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COST-ADJUSTED PREFERENCE FOR AYUSH HEALTHCARE SYSTEMS IN NORTH-EAST INDIA: UTILISATION-EXPENDITURE TRADE-OFF ACROSS AILMENTS

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ABSTRACT

The increasing fiscal burden on healthcare systems has strengthened the need to analyse healthcare utilisation in terms of economic efficiency. Both conventional biomedical care and traditional systems coexist in the pluralistic healthcare systems in India. Traditional and complementary healthcare systems are institutionalised under AYUSH systems in India. Despite the escalating utilisation of AYUSH services, limited empirical findings exist on its cost-adjusted utilisation efficiency across different ailments and diseases. Attempting to bridge this gap, this study creates a Cost-Adjusted Preference Index (CAPI) to evaluate the relationship between preference of utilisation and treatment cost across different AYUSH systems and diseases in North-East India. For this study, the NSS 79th round data set was used. Preference share (proxy for demand) and Cost intensity (proxy for price) are used to develop CAPI. Results exhibit that Unani has the highest mean CAPI, which indicates significant demand relative to expenditure in distinct ailments sectors like dental, gastrointestinal, cosmetic, etc. Ayurveda captured the largest share of AYUSH utilisation with moderate cost-adjusted performance. Whereas, Yoga and Naturopathy account for relatively higher cost-adjusted efficiency than Ayurveda. This CAPI framework gives a novel health-economic tool to analyse demand-cost coherence and may assist policy efforts for escalating allocative efficiency and fostering universal health coverage goals.

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INTRODUCTION

Globally, healthcare systems are increasingly facing the challenge of accessibility, providing equitable and high-quality care under the sustained fiscal constraints. Fiscal burden on public budgets, changes in epidemiological profile, and rising healthcare costs have jointly amplified the demand for more efficient healthcare management. Accordingly, health system performance in present-day assessment has advanced beyond simple metrics of healthcare utilisation coverage to place more explicit emphasis on efficient cost-conscious allocation of funds, value for money, maximising benefits per unit cost, etc(Health Care Systems: Efficiency and Institutions 2010). Resource-based obstacles are highly evident in low- and middle-income countries, where healthcare systems are under go with catastrophic health expenditure of households and extensive health budgetary constraints. After acceptance of Sustainable Development Goal 3 (SDG 3), countries are pledging to "promote well-being for all at all ages and ensure healthy lives".

Universal Health Coverage (UHC) and SDG 3 focus on not only service accessibility but also cost-efficient health service utilisation. Within global healthcare governance, cost-efficient healthcare utilisation becomes a central policy concern. Improving cost-efficient healthcare utilisation is not only a technical switch but also a joint effect on financing arrangements with a service-oriented mix of different healthcare systems. (Health Care Systems: Efficiency and Institutions 2010; Murray, Kreuser, and Whang n.d.). Notably, a recent study exhibits that globally 20 to 40 per cent of health expenditure is wasted due to inappropriate service delivery, inefficient healthcare utilisation(Chisholm and Evans n.d.). Globally, healthcare systems are pluralistic in nature. Conventional biomedicine, generally called allopathy, and traditional, complementary, alternative medicine (TCAM) coexist in the healthcare landscape. The World Health Organisation (WHO) comments on TCAM as "the sum of knowledge, skills and practices based on the beliefs, theories, and experiences indigenous to different cultures, applied in the sustaining of health and in the treatment of ailments and for diagnosis"(Traditional, Complementary and

Integrative Medicine n.d.). WHO emphasised the incorporation of TCAM into national health policy as a sustained strategy to enhance cultural acceptability, a people-centred healthcare system and financial safeguarding, basically in lower-middle income countries where the conventional biomedical system is disproportionately distributed. In the Indian healthcare system, both allopathy and traditional, conventional systems are present. These traditional, conventional and alternative type systems are formally institutionalised as AYUSH. This AYUSH system consists of seven different types of healthcare systems. Ayurveda, Yoga, Naturopathy, Unani, Siddha, Sowa-Rigpa and Homoeopathy. Ayurveda denotes "Science of Life", and it originated from different Vedic hymns based on guiding principles about health, life and disease. One of the oldest healing systems through physical workoutis the Yoga system, which originated in India. It is a combination of different body postures and exercises. Naturopathy is a method of treating different types of diseases through natural therapies like water therapy, fasting therapy, massage therapy, etc. The Unani system is mainly practised by Hakims. The unani system of healthcare mainly articulates through blood, back and yellow bile, phlegm, etc. Some Unani medicines are Kali Mirch, Sharbat Zuffa, Cinkara, Habb-e-Kabid, Arq-e-Mako,Qurs-e Mulliyan etc. Siddha mainly evolved from South-Indian Dravidian culture. Primarily, diseases are diagnosed through voice, colour of urine, colour of tongue, etc, and popular siddha medicine mainly contains sulfur, lead, silver, mercury, etc. The Sowa-Rigpa system of medicine is popular in the Himalayan regions. Some highlighted medicines, which are used in Sowa-Rigpa and originated in the Indian subcontinent, are Guggulu, Haridra, Ashwagandha, etc. These AYUSH systems have strong and significant bonding with India's sociocultural systems, andthey are utilised in preventive, curative and therapeutic care.

