Consumption of Milk a Probable Risk Factor of Hypertension in India: A Study Based on National Family Health Survey-5

Dhanmani Medhi[1], John Basumatary[2*], Ankumon Sarmah[3]

[1]*Assistant Professor, Department of Anthropology, Dibrugarh University. Email: medhi.dhanmoni900@gmail.com*
[2]*Assistant Professor, Department of Anthropology, Gurucharan College, Silchar. Email: johnbasumatarygccollege@gmail.com*
[3]*Assistant Professor, Centre for Computer Science and Application, Dibrugarh University. Email: ankumonsarmah@dibru.ac.in*

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ABSTRACT
Introduction: Chronic high blood pressure, often known as hypertension, can cause a number of cardiovascular issues due to its higher blood pressure levels. A growing body of research points to a possible link between the use of dairy products and a higher risk of hypertension. Objectives: The present study aims to provide information regarding a probable association between dairy consumption and hypertension among the population of India. Methodology: The current study uses data from the fifth series of the National Family Health Survey (NFHS-5) 2019–21 in order to examine this association. The sample size is 724115 in total. This study included eight factors in total: systolic and diastolic blood pressure, age, religion, ethnicity, education, wealth index, and frequency of milk/curd consumption. IMB-SPSS version 26.0 was used for all data analysis. Results: It was found that those consuming milk products daily and weekly have very strong chances of having stage 1(95.3% and 93.2%, respectively in 95% CI) and stage 2 hypertension (92.4% and 90.4%, respectively in 95% CI). daily consumption of milk products also significantly increases 80.3% the chance of having stage 3 hypertension as well (95% CI). Conclusion: It is abundantly obvious from the current study that consuming milk and curd on a daily and weekly basis considerably raises your risk of developing stage 1, stage 2, and stage 3 hypertension. Given that India consumes the most milk globally and that the bulk of it is unpasteurized, it is crucial to consider the connection between milk consumption and hypertension discovered in the current study.

1. Introduction

Millions of individuals throughout the world suffer from the common and deadly health disease known as hypertension, sometimes known as high blood pressure. Hypertension is the main risk factor in the development of cardiovascular disease (Lewington et al, 2002), and cardiovascular disease is the number one cause of death globally (WHO, 2011). It was reported that a 10mmHg reduction in systolic blood pressure (BP) could lower the risk of major stroke by 27%, heart failure by 28%, and cardiovascular disease events by 20% (Ettehad et al, 2016). Diet plays a key impact in the onset and treatment of hypertension, according to numerous studies. While a diet abundant in fruits, vegetables, whole grains, and lean protein can assist to lower blood pressure, a diet high in sodium, saturated fat, and processed foods can raise blood pressure. Several studies have shown a significant link between dietary elements and hypertension. For instance, a meta-analysis of randomised controlled studies discovered that cutting back on salt intake by just 4.4 grams per day can drop systolic blood pressure in persons with hypertension by 4.2 mmHg (He et al, 2013). Recently, a study showed that the optimal consumption of risk-decreasing foods (whole grains, vegetables, fruits, and dairy) resulted in a 42% reduction of type 2 diabetes, and a high intake of risk-increasing foods [red and processed meats, sugar-sweetened beverages (SSBs), and eggs] resulted in a 200% increase compared with non-consumption of the respective foods (Schwingshackl et al, 2017). Dietary pattern was more comprehensive to reflect the synthesized effect of foods or nutrients compared with individual food or nutrient (Jaalouk et al, 2019). It has been widely used as an alternative method to assess the relationship between whole diet and hypertension (Hu, 2002).

