Vitamin D deficiency and its associated factors in active TB patients at a tertiary hospital and three primary health care level facilities in Lusaka, Zambia

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Outline

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Introduction

- Vitamin D is a fat-soluble vitamin involved in calcium metabolism[1]
- Vitamin D deficiency (VDD) is principally caused by a lack of food sources or a reduction in sunlight exposure[2]
- VDD is classically associated with bone disorders[3]
- However, VDD been linked to increased susceptibility to TB[4]
- Prevalence of VDD among TB patients and its associated factors in Zambia unknown

1.Lips P. Vitamin D physiology. Prog Biophys Mol Biol. 2006 Sep;92(1):4-8. doi: 10.1016/j.pbiomolbio.2006.02.016. Epub 2006 Feb 28. PMID: 16563471.
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Literature Review

Author & Year	Study Design	Location	Main Findings
Huang et al (2016)	Met analysis	China (25 studies with 3,599 TB cases and 3063 controls)	Lower vitamin D levels was found in TB patients as compared to controls
Saturia et al (2014)	Systematic Review	USA (7 studies with 6,553 subjects)	Supplementation with vitamin D leads to better clinical outcomes in TB patients
Talat et al (2010)	Cohort	Pakistan (129 cases)	VDD deficiency was associated with increased risk for progression to TB

Literature Review cnt'd

Author & Year	Study Design	Location	Main Findings
Workineh et al (2017)	Comparative Cross Sectional Study	Ethiopia (126 cases,57 household contacts,70 community controls)	Vitamin D levels in TB patients were lower than community controls and household contacts, Prevalence of vitamin D deficiency was higher in TB patients (83.3%) than in community controls (67.1%) ($p < 0.01$)
Owolabi et al. (2016)	Matched Case-Control	Gambia (83 TB cases,98 controls)	25(OH) D levels are higher in serum of TB progressors and those with active disease compared to latently infected and uninfected subject
Banda et al (2018)	Cross-sectional	Malawi (161 cases)	74% of TB patients with suboptimal Vitamin D status. Lower vitamin D levels associated with colder months of the year, alcohol intake and food insecurity.

Study Problem and Justification

- Zambia is one of the 30 high TB burden countries in the world[1]
- VDD associated with increased burden of TB[2]
- Level of VDD in Zambian TB patients and general population unknown
- Knowing the prevalence of vitamin D deficiency in our active TB patients:
  - Adding to the body of knowledge
  - Providing a platform for clinical trials

1.https://www.who.int/news/item/17-06-2021-who-releases-new-global-lists-of-high-burden-countries-for-tb-hiv-associated-tb-and-drug-resistant-tb
2. Talat N, Perry S, Parsonnet J, Dawood G, Hussain R. Vitamin d deficiency and tuberculosis progression. Emerg Infect Dis. 2010 May;16(5):853-5. doi: 10.3201/eid1605.091693. PMID: 20409383; PMCID: PMC2954005.

Research Question

What is the prevalence and associated factors of vitamin D deficiency in TB patients at the UTH - Adult Hospital and three first level hospitals in Lusaka in comparison to adults without TB from the general population?

Objectives

General Objective:

To determine the prevalence of VDD in TB patients versus vitamin D deficiency in matched non-TB adults from the general population

Specific Objectives:

To determine the factors associated with VDD in active TB patients in comparison to non-TB adults from the general population

To compare the clinical and radiological status of patients presenting with active TB, and their vitamin D levels

Methodology

- Study Design: Cross sectional analytical study
- Study Sites
    - University Teaching Hospitals-Adult Hospital
    - Kanyama First Level Hospital
    - Chawama First Level Hospital
    - Chipata First Level Hospital
- Study duration: May 2020 to November 2020
- Study population: Laboratory confirmed TB patients and matched non-TB adults from the general population Sample size was calculated at 150
    - 20% added to account for non respondence and missing data (180 participants)
- TB patients were sampled conveniently while comparison group was recruited after matching (sex, age, HIV-status)