REVIEW OF LITERATURE

Inflammatory Bowel Disease's (IBD) cost rose between 2006 to 2016. These phenomena happen because of the utilisation of a biological agent. Within this time frame, inpatient and indirect costs are nearly stable, but expenditures on pharmaceutical goods have doubled. Key cost determinant is complications and disease activity (Pillai et al. 2019). Comprising both beneficiary volume and cost-effectiveness, policymakers emphasise efficiency over equity, excluding disease severity in healthcare utilisation. Moreover, utilisation ranking accentuates cardiovascular and mental health intervention to sustain financial validity (Meusel et al. 2023). In Canada, the Health Utilities Index (HUI) is a significant determinant of healthcare utilisation. A study investigates that a 10 per cent reduction in Costs occurs when health status improves by 0.1 (Lima and Kopec 2005). To value services, ordinal methods like discrete choice experiments and ranking are robustly used in health economics. For predicting demand and analysing practices, the mentioned tool intensifies trade-offs between non-health and health outcomes. Moreover, ordinal preference elicitation methods give lower cognitive burden compared to cardinal methods (Ali and Ronaldson 2012). A new index to measure healthcare utilisation has been developed by researchers called the HUTIL index. It measures healthcare utilisation by cost-based weighing associated with primary costs. A greater index value correlates with higher mortality and lower life expectancy (John, Rebell, and Donzé 2025). This study examines costing methods in health economics and distinguishes financial costs from economic costs. Also, explains top-down and bottom-up approaches under allocation methods and discusses about activity-based costing, micro & gross costing in health economics (Turner et al. 2025).

Found that complex cost-sharing measures tend to result in the forgoing of particular recommended care. Copayments and afterwards billing magnify medical adherence by enhancing price transparency (Salampessy et al. 2018). Health outcomes by incorporating values into Cost-Utility Analysis (CUA) and using Quality-adjusted-life-years (QALY) to measure quality against life expectancy (Neumann, Goldie, and Weinstein 2000). Willingness-to-pay (WTP) is oriented toward cost-benefit analysis, and quality-adjusted life years (QALY) is oriented toward cost-effectiveness analysis; both evaluate healthcare utilisation. WTP and QALYs are both coherent with welfare economics and health perspective, respectively (Liljas and Lindgren 2001).Cost-Value Analysis consolidates societal fairness with economic evaluations, and it utilises transformed values for the severely ill. This analytical framework facilitates graded willingness to pay. This coincides with higher costs per QALY, which are substantiated for greater illness severity, consistent with public equity values (Nord 2015). A Systematic review found the associations between healthcare quality and cost. One of the important methods to identify healthcare intensity is "End-of-Life Care Expenditure Index (EOL-EI)", developed by Dartmouth Atlas Project. "Acute Care Expenditure Index (AC-EI)" is another method that counts the expenditure on hospital services and physicians (Hussey, Wertheimer, and Mehrotra 2013). Insights from existing literature on healthcare utilisation and cost of utilisation are exhaustive. Existing studies on AYUSH systems in India mainly focus on patterns of use, disease burden, socio-economic factors, perception of patients, satisfaction, etc (Rana et al. 2025; Rudra et al. 2017). In the domain of healthcare utilisation, very few studies examine cost intensity, and fewer among these relate cost to utilisation in a way that enables relative assessment across ailments and different healthcare systems. Despite a rich global literature on healthcare utilisation, healthcare costs, and healthcare cost-efficiency, no study has used a cost-adjusted revealed preference framework for AYUSH systems. Addressing this gap, the objective of this study is to construct Cost-Adjusted Preference Index (CAPI) with ailment-specific preference shares and different AYUSH system-ailment cost intensity for analysing cost-preference trade-offs across different ailments and AYUSH systems.

DATA AND METHODOLOGY

Regionally, India is divided into six region-centric parts, like northern, eastern, western, central, southern and north-eastern parts. Out of these six parts, North-East India has a unique sociocultural tradition, different types of traditional and alternative medicine practices, and different geographic terrains. The North-Eastern region consists of eight states. These states are Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim. This study is bound with individuals aged 15 to 59 years, excluding senior citizens and children. Data set were taken from the National Sample Survey (NSS) 79th round, 2022-2023 on AYUSH. This survey is conducted by the Ministry of Statistics and Programme Implementation (MoSPI), Government of India(India - AYUSH of NSS 79th round: 2022-23 n.d.). Under the 79th round AYUSH data set, there are two data files present: one at the household level and the other at the individual level. The work involves merging these two data files to draw individual information. Moreover, applied survey weights to ensure proper population representation.

Cost-Adjusted Preference Index (CAPI) integrates two observable components

1. Preference Share (Proxy of Demand)

$$P_{js} = \frac{D_{js}}{D_j}$$

P_{js} =Preference share of AYUSH systems s for disease, ailment j
D_{js}=Number of users of AYUSH system s for ailment j
D_j=Total AYUSH user for ailment j

2. Cost Intensity (Proxy of Price)

$$C_{js} = \frac{\sum Expenditure_{js}}{D_{js}}$$

C_{js}=This captures the average monetary cost per user for each system-ailment combination.

3. Cost-Adjusted Preference Index (CAPI)

$$CAPI_{js} = \frac{C_{js}}{P_{js}}$$

$CAPI_{js}$=CAPI capture the ratio of preference share to cost intensity. This is a yielding measure of AYUSH utilisation per unit of expenditure. Higher CAPI values indicate a particular system elicits relatively high demand at a lower cost. It approaches greater economic efficiency from the AYUSH.