Findings of prospective cohort studies for the association of dairy intake with hypertension risk have been inconsistent (Alonso et al, 2005; Engberink et al, 2009; Engberink et al, 2009; Heraclides et al, 2012; Steffen et al, 2005; Wang et al, 2015; Wang et al, 2008). Some studies found an inverse association between higher dairy intake and hypertension risk (Wang et al, 2015; Wang et al, 2008), but others did not (Alonso et al, 2005; Engberink et al, 2009; Engberink et al, 2009; Heraclides et al, 2012; Steffen et al, 2005). Higher low-fat milk intake was associated with lower increases in blood pressure in whites but not in African Americans, suggesting that ethnic differences may modify the association between dairy intake and blood pressure (Steffen et al, 2005). However, the majority of these studies were done in populations of European descent (Alonso et al, 2005; Engberink et al, 2009; Engberink et al, 2009; Heraclides et al, 2012; Steffen et al, 2005; Wang et al, 2015; Wang et al, 2008), which generally have high dairy intake and different genetic and other lifestyle factors compared with Asians. Those studies used a reference group that consisted of low-intake consumers rather than

non-consumers; thus, the findings are inevitably limited to populations with a higher range of intake (Alonso et al, 2009) and may miss a potential association with dairy food intake at lower doses compared with practically no intake.

Possessing different nutrients, bioactive compounds, and processes of fermentation, various types of dairy products are inherently different. In addition, the popularity and contribution of a specific type of dairy product to total intake varies considerably across different populations, possibly influencing the incumbent associations. For example, yogurt consumption is generally lower than milk, and in the United States, only 6% of the population consume yogurt. However, in France, one-third of the population eat at least 5 servings on a weekly basis, and the majority of the population consume at least one serving in a day (Abreu et al, 2014). Moreover, consumption of dairy products might be influenced by some other variables related to health status. For instance, it has been elucidated that leaner, healthier, more-educated individuals, and females have greater intentions to consume yogurt (Abreu et al, 2014), which may conceivably affect the observed associations.

Given that both pattern and amount of dairy products consumption varies dramatically across different populations, comparing the highest vs. the lowest category of dairy products consumption would not be sufficiently informative, per se. On the other hand, due to a wide range in the amount of dairy products consumed, it is possible that the highest intake of a dairy product in one population be equal to the lowest intake in another (Companys et al, 2020; Vaskonen, 2003). Therefore, this study aims to provide information regarding a probable association between dairy consumption and hypertension among the population of India.

2. Material and methods

The data used in this study is from the fifth series of National Family Health Survey (NFHS-5) 2019-21. It was conducted under the stewardship of Ministry of Health and Family Welfare (MoHFW), Government of India. International Institute of Population Sciences (IIPS), Mumbai acted as the nodal agency and it was funded by the United States Agency for International Development (USAID), the United Kingdom Department for International Development (DFID), the Bill and Melinda Gates Foundation (BMGF), UNICEF, UNFPA, the MacArthur Foundation, and the Government of India. The technical assistance was by ICF, Maryland, USA.

NFHS-5 fieldwork for India was conducted in two phases, phase one from 17 June 2019 to 30 January 2020 and phase two from 2 January 2020 to 30 April 2021 by 17 Field Agencies and gathered information from 636,699 households, 724,115 women, and 101,839 men. Data from 30 states/UTs were collected in the fifth series of National Family and Health Survey. The individual file was accessed in this study. The total sample size is 724115. A total of eight variables were used in this study, i.e., systolic blood pressure, diastolic blood pressure, age, religion, ethnicity, education, wealth index and frequency of consumption of milk/curd.

For blood pressure classification Indian hypertension classification, given in fourth edition of Indian Guidelines on Hypertension (IGH-IV) formulated jointly by the Association of Physician in India (API), Cardiological Society of India (CSI), Indian College of Physician (ICP) and Hypertension Society of India (Shah et al, 2020), was used in the present study:

Table 1: Indian classification of hypertension

Categories	Systolic (mmHg)		Diastolic (mmHg)
Optimal	<120	and	<80
Normal	<130	and	<85
High normal	130-139	or	85-89
Hypertension			
Stage 1	140-159	or	90-99
Stage 2	160-179	or	100-109
Stage 3	≥180	or	>110
Isolated Systolic Hypertension			
Grade 1	140-159	and	<90
Grade 2	>160	and	<90

The data accessed was further analysed with the help of Pearson's correlation and coefficient test and multinomial regression method. All the probabilities below .05 level was considered statistically significant in this study. The state-wise distribution of hypertension was presented in the national map. All the data analysis was done in IMB-SPSS version 26.0.