Variables

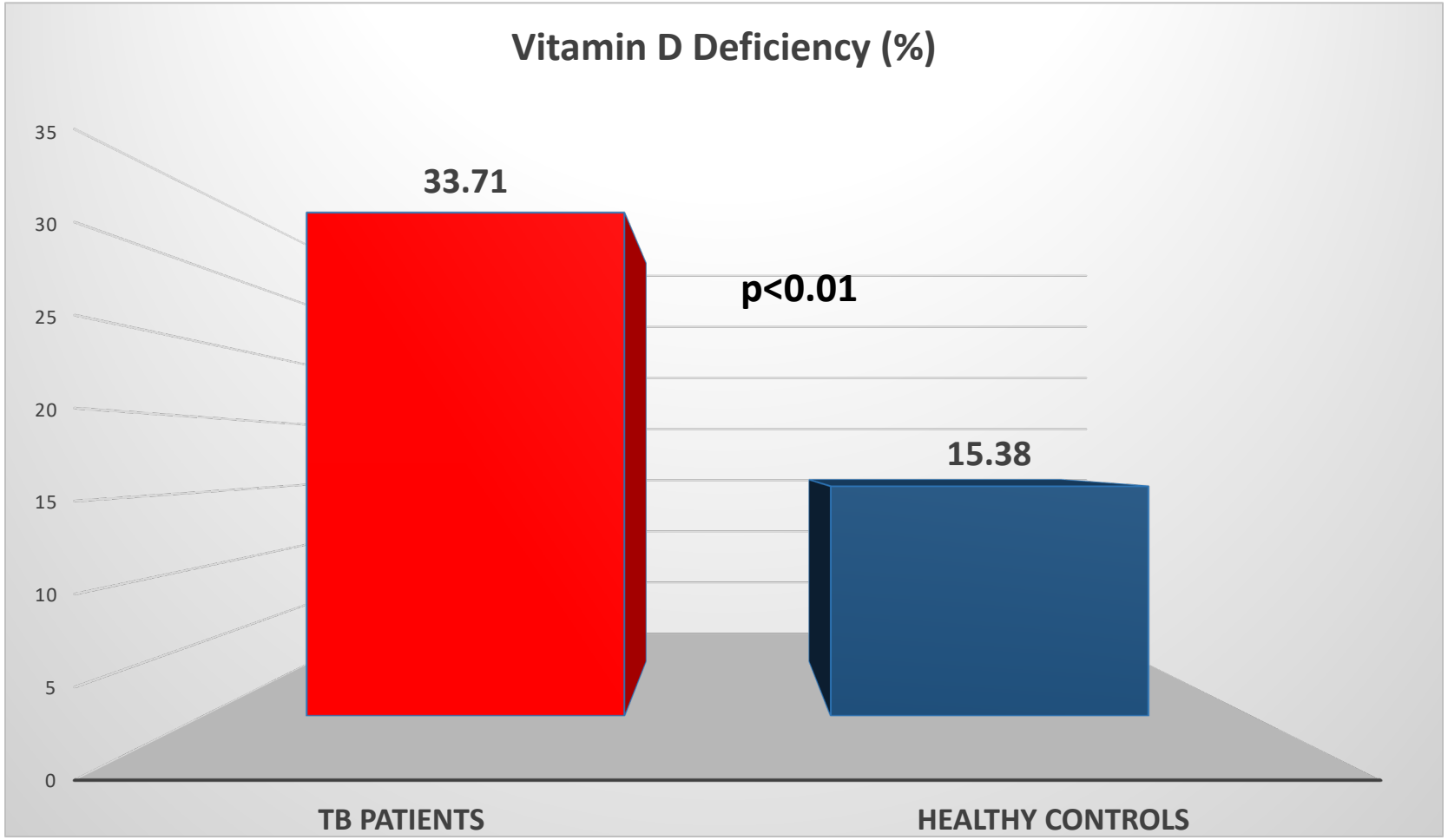
Independent variables	Scale of measurement	Dependent variable
Age	continuous	Vitamin D Status (as defined by the Endocrine Society)[1] • Deficiency (<30 ng/ml) • Non-Deficiency (≥30 ng/ml)
Gender	categorical	
Area of Residence	categorical	
HIV Status	categorical	
Sunlight exposure (hours)	continuous	
Alcohol	categorical	
BMI	categorical	
MUAC	categorical	
Overt Malnutrition	categorical	
TB I Score	continuous	
Karnofsky Performance Index	continuous	
Timika Chest X-ray Score	continuous	

1.Michael F. Holick and others, Evaluation, Treatment, and Prevention of Vitamin D Deficiency: an Endocrine Society Clinical Practice Guideline, The Journal of Clinical Endocrinology & Metabolism, Volume 96, Issue 7, 1 July 2011, Pages 1911–1930, https://doi.org/10.1210/jc.2011-0385