A weighted log-linear fixed model was used to evaluated whether system-level variation is present in CAPI after accounting for ailment heterogeneity.

$ln\ (CAPI_{js}) = \alpha + \delta_j + \theta_s + \varepsilon_{js}$

$CAPI_{js}$= Cost-adjusted preference index for ailment j and system s,
δ_j= Ailment fixed effects controlling for ailment specific variation,
θ_s= System-level structural differences,
ε_{js}= *error term*

RESULTS

Ailment	System of Medicine	D_js	D_j	Preference Share Pjs	Cost Intensity Cjs	CAPI
Acute_Conditions	Ayurveda	2062904	2672095	0.772018	404.58	0.001908
Acute_Conditions	Homoeopathy	659122	2672095	0.246669	581.33	0.000424
Acute_Conditions	Naturopathy	921533	2672095	0.344873	200.36	0.001721
Acute_Conditions	Siddha	19993	2672095	0.007482	762.82	0.00001
Acute_Conditions	Sowa-Rigpa	9893	2672095	0.003702	266.18	0.000014
Acute_Conditions	Unani	15504	2672095	0.005802	2524.47	0.000002
Acute_Conditions	Yoga	73006	2672095	0.027322	21.97	0.001244
Anorectal	Ayurveda	182325	219293	0.831422	1360.1	0.000611
Anorectal	Homoeopathy	57303	219293	0.26131	883.28	0.000296
Anorectal	Naturopathy	32783	219293	0.149492	180.83	0.000827
Anorectal	Siddha	1750	219293	0.007982	646.92	0.000012
Anorectal	Sowa-Rigpa	426	219293	0.001943	172.47	0.000011
Anorectal	Unani	1180	219293	0.005382	704.8	0.000008
Anorectal	Yoga	8577	219293	0.039113	81.81	0.000478
Cancer	Ayurveda	12682	12878	0.984799	2075.97	0.000474
Cancer	Homoeopathy	4576	12878	0.355312	1586.87	0.000224
Cancer	Naturopathy	9289	12878	0.721361	732.38	0.000985
Cancer	Siddha	1087	12878	0.084387	1642.85	0.000051
Cancer	Unani	224	12878	0.017369	500	0.000035
Cardio_vascular	Ayurveda	144890	182642	0.793303	1544.09	0.000514
Cardio_vascular	Homoeopathy	44659	182642	0.244515	826.77	0.000296
Cardio_vascular	Naturopathy	66167	182642	0.362278	336.12	0.001078
Cardio_vascular	Siddha	5478	182642	0.029992	22.27	0.001347
Cardio_vascular	Sowa-Rigpa	167	182642	0.000917	46.2	0.00002
Cardio_vascular	Unani	1653	182642	0.009051	850	0.000011
Cardio_vascular	Yoga	12248	182642	0.067062	13.5	0.004968
Cosmetics	Ayurveda	1669728	1849266	0.902914	348.06	0.002594
Cosmetics	Homoeopathy	260973	1849266	0.141122	578.9	0.000244
Cosmetics	Naturopathy	518308	1849266	0.280278	145.15	0.001931
Cosmetics	Siddha	4622	1849266	0.002499	852.24	0.000003
Cosmetics	Sowa-Rigpa	3735	1849266	0.00202	306.55	0.000007
Cosmetics	Unani	279740	1849266	0.151271	2.48	0.060996
Cosmetics	Yoga	94801	1849266	0.051264	86.97	0.000589
Dental	Ayurveda	320367	409200	0.782912	406.66	0.001925
Dental	Homoeopathy	108527	409200	0.265217	439.21	0.000604
Dental	Naturopathy	67619	409200	0.165248	179.83	0.000919
Dental	Siddha	4569	409200	0.011167	556.6	0.00002
Dental	Sowa-Rigpa	178	409200	0.000436	313.82	0.000001
Dental	Unani	73948	409200	0.180716	4.3	0.042027
Dental	Yoga	1882	409200	0.004601	93.84	0.000049
ENT_&_Ophthalmic	Ayurveda	229679	334028	0.687603	731.9	0.000939
ENT_&_Ophthalmic	Homoeopathy	145458	334028	0.435465	544.38	0.0008
ENT_&_Ophthalmic	Naturopathy	125757	334028	0.376486	195.54	0.001925
ENT_&_Ophthalmic	Siddha	6269	334028	0.018768	724.89	0.000026
ENT_&_Ophthalmic	Sowa-Rigpa	781	334028	0.00234	2354.29	0.000001
ENT_&_Ophthalmic	Unani	1577	334028	0.004721	592.74	0.000008
ENT_&_Ophthalmic	Yoga	36354	334028	0.108837	15.82	0.00688
Female_Reproductive_System	Ayurveda	244236	321863	0.758821	926.74	0.000819
Female_Reproductive_System	Homoeopathy	152466	321863	0.473697	1014.45	0.000467
Female_Reproductive_System	Naturopathy	101468	321863	0.315252	192.49	0.001638
Female_Reproductive_System	Siddha	764	321863	0.002374	1437.27	0.000002
Female_Reproductive_System	Sowa-Rigpa	1097	321863	0.003408	349.61	0.00001
Female_Reproductive_System	Unani	1493	321863	0.004638	311.53	0.000015
Female_Reproductive_System	Yoga	10589	321863	0.032898	16.62	0.001979
Gastrointestinal_System	Ayurveda	1769071	1987474	0.890111	451.51	0.001971
Gastrointestinal_System	Homoeopathy	248262	1987474	0.124913	643.68	0.000194
Gastrointestinal_System	Naturopathy	467838	1987474	0.235393	160.16	0.00147
Gastrointestinal_System	Siddha	8995	1987474	0.004526	1175.55	0.000004
Gastrointestinal_System	Sowa-Rigpa	4962	1987474	0.002497	543.25	0.000005
Gastrointestinal_System	Unani	323849	1987474	0.162945	19.7	0.008271
Gastrointestinal_System	Yoga	45900	1987474	0.023095	72.32	0.000319

