ORIGINAL RESEARCH LETTER

Random glucose sampling as screening tool for diabetes among disadvantaged tuberculosis patients residing in urban slums in India

To the Editor:

Noncommunicable diseases like diabetes are increasingly recognised as important risk factors for tuberculosis (TB) and poor treatment outcomes [1]. While the link between TB and diabetes was described many decades ago, several recent epidemiological studies and systematic reviews have confirmed the association of diabetes with a three-fold increased risk of developing TB [2]. Since 2011, the World Health Organization has recommended bidirectional screening of all TB patients for diabetes [3]. However, it is currently unclear at which point in treatment one should screen and which diagnostic tools should be used. Following the American Diabetes Association, diabetes is diagnosed by a fasting plasma glucose $\geqslant 7$ mmol·L^{-1}, a 2-h plasma glucose value $\geqslant 11.1$ mmol·L^{-1} during the oral glucose tolerance test, glycated haemoglobin (HbA1C) $\geqslant 48$ mmol·mol^{-1} or a random plasma glucose value $\geqslant 11.1$ mmol·L^{-1} in patients with classic symptoms of hyperglycaemia [4]. The Concurrent Tuberculosis and Diabetes Mellitus (TANDEM) consortium recently suggested a simplified two-step diagnostic algorithm where all patients with random plasma glucose levels >6.1 mmol·L^{-1} receive point-of-care HbA1C testing [4]. With laboratory-based HbA1C as the gold standard, this two-step combination resulted in a sensitivity and specificity of >90% to detect diabetes. Here, we evaluate the feasibility of diabetes screening by random glucose sampling among disadvantaged TB patients residing in urban slums in New Delhi, India.

India has the highest TB burden worldwide, with 1.9 million cases notified in 2017 and an incidence rate of 204 cases per 100 000 population [5]. Considering that an estimated 11% of urban and 3% of rural people above age 15 years have diabetes, the Revised National Tuberculosis Control Programme (RNTCP) of India recommends bidirectional screening as well as prioritised case finding among contacts with diabetes [6]. Diabetes screening among TB patients registered under the RNTCP yielded a prevalence of 11.9% [7]; however, no information is available on patients who are treated outside the RNTCP. Operation ASHA (OpASHA), a not-for-profit nongovernmental organisation (NGO) founded in 2006, is dedicated to bringing free TB treatment to disadvantaged patients in urban slums and poor rural communities that might otherwise not be able to seek treatment through private entities or the RNTCP. OpASHA currently serves 20 million people in six Indian states, in eight Cambodian provinces and in Afghanistan. They have a team of 292 field workers, 150 community partners and ~4000 village healthcare workers. A biometric attendance terminal is employed using fingerprints to identify patients and healthcare workers during treatment visits. Using an Android (Google LLC, Mountain View, CA, USA) application that features automated mobile telephone messaging to patients in case of missed visits as well as digitised records, OpASHA has markedly improved treatment adherence, with few missed doses among its patients. OpASHA-treated patients achieve high treatment outcomes with less initial treatment default than the national TB programme [8, 9].

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Recently, a two-step diagnostic algorithm to diagnose diabetes among TB patients was proposed comprising random glucose and point-of-care HbA1c. This study evaluates the first part of this algorithm among disadvantaged TB patients. http://ow.ly/UI7d30nK1UN

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TABLE 1 Descriptive statistics

Patient characteristics	Random plasma glucose			All patients
	⩽6.1 mmol·L^{-1}	>6.1–⩽11.1 mmol·L^{-1}	>11.1 mmol·L^{-1}	
Patients n	1437	270	66	1773
Age years median (IQR)	27*** (21–38)	42*** (30–50)	47.5*** (42–51)	30 (22–43)
Sex proportion				
Female	0.43#	0.41#	0.44#	0.43
Male	0.56#	0.59#	0.56#	0.57

In nine instances, the glucose results were excluded due to probably erroneous entries (>27.8 mmol·L^{-1}); for five entries, sex information was unavailable. The Wilcoxon signed-rank nonparametric test was used for the variables age and sex. IQR: interquartile range. #: nonsignificant; ***: p<0.001.