Baseline Characteristics

	TB patients		**Non-TB Adults**		**p-value**
	N (%) 89 (100)	Mean (+/-SD) Median (IQR)	N (%) 78 (100)	Mean (+/SD) Median (IQR)	
Male	69 (77.53)		57 (73.08)		0.51
Age		27.5 (24-38)		32 (25-37)	0.30
HIV positive	31 (34.83)		28 (35.90)		0.89
High Density Residence	70 (78.65)		26 (33.33)		**<0.01**
Sunlight Exposure (hrs)		1.5 [1-4]		2 [1-4]	0.38
Alcohol use	51 (57.30)		33 (42.31)		0.06
BMI (kg/m^2)		18.22 (±2.55)		23.1 (±3.74)	**<0.01**

Prevalence of Vitamin D Deficiency



Analysis of TB patients based on Vitamin D status

	VDD		**Non VDD**		**p-value**
	N(%) 30 (100)	Mean (±SD) Median (IQR)	N (%) 59 (100)	Mean (±SD) Median (IQR)	
Male	24 (80.00)		45(76.27)		0.69
Age		32 (28-38)		29 (25-37)	0.58
HIV positive	12 (40.00)		19 (32.20)		0.47
Symptom Duration		3 (2-12)		4 (3-9)	0.14
BMI <18.5	19 (63.33)		28 (47.46)		0.16
MUAC < 22cm	12 (40.00)		14(23.73)		0.11
O. Malnutrition	6 (20.00)		1(1.69)		**<0.01**
TB I Score		5.98 (± 2.17)		6.36 (± 2.17)	0.43
KPI		70 (60-80)		80 (70-90)	**0.01**
T. CXR Score		75 (45-115)		42.5 (20-75)	**0.01**

Logistic Regression for Associated Factors with Vitamin D Deficiency

Variable	COR	p-value	AOR	p-value
TB Status				
Non-Active TB	1		1	
Active TB	2.80 (1.31-5.96)	<0.01	2.27 (1.04-4.95)	**0.04**
Nutritional Status				
BMI				
>18.5	1		1	
<18.5	2.50 (1.20 -5.20)	0.01	1.34 (0.54- 3.29)	0.52
Overt Malnutrition				
No				
Yes	20.66 (2.4- 177.2)	<0.01	14.5 (1.65-126.97)	**0.02**

Discussion

- Prevalence of VDD of 33.71% in TB patients in our study
  - Higher than Nouri Vaskeh et al in Iran and Wejste et al in Guinea Bissau[1]
  - Lower than Ustianowski et al in London and Workineh et al in Ethiopia[2]
  - Possible explanations are variances in climate, cultural and dietary habits of the populations[2]
- VDD of 15.38% in our controls is at odds with findings by Jaimni et al in India and Taseem et al in Ethiopia[3]
  - Included some relatives of admitted patients as controls in their study

1.Nouri-Vaskeh M, Sadeghifard S, Saleh P, Farhadi J, Amraii M, Ansarin K. Vitamin D Deficiency among Patients with Tuberculosis: a Cross-Sectional Study in Iranian-Azari Population. Tanaffos. 2019 Jan;18(1):11-17. PMID: 31423135; PMCID: PMC6690331.
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3. Tessema, B., Moges, F., Habte, D. et al. Vitamin D deficiency among smear positive pulmonary tuberculosis patients and their tuberculosis negative household contacts in Northwest Ethiopia: a case–control study. Ann Clin Microbiol Antimicrob 16, 36 (2017). https://doi.org/10.1186/s12941-017-0211-3

Discussion cnt'd

- Association of VDD with TB in the study population which is in line with most literature[1]
- Link with overt malnutrition similar to findings by Meker et al.
  - TB and malnutrition have a bidirectional relationship
- VDD TB patients had a lower Karnofsky Performance index.
  - Implies a greater severity of illness which agrees with findings by Farazi et al[2]
- VDD TB patients had a higher extent of radiological damage in keeping with literature[3]

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Limitations

- Cross-Sectional Study so causation cannot be inferred
- Matching was not done for Social Economic Status
- Recruitment of participants in the cold months (June 2020 and July 2020) was hampered by the first COVID-19 wave

Conclusions

- A significant difference was found in the prevalence of vitamin D deficiency in active TB patients compared to a matched non-TB adults from the general population
- Vitamin D deficiency was associated with Active TB and under nutrition
- Vitamin D deficiency in Active TB was associated with more clinical and radiologically severe disease
- Findings warrant further studies in the role of vitamin D in TB in Zambia

Recommendations

- TB patients with undernutrition should be screened for vitamin D deficiency
- Vitamin D supplementation ought to be considered in TB patients especially those with under nutrition
- We suggest a larger longitudinal study to be done to look at vitamin D deficiency and vitamin D supplementation in TB patients and their close contacts

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“A journey of a thousand miles begins with a single step” – Lao Tzu