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General_Immune_Boosting	Ayurveda	2074580	2403862	0.86302	327.41	0.002636
General_Immune_Boosting	Homoeopathy	205721	2403862	0.085579	571.65	0.00015
General_Immune_Boosting	Naturopathy	800097	2403862	0.332838	161.24	0.002064
General_Immune_Boosting	Siddha	15466	2403862	0.006434	788.87	0.000008
General_Immune_Boosting	Sowa-Rigpa	14735	2403862	0.00613	262.97	0.000023
General_Immune_Boosting	Unani	382047	2403862	0.15893	1.12	0.141902
General_Immune_Boosting	Yoga	167918	2403862	0.069854	21.06	0.003317
Genitourinary_System	Ayurveda	87455	102351	0.854465	1336.34	0.000639
Genitourinary_System	Homoeopathy	20761	102351	0.202846	1374.68	0.000148
Genitourinary_System	Naturopathy	7894	102351	0.077125	249.89	0.000309
Genitourinary_System	Sowa-Rigpa	489	102351	0.004783	257.55	0.000019
Genitourinary_System	Unani	4247	102351	0.041495	1423.63	0.000029
Genitourinary_System	Yoga	2706	102351	0.026441	26.22	0.001008
Geriatric_Problems	Ayurveda	23513	24407	0.963366	152.55	0.006315
Geriatric_Problems	Homoeopathy	15178	24407	0.62187	122.12	0.005092
Geriatric_Problems	Naturopathy	1322	24407	0.054162	0.00	
Geriatric_Problems	Unani	6093	24407	0.249632	0.00	
Geriatric_Problems	Yoga	283	24407	0.011615	0.00	
Hepato_biliary_System	Ayurveda	224304	255764	0.876996	592.67	0.00148
Hepato_biliary_System	Homoeopathy	67849	255764	0.26528	702.04	0.000378
Hepato_biliary_System	Naturopathy	42988	255764	0.168078	165.09	0.001018
Hepato_biliary_System	Siddha	224	255764	0.000875	2000	0
Hepato_biliary_System	Sowa-Rigpa	578	255764	0.002258	295.78	0.000008
Hepato_biliary_System	Unani	2531	255764	0.009897	321.25	0.000031
Hepato_biliary_System	Yoga	19817	255764	0.077481	0.00	
Integumentary_System	Ayurveda	134640	167661	0.803048	436.78	0.001839
Integumentary_System	Homoeopathy	49720	167661	0.296549	500.91	0.000592
Integumentary_System	Naturopathy	35285	167661	0.210454	122.95	0.001712
Integumentary_System	Siddha	2673	167661	0.015946	913.42	0.000017
Integumentary_System	Sowa-Rigpa	3144	167661	0.018752	400	0.000047
Integumentary_System	Unani	5332	167661	0.031805	1366.88	0.000023
Integumentary_System	Yoga	542	167661	0.003233	162.35	0.00002
Musculoskeletal_System	Ayurveda	1233330	1443489	0.854409	675.87	0.001264
Musculoskeletal_System	Homoeopathy	341243	1443489	0.236402	780.17	0.000303
Musculoskeletal_System	Naturopathy	245567	1443489	0.170121	131.52	0.001293
Musculoskeletal_System	Siddha	20470	1443489	0.014181	683.54	0.000021
Musculoskeletal_System	Sowa-Rigpa	8717	1443489	0.006039	763.44	0.000008
Musculoskeletal_System	Unani	78359	1443489	0.054285	71.41	0.00076
Musculoskeletal_System	Yoga	96817	1443489	0.067072	81.76	0.00082