3. Results

The state-wise distribution of total population according to blood pressure categories. The hilly state of Sikkim, which is one of the smallest states of the entire nation was found to be having the highest percentage of total hypertensive individuals. The lowest total hypertensive percentage is also found to be in another small hilly state, i.e., Ladakh. The highest percentage of individuals in the optimal or below normal category was found to be in the state of Goa (table 2).

Table 2: State-wise distribution of sample according to blood pressure categories

States	Normal	Optimal	High normal	S1 Hypertension	S2 Hypertension	S3 Hypertension	Total Hypertension	ISHG1	ISHG2	Total ISH
Jammu & Kashmir	8014 (36.09%)	6455 (29.07%)	4716 (21.24%)	1959 (8.82%)	266 (1.2%)	20 (0.09%)	2245 (10.11%)	705 (3.17%)	71 (0.32%)	776 (3.49%)
Himachal Pradesh	2481 (24.49%)	4559 (45%)	1713 (16.91%)	1019 (10.06%)	176 (1.74%)	27 (0.27%)	1222 (12.06%)	141 (1.39%)	14 (0.14%)	155 (1.53%)
Panjab	4524 (22.73%)	6257 (31.44%)	3998 (20.09%)	3312 (16.64%)	909 (4.57%)	99 (0.5%)	4320 (21.71%)	696 (3.5%)	108 (0.54%)	804 (4.04%)
Chandigarh	163 (24.92%)	252 (38.53%)	118 (18.04%)	79 (12.08%)	25 (3.82%)	0	104 (15.9%)	14 (2.14%)	3 (0.46%)	17 (2.6%)
Uttarakhand	3110 (24.85%)	4385 (35.03%)	2494 (19.92%)	1794 (14.33%)	387 (3.09%)	31 (0.25%)	2212 (17.67%)	291 (2.32%)	25 (0.2%)	316 (2.52%)
Haryana	5228 (25.47%)	7737 (37.69%)	3944 (19.21%)	2431 (11.84%)	563 (2.74%)	37 (0.18%)	3031 (14.77%)	527 (2.57%)	60 (0.29%)	587 (2.86%)
NCT of Delhi	2490 (25.08%)	3786 (38.13%)	1769 (17.82%)	1271 (12.8%)	305 (3.07%)	35 (0.35%)	1611 (16.23%)	225 (2.27%)	47 (0.47%)	272 (2.74%)
Rajasthan	11975 (28.7%)	15765 (37.78%)	8331 (19.96%)	4138 (9.92%)	618 (1.48%)	59 (0.14%)	4815 (11.54%)	775 (1.86%)	71 (0.17%)	846 (2.03%)
Uttar Pradesh	23543 (26.72%)	35308 (40.07%)	15512 (17.6%)	9133 (10.36%)	1826 (2.07%)	171 (0.19%)	11130 (12.63%)	2295 (2.6%)	338 (0.38%)	2633 (2.99%)
Bihar	9120 (22.29%)	21829 (53.35%)	5416 (13.24%)	3140 (7.67%)	598 (1.46%)	42 (0.1%)	3780 (9.24%)	623 (1.52%)	151 (0.37%)	774 (1.89%)
Sikkim	690 (22.77%)	798 (26.34%)	604 (19.93%)	594 (19.6%)	225 (7.43%)	43 (1.42%)	862 (28.45%)	72 (2.38%)	4 (0.13%)	76 (2.51%)
Arunachal Pradesh	5229 (27.26%)	5189 (27.06%)	4135 (21.56%)	3111 (16.22%)	786 (4.1%)	108 (0.56%)	4005 (20.88%)	556 (2.9%)	65 (0.34%)	621 (3.24%)
Nagaland	2656 (28.01%)	3437 (36.25%)	1752 (18.48%)	1056 (11.14%)	255 (2.69%)	64 (0.68%)	1375 (14.5%)	240 (2.53%)	21 (0.22%)	261 (2.75%)
Manipur	1804 (22.91%)	3365 (42.74%)	1371 (17.41%)	941 (11.95%)	253 (3.21%)	28 (0.36%)	1222 (15.52%)	105 (1.33%)	7 (0.09%)	112 (1.42%)
Mizoram	1791 (25.31%)	3456 (48.84%)	971 (13.72%)	663 (9.37%)	147 (2.08%)	4 (0.06%)	814 (11.5%)	39 (0.55%)	5 (0.07%)	44 (0.62%)
Tripura	1735 (24.27%)	3412 (47.72%)	985 (13.78%)	686 (9.59%)	172 (2.41%)	19 (0.27%)	877 (12.27%)	127 (1.78%)	14 (0.2%)	141 (1.97%)
Meghalaya	3306 (25.96%)	5473 (42.98%)	2268 (17.81%)	1236 (9.71%)	256 (2.01%)	27 (0.21%)	1519 (11.93%)	151 (1.19%)	17 (0.13%)	168 (1.32%)
Assam	9335 (27.54%)	13402 (39.54%)	5854 (17.27%)	3344 (9.87%)	863 (2.55%)	115 (0.34%)	4322 (12.75%)	877 (2.59%)	104 (0.31%)	981 (2.89%)
West Bengal	5033 (24.31%)	9143 (44.16%)	3491 (16.86%)	1939 (9.37%)	506 (2.44%)	65 (0.31%)	2510 (12.12%)	473 (2.28%)	52 (0.25%)	525 (2.54%)
Jharkhand	7074 (27.82%)	10384 (40.84%)	4508 (17.73%)	2300 (9.05%)	454 (1.79%)	57 (0.22%)	2811 (11.06%)	567 (2.23%)	80 (0.31%)	647 (2.54%)
Orisha	6383 (23.5%)	10968 (40.38%)	4805 (17.69%)	3489 (12.84%)	796 (2.93%)	94 (0.35%)	4379 (16.12%)	577 (2.12%)	53 (0.2%)	630 (2.32%)
Chhattisgarh	6676 (24.42%)	10431 (38.16%)	5082 18.59%)	3441 (12.59%)	744 (2.72%)	85 (0.31%)	4270 (15.62%)	731 (2.67%)	143 (0.52%)	874 (3.2%)
Madhya Pradesh	11243 (24.87%)	18259 (40.39%)	7935 (17.55%)	5339 (11.81%)	1171 (2.59%)	113 (0.25%)	6623 (14.65%)	1032 (2.28%)	115 (0.25%)	1147 (2.54%)
Gujrat	8198 (25.3%)	14463 (44.64%)	5131 (15.84%)	3120 (9.63%)	701 (2.16%)	64 (0.2%)	3885 (11.99%)	630 (1.94%)	91 (0.28%)	721 (2.23%)
Dadra & Nagar Haveli & Daman & Diu	674 (25.79%)	1014 (38.81%)	584 (22.35%)	213 (8.15%)	44 (1.68%)	5 (0.19%)	262 (10.03%)	72 (2.76%)	7 (0.27%)	79 (3.02%)
Maharashtra	7498 (23.24%)	14568 (45.15%)	5346 (16.57%)	3427 (10.62%)	660 (2.05%)	57 (0.18%)	4144 (12.84%)	608 (1.88%)	101 (0.31%)	709 (2.2%)

