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1953. Impact of Baseline Nutritional Status on Tuberculosis Severity in India: a multicenter prospective cohort analysis

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Background. India bears a quarter of the global tuberculosis (TB) burden. Previous studies have shown that more than 50% of persons with TB in India are undernourished and that undernutrition is associated with increased risk of unfavorable TB outcomes and mortality. The effect of nutritional status may be explained by its effect on other factors associated with poor outcomes. In this study, we assessed the impact of undernutrition at TB detection on markers of TB severity.

Table 1. Characteristics of participants by markers of tuberculosis (TB) severity

Characteristics	Cavitation (n, %)		Percentage of lung affected (mean, sd) ¹	Sputum smear positivity (n, %)		MGIT TTP ² (weeks) (mean, sd)
	Yes N=1100	No N=874		Yes N=1384	No N=1265	
Age category						
18-29 years	279 (26.0)	221 (25.8)	26.7 (19.0)	225 (16.6)	325 (26.1)	1.49 (0.73)
30-39 years	238 (22.2)	194 (22.7)	28.3 (18.1)	294 (21.7)	270 (21.7)	1.33 (0.64)
40-49 years	290 (27.1)	247 (28.9)	30.4 (17.9)	411 (30.3)	343 (27.6)	1.23 (0.62)
50-59 years	187 (17.4)	151 (17.7)	31.2 (18.1)	299 (22.1)	209 (16.8)	1.26 (0.64)
60-69 years	62 (5.8)	37 (4.3)	30.7 (16.1)	105 (7.7)	81 (6.5)	1.38 (0.83)
70-82 years	16 (1.5)	5 (0.6)	30.4 (19.5)	22 (1.6)	16 (1.3)	1.45 (0.97)
Sex						
Male	804 (73.1)	582 (66.6)	30.4 (18.2)	1087 (78.5)	875 (69.2)	1.32 (0.69)
Female	296 (26.9)	292 (33.4)	25.8 (18.0)	297 (21.5)	389 (30.8)	1.40 (0.70)
Income						
<3000 Rs ³	73 (7.4)	36 (4.8)	35 (21.5)	126 (9.8)	75 (6.5)	1.23 (0.63)
3000-5000 Rs	222 (22.4)	79 (10.5)	30.3 (16.5)	390 (30.3)	224 (19.5)	1.29 (0.63)
5001-10000 Rs	377 (38.1)	289 (38.3)	28.0 (16.7)	484 (37.6)	435 (37.9)	1.38 (0.77)
>10000 Rs	317 (32.1)	350 (46.4)	27.6 (19.4)	286 (22.2)	415 (36.1)	1.36 (0.63)
Baseline BMI						
<17 kg/m ²	475 (43.9)	231 (26.6)	34.2 (18.5)	604 (44.1)	425 (33.9)	1.36 (0.76)
≥17 kg/m ²	607 (56.1)	639 (73.4)	25.8 (17.5)	766 (55.9)	828 (66.1)	1.32 (0.63)
Smoking						
Ever	422 (38.4)	291 (33.3)	31.6 (17.5)	685 (49.5)	437 (34.6)	1.24 (0.66)
Never	677 (61.6)	583 (66.7)	27.6 (18.5)	698 (50.5)	827 (65.4)	1.41 (0.71)
Alcohol misuse						
Yes	244 (22.2)	150 (17.2)	32.8 (19.4)	200 (14.5)	191 (15.1)	1.29 (0.62)
No	856 (77.8)	724 (82.8)	27.7 (17.7)	1184 (85.5)	1074 (84.9)	1.35 (0.70)
Diabetes						
Yes	363 (33.3)	327 (37.5)	28.1 (14.7)	484 (35.3)	417 (33.0)	1.29 (0.64)
No	727 (66.7)	544 (62.5)	29.4 (19.6)	889 (64.7)	845 (67.0)	1.36 (0.71)
HIV						
Yes	16 (1.5)	34 (3.9)	28.9 (23.2)	7 (0.5)	49 (3.9)	1.54 (0.78)
No	1084 (98.5)	840 (96.1)	28.9 (18.1)	1377 (99.5)	1216 (96.1)	1.34 (0.69)

1. sd = standard deviation

2. MGIT TTP = Mycobacteria Growth Indicator Tube time to positive

3. Rs = Rupees

Methods. We analyzed prospectively collected data for persons with TB aged ≥ 18 years from five Regional Prospective Observational Research for Tuberculosis (RePORT) - India sites. We built multivariable regression models to assess relationships between undernutrition at TB detection (baseline body mass index (BMI), kg/m²) and markers of severity. We used logistic regression for lung cavitation and high-grade sputum smear positivity (defined as smear grade ≥ 2+), and linear regression for percentage of lung affected and time to positivity of Mycobacteria Growth Indicator Tube (MGIT; weeks). The models included age, sex, symptom duration a priori and all variables with p < 0.2 in univariate analysis.

Results. We had baseline BMI on 2898 persons with TB and 1132 (39.06%) of participants had moderate-severe undernutrition (BMI < 17 kg/m²) at treatment initiation. After adjusting for age, sex, symptom duration, income, HIV status, diabetes, smoking, and alcohol misuse (defined as having an AUDIT-c score ≥ 3 for females

and ≥ 4 for males), baseline BMI < 17 kg/m² was associated with increased odds of lung cavitation (aOR 1.67, 95% confidence interval [CI]: 1.32, 2.10), increased odds of high bacillary sputum grade (aOR 1.33, 95%CI: 1.12, 1.60), an average 7.13% (95%CI: 5.11, 9.16) more lung affected, and an average 0.045 (95%CI: -0.024, 0.11) longer time to liquid culture positivity.