Nervous_System	Ayurveda	233634	274855	0.850028	981.36	0.000866
Nervous_System	Homoeopathy	73406	274855	0.267073	923.89	0.000289
Nervous_System	Naturopathy	48296	274855	0.175715	283.52	0.00062
Nervous_System	Siddha	15395	274855	0.05601	513.93	0.000109
Nervous_System	Sowa-Rigpa	1821	274855	0.006627	1666.06	0.000004
Nervous_System	Unani	6211	274855	0.022598	6124.91	0.000004
Nervous_System	Yoga	19996	274855	0.072751	128.78	0.000565
Obesity	Ayurveda	85216	108105	0.788274	815.78	0.000966
Obesity	Homoeopathy	12420	108105	0.114891	806.41	0.000142
Obesity	Naturopathy	20327	108105	0.188028	208.04	0.000904
Obesity	Siddha	937	108105	0.008669	0.00	
Obesity	Sowa-Rigpa	2101	108105	0.019434	457.87	0.000042
Obesity	Unani	120	108105	0.001115	350	0.000003
Obesity	Yoga	62230	108105	0.575648	98.97	0.005816
Others_(Bites-Burn-etc.)	Ayurveda	888273	1022162	0.869014	446.21	0.001948
Others_(Bites-Burn-etc.)	Homoeopathy	108836	1022162	0.106476	625.97	0.00017
Others_(Bites-Burn-etc.)	Naturopathy	353779	1022162	0.346109	224.61	0.001541
Others_(Bites-Burn-etc.)	Siddha	19118	1022162	0.018704	785.92	0.000024
Others_(Bites-Burn-etc.)	Sowa-Rigpa	2447	1022162	0.002395	410.53	0.000006
Others_(Bites-Burn-etc.)	Unani	169008	1022162	0.165344	8.19	0.020189
Others_(Bites-Burn-etc.)	Yoga	13170	1022162	0.012884	16.48	0.000782
Panchakarma_RegimentalTherapy_etc.	Ayurveda	38664	113858	0.33958	370.66	0.000916
Panchakarma_RegimentalTherapy_etc.	Homoeopathy	6032	113858	0.052977	1026.27	0.000052
Panchakarma_RegimentalTherapy_etc.	Naturopathy	78746	113858	0.691614	203.91	0.003392
Panchakarma_RegimentalTherapy_etc.	Yoga	6268	113858	0.055054	45.02	0.001223
Poorvakarma_Thokkanam_etc.	Ayurveda	20349	20349	1	104.38	0.00958
Poorvakarma_Thokkanam_etc.	Homoeopathy	6411	20349	0.315049	328.17	0.00096
Poorvakarma_Thokkanam_etc.	Naturopathy	13269	20349	0.652046	47.99	0.013587
Poorvakarma_Thokkanam_etc.	Unani	5516	20349	0.271057	0.00	
Poorvakarma_Thokkanam_etc.	Yoga	1754	20349	0.086184	0.00	
Prediabetes_Diabetes_Thyroid_Disease	Ayurveda	295239	348306	0.847642	1111.35	0.000763
Prediabetes_Diabetes_Thyroid_Disease	Homoeopathy	100099	348306	0.287389	872.1	0.00033
Prediabetes_Diabetes_Thyroid_Disease	Naturopathy	74184	348306	0.212987	328.28	0.000649
Prediabetes_Diabetes_Thyroid_Disease	Siddha	1448	348306	0.004157	1393.33	0.000003
Prediabetes_Diabetes_Thyroid_Disease	Sowa-Rigpa	3505	348306	0.010064	709.91	0.000014
Prediabetes_Diabetes_Thyroid_Disease	Unani	1100	348306	0.00316	408.13	0.000008
Prediabetes_Diabetes_Thyroid_Disease	Yoga	26257	348306	0.075385	30.36	0.002483
Psychiatric	Ayurveda	127038	167408	0.758849	238.58	0.003181
Psychiatric	Homoeopathy	40244	167408	0.240393	1117.16	0.000215