Andhra Pradesh	2081 (19.89%)	5222 (49.91%)	1604 15.33%)	1097 (10.49%)	266 (2.54%)	21 (0.2%)	1384 (13.23%)	151 (1.44%)	20 (0.19%)	171 (1.63%)
Karnataka	6320 (21.8%)	13756 (47.45%)	4276 (14.75%)	3017 (10.41%)	854 (2.95%)	82 (0.28%)	3953 (13.64%)	610 (2.1%)	75 (0.26%)	685 (2.36%)
Goa	446 (22.78%)	1050 (53.63%)	245 (12.51%)	143 (7.3%)	31 (1.58%)	3 (0.15%)	177 (9.04%)	35 (1.79%)	5 (0.26%)	40 (2.04%)
Lakshadweep	312 (26.11%)	481 (40.25%)	237 (19.83%)	90 (7.53%)	24 (2.01%)	0	114 (9.54%)	50 (4.18%)	1 (0.08%)	51 (4.27%)
Kerela	2331 (22.08%)	5174 (49.02%)	1559 (14.77%)	973 (9.22%)	240 (2.27%)	33 (0.31%)	1246 (11.8%)	223 (2.11%)	22 (0.21%)	245 (2.32%)
Tamil Nadu	5269 (21.29%)	12205 (49.31%)	3571 (14.43%)	2497 (10.09%)	618 (2.5%)	77 (0.31%)	3192 (12.9%)	450 (1.82%)	64 (0.26%)	514 (2.08%)
Puducherry	847 (23.64%)	1579 (44.07%)	628 (17.53%)	364 (10.16%)	85 (2.37%)	5 (0.14%)	454 (12.67%)	72 (2.01%)	3 (0.08%)	75 (2.09%)
Andaman & Nicobar Island	538 (22.99%)	924 (39.49%)	415 (17.74%)	273 (11.67%)	92 (3.93%)	11 (0.47%)	376 (16.07%)	80 (3.42%)	7 (0.3%)	87 (3.72%)
Telangana	5120 (19.88%)	13017 (50.54%)	3479 (13.51%)	2893 (11.23%)	814 (3.16%)	74 (0.29%)	3781 (14.68%)	316 (1.23%)	45 (0.17%)	361 (1.4%)
Ladakh	887 (38.68%)	658 (28.7%)	467 (20.37%)	148 (6.45%)	14 (0.61%)	0	162 (7.06%)	112 (4.88%)	7 (0.31%)	119 (5.19%)
Total	174124 (25.16%)	288161 (41.64%)	119314 (17.24%)	74670 (10.79%)	16744 (2.42%)	1775 (0.26%)	93189 (13.47%)	15248 (2.2%)	2016 (0.29%)	17264 (2.49%)