Table2. Univariate predictors of cavitation, relative percentage of lung affected, sputum smear positivity, and mycobacterial burden, India

	Univariate OR for cavitation (95% CI)	Univariate relative percentage of lung affected (95% CI)	Univariate OR for sputum smear positivity (95% CI)	Univariate relative time of MGIT TTP (week) (95% CI)
Baseline BMI				
BMI < 17 kg/m ²	2.16 (1.79, 2.63) p=0.0001	8.41 (6.60, 10.22) p<0.0001	1.54 (1.31, 1.80) p<0.0001	0.042 (-0.020, 0.103) p=0.18
BMI $\geq$ 17 kg/m ²	Ref	Ref	Ref	Ref
Age (years)	1.00 (0.99, 1.01) p=0.89	0.11 (0.065, 0.19) p<0.0001	1.01 (1.01, 1.02) p<0.0001	-0.0048 (-0.0069, -0.0027) p<0.0001
Sex				
Male	1.36 (1.12, 1.65) p=0.0018	4.59 (2.70, 6.48) p<0.0001	1.63 (1.37, 1.94) p<0.0001	-0.081 (-0.13, -0.032) p=0.002
Female	Ref	Ref	Ref	Ref
Symptom Duration (month)	0.96 (0.94, 0.98) p=0.00026	0.32 (0.12, 0.52) p=0.0018	0.94 (0.92, 0.96) p<0.0001	0.0032 (-0.0050, 0.011) p=0.45
Income				
<3000 Rs	Ref	Ref	Ref	Ref
3000-5000 Rs	1.39 (0.86, 2.22) p=0.18	-4.75 (-8.97, -0.52) p=0.028	1.04 (0.74, 1.44) p=0.83	0.062 (-0.056, 0.18) p=0.31
5001-10000 Rs	0.64 (0.42, 0.98) p=0.043	-7.02 (-10.36, -3.67) p=0.00003	0.66 (0.48, 0.90) p=0.010	0.16 (0.042, 0.27) p=0.0073
>10000 Rs	0.45 (0.29, 0.68) p=0.00022	-7.45 (-11.42, -3.48) p=0.00024	0.41 (0.30, 0.57) p<0.0001	0.13 (0.0063, 0.25) p=0.039
HIV				
Yes	0.36 (0.19, 0.65) p=0.001	-0.0051 (-5.21, 5.20) p=0.998	0.13 (0.05, 0.26) p<0.0001	0.20 (-0.067, 0.47) p=0.14
No	Ref	Ref	Ref	Ref
Diabetes				
Yes	0.83 (0.69, 1.00) p=0.051	-1.32 (-3.27, 0.64) p=0.19	1.10 (0.94, 1.30) p=0.23	-0.074 (-0.14, -0.0072) p=0.03
No	Ref	Ref	Ref	Ref
Smoking				
Non-smoker	Ref	Ref	Ref	Ref
Current-smoker	1.25 (1.04, 1.5) p=0.020	4.03 (2.16, 5.89) p<0.0001	1.86 (1.59, 2.17) p<0.0001	-0.18 (-0.24, -0.12) p<0.0001
Alcohol Misuse				
Yes	1.38 (1.10, 1.73) p=0.0057	5.09 (3.03, 7.15) p<0.0001	0.95 (0.77, 1.18) p=0.64	-0.057 (-0.14, 0.027) p=0.18
No	Ref	Ref	Ref	Ref

1. MGIT TTP = Mycobacteria Growth Indicator Tube time to positive
2. Rs = Rupees

Table3. Multivariable models of the effect of body mass index (BMI) on cavitation, percentage of lung affected, sputum smear positivity, and mycobacterial burden, India

	Cavitation		Lung affected (%)		Sputum smear positivity		MGIT (TTP) (week)	
	aOR ¹ (95%CI)	p-value	Relative Percentage ² (95%CI)	p-value	aOR ³ (95%CI)	p-value	Relative time to positive ⁴ (95%CI)	p-value
Baseline BMI								
Baseline BMI < 17 kg/m ²	1.67 (1.32, 2.10)	<0.0001	7.13 (5.11, 9.16)	<0.0001	1.33 (1.12, 1.60)	0.0018	0.045 (-0.024, 0.11)	0.20
Baseline BMI $\geq$ 17 kg/m ²	Ref		Ref		Ref		Ref	

1. The adjusted odds ratio (aOR) is adjusted for age, sex, symptom duration, income, HIV, diabetes, smoking, and alcohol misuse
2. The adjusted relative percentage is adjusted for age, sex, symptom duration, income, diabetes, smoking, and alcohol misuse
3. The adjusted odds ratio (aOR) is adjusted for age, sex, symptom duration, income, HIV, and smoking
4. The adjusted relative time to positivity is adjusted for age, sex, symptom duration, income, HIV, diabetes, smoking, and alcohol misuse

Conclusion. To our knowledge, this is the largest prospective cohort study evaluating the association between undernutrition and markers of TB severity. While our analysis cannot account for the bidirectional relationship between TB disease and nutritional status, it does highlight the impact of systematic nutritional assessment in persons with TB.

Disclosures. Devasahayam J. Christopher, DNB, FRCP, Abbot, India: Honoraria| Astra Zeneca: Honoraria|Cipla, India: Honoraria|JB Chemicals: Honoraria|Lupin pharmaceuticals: Honoraria|Pfizer: Honoraria|Zydus Cadila: Honoraria