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Psychiatric	Naturopathy	30254	167408	0.180717	108.91	0.001659
Psychiatric	Siddha	636	167408	0.0038	170.46	0.000022
Psychiatric	Sowa-Rigpa	100	167408	0.0006	550	0.000001
Psychiatric	Unani	68259	167408	0.40774	0.23	1.772783
Psychiatric	Yoga	18741	167408	0.111949	20.57	0.005442
Respiratory_System	Ayurveda	3926934	4590652	0.85542	238.06	0.003593
Respiratory_System	Homoeopathy	677948	4590652	0.14768	429.34	0.000344
Respiratory_System	Naturopathy	928278	4590652	0.20221	80.65	0.002507
Respiratory_System	Siddha	20871	4590652	0.004546	668.58	0.000007
Respiratory_System	Sowa-Rigpa	13923	4590652	0.003033	368	0.000008
Respiratory_System	Unani	481931	4590652	0.104981	7.22	0.01454
Respiratory_System	Yoga	72480	4590652	0.015789	30.63	0.000515

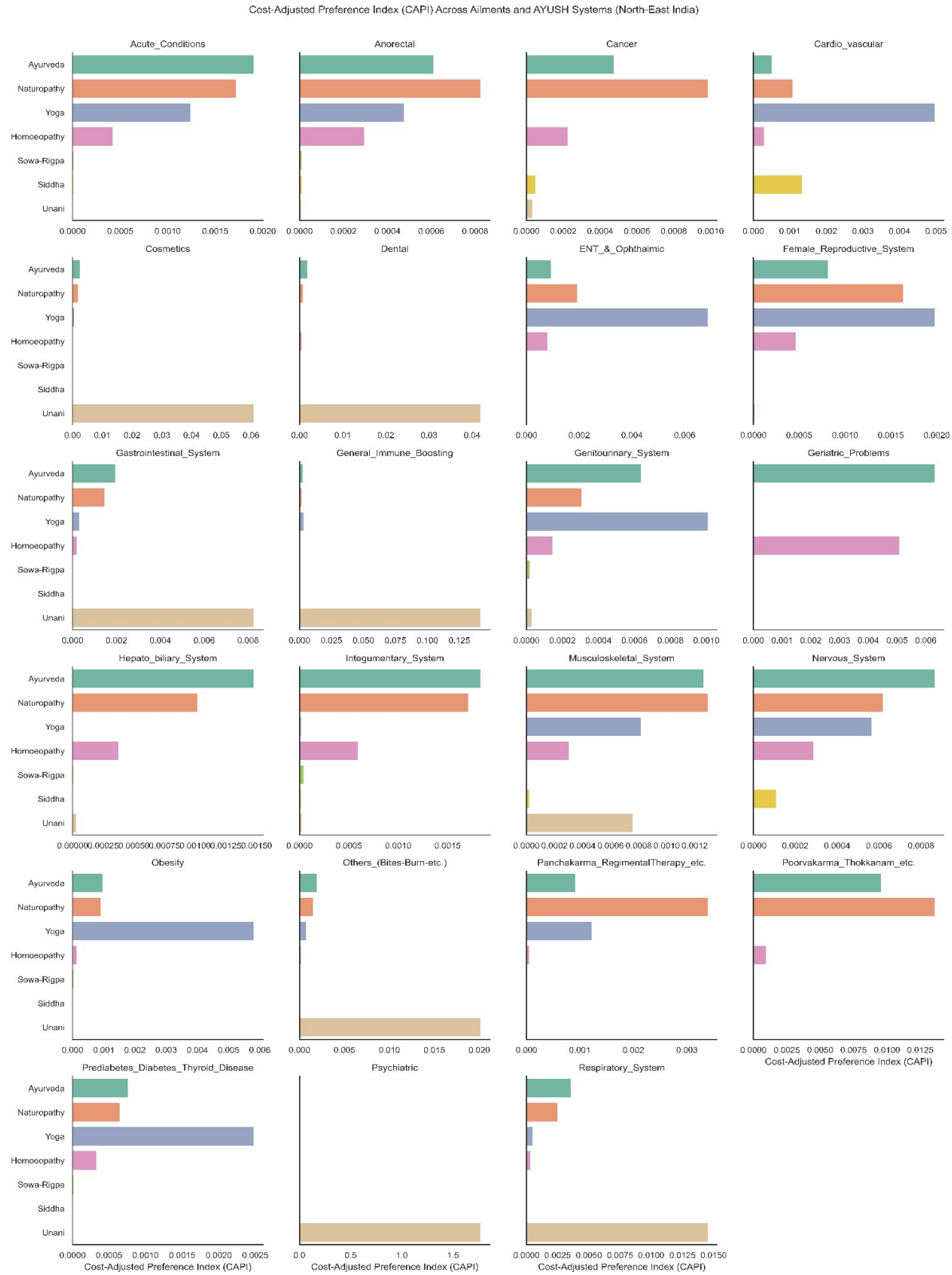

Fig. 1. Cost-Adjusted Preference Index (CAPI) Across Ailments and AYUSH Systems. (Source: Authors calculation from the NSS 79th round data on AYUSH)

Log-linear fixed effect model exhibits R^2 =0.792 and adjusted R^2 =0.741, with F-significant level P<0.001. The system-level coefficient is explained through taking Ayurveda as a reference category. Unani exhibits high and statistically significant coefficient (β = 2.31, p <0.001). These results highlighted that after adjusting utilisation magnitude and ailment composition, CAPI of Unani is nearly 10 times more than of Ayurveda. The homoeopathy system found that a negative coefficient (β = -1.80, p<0.001). It suggesting that, after fixing ailment effects, CAPI of homoeopathy is approximately 80 percent lower than Ayurveda. Results for Siddha (β= -4.67, p < 0.001) and Sowa-Rigpa (β= -5.19, p<0.001) exhibits lower demand-cost congruence with compared to Ayurveda. Whereas Yoga and Naturopathy are clustering with Ayurveda in value terms, this event significantly suggests that CAPI values of the mentioned system are not notably different from Ayurveda.

AYUSH systems for the same ailment. For anorectal type disorder, Naturopathy shows the largest CAPI, due to low-cost burden. This result exhibits that nutritional and dietary management, with lifestyle enrichment, may give more economically efficient treatment than huge cost interventions for fistula, piles, and other types of ailments. For Cancer-oriented ailments, Ayurveda exhibits the largest utilisation. Due to high cost (₹ 2075) magnitude for Ayurveda utilisation, its capture lower CAPI. For treatment purposes of these types of disease, recipients of care may choose therapeutically oriented utilisation. Yoga captures the highest CAPI for treatment of cardiovascular type diseases, maybe because of low care-related costs. Yoga-based treatment for cardio-vascular type diseases may be beneficial for long-term treatment with economically efficient costs. Unani captures high CAPI with low expenditure for cosmetics-related ailments like hair, skin, beauty, etc.