Here, S1 is stage 1, S2 is stage 2, S3 is stage 3, ISHG1 is Isolated Systolic Hypertension Grade 1 and ISHG2 is Isolated Systolic Hypertension Grade 2.

Table 3: Pearson's correlation coefficient test for blood pressure and socio-demographic factors with frequency of consumption of milk products

Variables	Blood pressure	Age	Religion	Ethnicity	Education	Wealth Index	FCM
Blood pressure	1	.239**	.010**	.000	-.106**	.020**	.003*
Age	.239**	1	.006**	-0.002	-.383**	.057**	-.014**
Religion	.010**	.006**	1	.094**	-0.002	-.059**	.033**
Ethnicity	.000	-0.002	.094**	1	-.012**	-.102**	.050**
Education	-.106**	-.383**	-0.002	-.012**	1	.410**	-.086**
Wealth Index	.020**	.057**	-.059**	-.102**	.410**	1	-.199**
FCM	.003*	-.014**	.033**	.050**	-.086**	-.199**	1

Here, FCM is frequency of consumption of milk/curd

*p value significant at .05 level

**p value significant at .01 level

Table 4: Multinomial regression analysis of hypertension and frequency of dairy consumption

Frequency	Stage1				Stage 2				Stage 3			
	Sig.	Exp(B)	95% CI		Sig.	Exp(B)	95% CI		Sig.	Exp(B)	95% CI	
			Lower	Upper			Lower	Upper			Lower	Upper
Daily	.000	0.953	0.931	0.976	.000	0.923	0.885	0.964	.001	0.803	0.709	0.909
Weekly	.000	0.932	0.908	0.956	.000	0.904	0.863	0.948	.065	0.882	0.772	1.008
Occasionally	.	.	.	.	.	.	.	.	.	.	.	.
Never	.026	1.044	1.005	1.084	.006	1.097	1.026	1.173	.702	0.963	0.794	1.169

Blood pressure was found to be associated significantly with age, religion, education and wealth index. As the age increases chances of having hypertension also increases. The probability of having hypertension is also high among the religious minorities and also among the richest families. Frequency of having milk or curd has positive and significant association with hypertension. Age, education and wealth index are negatively and significantly associated with milk or curds. While, ethnicity, and religion is positively associated with consumption of milk (table 3).

