/ obese was higher among currently married men and widowed/divorced compared to never married men. This result was corroborated with the study conducted by Odencrants *et al.* (18). Men who were currently working were less likely underweight than unemployed men, while overweight/obese were more likely among unemployed men than employed.

Another interesting finding of this study was access to media that was significantly associated with over and under nutritional status. In addition to the above factors, men who lacked access to media were more likely to be under nourished, while overweight/ obese were more among those who had access to daily media. Radio and TV are the key sources of information on various health issues. Through access to media, people receive and learn information on healthy eating behavior and lifestyle. Similar result has been observed by another study conducted by Letamo and Navaneetham (10).

The analysis also found that the prevalence of underweight and overweight/obesity were dependent on socioeconomic characteristics of men. These results were corroborated with the study done by Dutta *et al.* (5) and Subramanyan *et al.* (19) that showed a higher prevalence of underweight among adults with low socioeconomic status. Several studies have reported prevalence of overweight and obesity among adolescents with poor rural socioeconomic status, with the magnitudes being higher in higher socioeconomic groups residing in urban regions (20-22). The prevalence of overweight/obesity coupled with several non-communicable diseases increased the relative risks of mortality and morbidities in the population. Other reasons for overweight/ obesity are sedentary lifestyle, which has lowered the physical activity resulting in lower energy consumption and higher socioeconomic status and increased per capita income (23).

Considering the regional variation, the likelihood of underweight was higher in all regions compared to north-eastern region. In contrast, the likelihood of overweight/obesity was higher in south, east and western regions compared to north-eastern region. This may be due to the fact that north-eastern region had higher proportion of tribal communities. Substantial variations were present across the regions in the prevalence of underweight and overweight/ obesity among rural men. Overall, the highest prevalence of underweight was found in the central region. It may be due the fact that central region constitutes Empowered Action Group (EAG) States

and these states are more vulnerable and need more attention. Similarly, the prevalence of overweight was higher in southern region followed by northern region. A cross national analysis conducted in 75 countries on overweight/obesity found that high consumption of fish and aerated drinks increased the overweight/obesity status. The consumption of fish and fish products were higher in southern region compared to other regions. It may be the one of the factors for high prevalence of overweight/obese in southern region (24).

The limitation of the study was the cross-sectional type as no causal relationship could be recognized. We have used underweight and overweight/obese status to measure the nutritional status of rural men. Moreover, NFHS is not providing several other risk factors for underweight and overweight/obese status such as sleeping patterns, physical activity and level of stress.

Conclusion

The situation of this double burden of malnutrition among rural men is alarming in India. The study also showed high clustering of underweight in central and eastern regions, whereas overweight/obese was more clustered in southern region. The results of this study suggest that, underweight and overweight/obese have significant association with socioeconomic factors. It needs proactive measures to prevent underweight and overweight/obesity which are important for effective policy making and program implementation to address this situation. Economic well-being of men should be considered by creating more job opportunities so that the underprivileged, and economically deprived men can get adequate income and can take care of themselves and their families in terms of proper food and diet to address this issue. Overall, this study suggested an overarching approach to be considered in fighting with the dual burden of malnutrition among rural men in India.

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Conflict of Interest

None declared.

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