Table 1. System-level comparison of AYUSH users, Mean Cost Intensity, Mean CAPI

System of Medicine	Total Users	Mean Cost Intensity	Mean CAPI
Unani	1909926	708.772273	0.103082
Ayurveda	16029055	699.026522	0.002076
Yoga	792339	48.411364	0.002026
Naturopathy	4991049	201.715652	0.001989
Homoeopathy	3407214	751.293478	0.000553
Siddha	150765	828.392632	0.000094
Sowa-Rigpa	72804	552.341053	0.000013

(Source: Authors calculation from the NSS 79th round data on AYUSH)

Table 2. Robustness Analysis

System of Medicine	Bootstrapped Mean (95%CI)	Probability (Rank1)	Mean CAPI (After excluding Zero-Cost)
Unani	0.105381(0.005690-0.324832)	0.994000	0.103082
Ayurveda	0.002069(0.001339-0.002942)	0.002000	0.002076
Yoga	0.002042(0.001119-0.003032)	0.002000	0.002026
Naturopathy	0.001999(0.001245-0.003233)	0.002000	0.001989
Homoeopathy	0.000552(0.000284-0.001004)	0.000000	0.000553
Siddha	0.000094(0.000012-0.000253)	0.000000	0.000094
Sowa-Rigpa	0.000013(0.000008-0.000019)	0.000000	0.000013

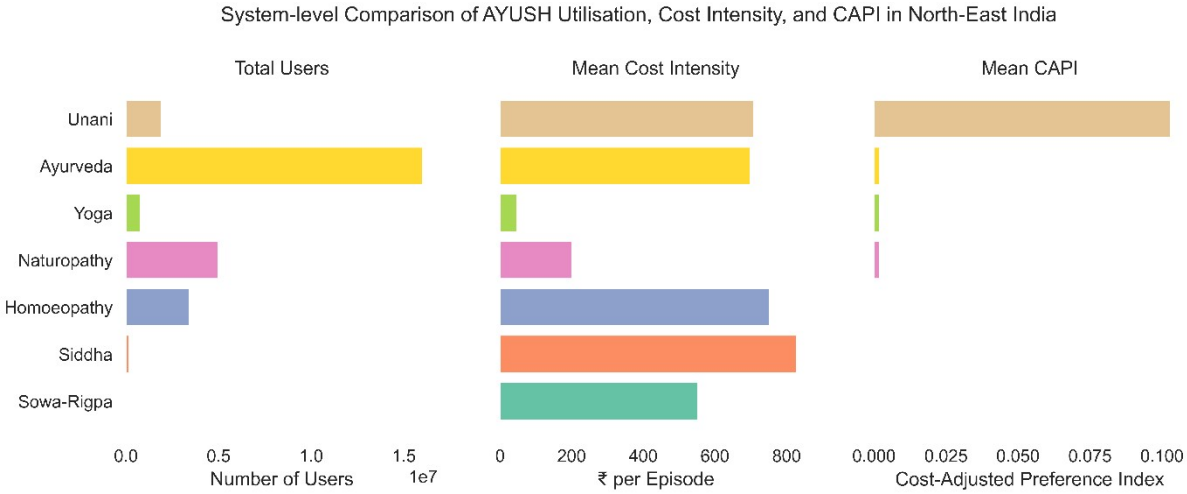

Fig. 2. System-level Comparison of AYUSH Utilisation, Cost Intensity, and CAPI (Source: Authors calculation from the NSS 79th round data on AYUSH)

DISCUSSION

In the acute type conditions, Ayurveda captures the highest share of utilisation. It may exhibit large accessibility of this system. CAPI of Ayurveda is nearly matched with the CAPI of Naturopathy and Yoga. Yoga has a small preference share of nearly 2.7 per cent, but its CAPI (0.001244) showed high economic efficiency because of minimal expenditure per user, in acute type ailments like pain, spine disc disorders, etc. This significantly shows that minimal cost and non-biomedical type measures properly give differential utilisation for acute type ailments. The summation of D_{js}across a particular systemexceeds D_j, maybe because individuals utilise multiple

Naturopathy and Unani capture good CAPI for the treatment of dental-related ailments. Unani exhibits high CAPI (0.04203). It may suggest that lower expenditure for dental care is given through community-based traditional practices. For ophthalmic and ENT-based ailments, Yoga captures the highest CAPI. Ayurveda takes a significant position on female reproductive ailments. Naturopathy and Yoga take higher CAPIs. Yoga treatment of female reproductive health ailments takes minimal costs with supportive lifestyle-oriented therapies. With low-cost effect, Unani records maximum CAPI for gastrointestinal disorders and immune boosting. Naturopathy also takes a good position for gastrointestinal disorders and immune boosting. This signifies that lifestyle-oriented healthcare management

and diet-based treatment deliver higher economic stability for the mentioned ailments. For genitourinary ailments, Yoga takes higher CAPI, and for geriatric problems, Ayurveda and Homoeopathy achieve high CAPI. The mentioned zero-cost figure may exhibit subsidised free treatment or limitation of reporting. Naturopathy captures high CAPI for Hepato-biliary ailments, maybe because patients took Naturopathy for liver or metabolic type disorders through lifestyle-oriented enrichments with low-cost intensity. Ayurveda and Naturopathy took high CAPI for disorders like knee problems, spine disc problems, and musculoskeletal disorders. Physical therapy, movement-based therapy under Yoga and Naturopathy, offers economically efficient treatments for these types of disorders. For nervous system-related disorders, Ayurveda captures the majority of utilisation. Due to high cost-orientation, this system gives a significant CAPI. For neurological care, Yoga takes a low-cost orientation and gives a good CAPI (0.000565). Mainly, the obesity problem arises due to a lack of physical movement. Yoga is one of the important systems under the AYUSH healthcare system, which gives physical therapy and body-movement therapy at a low price. Maybe because of this reason, for the treatment of obesity, Yoga captures high CAPI. For bites, burn-type ailments, Unani captures high CAPI with low-cost intensity. For panchakarma and poorvakarma therapies, Naturopathy took high CAPI. Under metabolic type disorders, Yoga captures higher CAPI with low-cost interventions. This type of AYUSH system gives long-term treatment with minimum-cost intensity for diabetes and thyroid-type ailments. For psychiatric care, due to very low-cost intensity, Unani takes a high CAPI. The homoeopathy system takes a high cost for psychiatric treatment, maybe because of the large scalability of mental health treatment. Unani and Naturopathy exhibit high CAPI for respiratory-oriented diseases. These results may focus on a preventive and holistic perspective for respiratory disease treatment by the mentioned systems.