The stage 1 hypertension was significantly and strongly defined by the consumption of milk products. It was found that those consuming milk products daily and weekly have very strong chances of having stage 1(95.3%

and 93.2%, respectively in 95% CI) and stage 2 hypertension (92.4% and 90.4%, respectively in 95% CI). Apart from this, daily consumption of milk products also significantly increases 80.3% the chance of having stage 3 hypertension as well (95% CI) (table 4).

4. Discussion

It has been found in the present study that daily and weekly consumption of milk and curd significantly increases the chances of having stage 1, stage 2 and stage 3 hypertension than those consuming it occasionally and never consuming it among the Indians. The daily and weekly consumption of fried foods as well significantly increase the chances of having stage 2 and stage 3 hypertension. However, it doesn't make any significant affect in stage 1 hypertension.

Studies have talked about the inverse relationship between dairy consumption and hypertension. This is important to note that the amount of fat content is a crucial variable in defining the association of the dairy consumption with hypertension. Low fat dairy consumption is found to be associated with lower risk of hypertension (Engberink et al, 2009). Similar result was also observed among women with consumption of skimmed milk and low risk of hypertension (Wang et al, 2008). However, in recent study it has been found that compared to the those who never have dairy products, those having less than once per week and more than or equal to 1 time in a week, have significantly higher chances of having hypertension (Wang et al, 2022). In previous studies no clear pattern has been seen in the nature of association between dairy consumption and hypertension (Rietsema et al, 2019; Feng et al, 2022; Heidari et al, 2021; Soedamah-Muthu et al, 2012; Aljuraiban et al, 2018). Indian is the largest country in the world in terms milk production (FAO, 2021). In the present study, the nationally representative data shows that there is positive and significant association between consumption of milk products and hypertension. The production and consumption of dairy in India is quite different than rest of the world. In India the huge amount of consumption of dairy is actually in unpasteurized form through informal channels (Nicolini et al, 2022). This essentially raises the question regarding the quality and the impact of it in overall health.

These two factors need to be taken into account while talking about Indian scenario. As India is the largest consumer of milk and majority being unpasteurized, it is very important that daily and weekly consumption of milk in India is significantly increasing the chance of having hypertension as found in the present study. From a microbiological point of view, even refrigerating unpasteurized milk after boiling in India, increases the standard plate count (SPC) at the end of 24h (Agarwal et al, 2012). It has been reported that based on the market demand the milk farmers of India, prefer water buffalos as they produce milk with a higher fat content than cow. In fact, majority of the packaged milk as well is a combination of both water buffalo and cow milk in India (Karen, 2022) These factors need to be further emphasized to reiterate the positive association of dairy consumption with hypertension in India.

Frequency of consumption of milk products is significantly and positively associated with religion and ethnicity. This means that the religious majorities and communal minorities are found to be consuming significantly more dairy products. However, education, age and wealth index are found to be associated significantly negatively with the frequency of consumption of milk and milk products. This could imply that the risk of hypertension is higher among the religious majorities like Hindu or Muslims, who are also less educated and poorer in the socio-economic scale in India. To relate this with the prior inference, it would help paint a picture in the direction that may be those individuals belonging to the religious majorities and in the poorer economic section of the society with low education, consuming unpasteurised milk and dairy products regularly with a higher fat content are having significantly higher risks of hypertension in India.

5. Conclusions

Even through very small sample is there in reference to available literature pertaining to the association between consumption of milk products and hypertension; it needs to be observed with gravitas. In the present study it has been clearly seen that daily and weekly consumption of milk and curd statistically significantly increases the chances of having stage 1, 2, and 3 hypertensions. India being the largest consumer of milk in the world and the majority of it being unpasteurised, it is very important to ponder upon the association found in the present study between consumption of milk and hypertension.

Conflict of interest

None

Author's contribution

JB came up with the concept and design. DM and AS have arranged and prepared the data. Data analysis was done by JB and the manuscript and final draft was done by JB and DM.

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