To evaluate the statistical stability of the CAPI, a non-parametric bootstrap resampling (2000 iterations) was conducted to create 95% confidence intervals. Unani's bootstrapped mean (0.1054) is closely related to the original CAPI. The wide confidence intervals (0.0057-0.3248) of Unani significantly suggest high variability in ailment-level utilisation intensity. Moreover, this high CAPI is not estimation bias and reflects the original engagement of demand relative to cost. This robustness check also confirms that Ayurveda, Yoga and Naturopathy have narrow confidence intervals with significant stable estimates. Siddha and Sowa-Rigpa exhibited low variability with a low index value. Bootstrap ranking probabilities across 2000 samples were conducted for another stability check. The highest stimulation score is around 99.4% for Unani, significantly indicating dominance in CAPI.Another sensitivity test was conducted for re-estimation of system-level CAPI values after omitting the zero-cost figure which may exhibits subsidised free treatment or limitation of reporting. The results also exhibit that the resulting mean estimates remained stable across all AYUSH systems. These results signify that the identified variation in demand-cost coherence suggests systemic utilisation structure instead of price distortions. By this study, it is confirmed that Ayurveda creates a strong and significant position under AYUSH healthcare utilisation in North-East India. With mean cost intensity (₹ 699), this system takes mean CAPI (0.00208). This result significantly suggests that Ayurveda works as a fair cost-adjusted system for different ailments when preference share is guided by cost intensity. Yoga shows the lowest mean cost intensity, and it captures the mean CAPI of 0.00203, quite similar to Ayurveda. This result exhibits that Yoga performs in economically efficient manners for lifestyle enrichment, different disease treatment management, and preventive healthcare management in North-East India. Naturopathy system is utilised by nearly 5 million individuals in this region and it capture mean CAPI of 0.00199. Unani capture means CAPI (0.103); this result exhibits that Unani gives the highest utilisation intensity per unit of cost. Homoeopathy exhibits a mean cost intensity of ₹ 751 with a mean CAPI of 0.00055. Lower mean CAPI for Siddha and Sowa-Rigpa reflects its culturally restricted usage in this region and may lack specialised practice.

CONCLUSION

This study expands the empirical evaluation of AYUSH systems by incorporating Cost-Adjusted Preference Index (CAPI) in North-East India. CAPI developed with preference share and cost intensity. Results also exhibit that utilisation dominance and economic efficiency are not similar. Ayurveda capture a larger user base, but it creates a fairly moderate CAPI. Meanwhile, Yoga and Naturopathy persistently administer substantially higher cost-adjusted performance. Under the all-AYUSH systems, Unani shows a significantly efficient outcome, with low-cost intensity in specific service domains. For lifestyle-related, under chronic conditions, ENT-specific, cardio-vascular related ailments, Yoga and Naturopathy create higher cost-adjusted efficiency. Meanwhile, Unani shows better efficiency for cosmetic, dental-related problems, immune-boosting care and gastrointestinal problems. Evidence of this study suggests that utilisation of AYUSH systems in North-East India is heterogeneous and economically skewed. Universal health coverage (UHC) focuses not only on proper healthcare service availability but also efficient utilisation of healthcare resources and financial protection. The result from the CAPI said that Yoga and Naturopathy offer high utilisation with minimum cost, marked them with the UHC goal specifically for musculoskeletal, chronic diseases, metabolic ailments and aligned Unani systems with immune care, dental, cosmetic, respiratory ailments, etc. Whereas, high-cost systems with minimum CAPI of Siddha, Sowa-Rigpa require proper supply-chain enhancement, improvements of cost audits and standard treatment protocol. These measures may quantify economic viability with cost-demand coherence for Siddha and Sowa-Rigpa systems. Inclusion of public health insurance in AYUSH healthcare systems to incentivise high-CAPI service for chronic diseases magnifies low-cost therapeutic alternatives compared to other biomedical treatments. This policy measure may align with the key principle of "SDG 3-Leave No One Behind". Moreover, these policy measures may benefit low-income households and enhance utilisation of AYUSH systems where limited biomedical infrastructure is present. The evidence of this study significantly implies that volume-based proliferation to value-based incorporation of AYUSH within India's healthcare system. By allocating funds to systems with strong demand-cost congruence, policymakers can intensify allocative efficiency, scale up affordable curative and preventive care, and diminish disease burden. Hence, CAPI can work as an auxiliary health-economic monitoring tool for appraising progress towards SDG, specifically target SDG 3.8.1 (Service Coverage) and SDG 3.8.2 (Financial Protection).

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