Here, we aimed to investigate the feasibility of random glucose sampling, the first step of the two-step diagnostic approach proposed by the TANDEM consortium, among this difficult-to-reach patient population. OpASHA initiated a pilot intervention in its TB treatment centres in East, West and South Delhi consisting of training staff to measure blood glucose and to provide appropriate diabetes counselling, as well as distribution of glucometers, and test kit supply and minor infrastructure investments. Glucometers were procured from Accu-Check (Glucometers, Active Test strips and retractable Uno Lancets; all Roche Diagnostics, Basel, Switzerland). Endocrinologists practicing in proximity to the Delhi slum areas agreed to manage patients diagnosed with possible diabetes. Patients who did not want to be tested for diabetes continued to receive TB treatment and care.

Between 2013 and 2015, a total of 1773 patients were screened for diabetes by trained OpASHA personnel (table 1). We identified a total of 336 (19%) patients with random glucose levels >6.1 mmol·L^{-1} who qualified to receive point-of-care HbA1c testing to confirm diabetes following the TANDEM two-step algorithm, which was, however, not available in the OpASHA treatment centres [4]. Among these patients, 66 (4% of total) were found to have diabetes based on glucose levels >11.1 mmol·L^{-1}. Of these 66 patients, 20 were known diabetics and already on treatment. The remaining patients were referred to one of the collaborating endocrinologists for further diagnostics and treatment. Increasing age was significantly associated with elevated glucose levels (table 1). Male sex was slightly overrepresented in our screening population but not linked to increased glucose values (table 1). Most of the screened TB patients were treated for pulmonary TB (68%). The majority (86.0%) of these were new diagnoses with the remaining being previously treated cases.

Our investigation shows that random glucose sampling is a feasible and simple tool to implement in resource-poor settings with disadvantaged communities once appropriate training of staff is achieved. We found high numbers of patients with elevated random glucose levels. However, to accurately diagnose diabetes in this setting and to follow the TANDEM diagnostic algorithm, local point-of-care HbA1c testing is indispensable and future efforts should focus on implementing this second step of the TANDEM approach in such settings. Limitations of this study include challenging data collection that resulted in missing data and incorrect data entry in a few cases. The voluntary nature of the glucose measurement could be subject to unaccounted selection bias. It is important to provide diabetes screening to all TB patients, notably vulnerable TB patients that reside in slums, villages and hard-to-reach areas that are not under treatment through a national TB programme. Both national programmes and NGOs caring for TB patients should therefore implement routine diabetes screening using random glucose sampling as a first step with point-of-care HbA1c as confirmation to identify undetected diabetes cases.

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References

1 Lönnroth K, Roglic G, Harries AD. Improving tuberculosis prevention and care through addressing the global diabetes epidemic: from evidence to policy and practice. *Lancet Diabetes Endocrinol* 2014; 2: 730–739.
2 Jeon CY, Murray MB. Diabetes mellitus increases the risk of active tuberculosis: a systematic review of 13 observational studies. *PLoS Med* 2008; 5: e152.
3 World Health Organization. Collaborative framework for care and control of tuberculosis and diabetes. Geneva, World Health Organization, 2011.
4 Grint D, Alisjhabana B, Ugarte-Gil C, *et al.* Accuracy of diabetes screening methods used for people with tuberculosis, Indonesia, Peru, Romania, South Africa. *Bull World Health Organ* 2018; 96: 738–749.
5 World Health Organization. WHO Tuberculosis Country Profile India. https://extranet.who.int/sree/Reports?op=Replet&name=%2FWHO_HQ_Reports%2FG2%2FPROD%2FEXT%2FTBCountryProfile&ISO2=IN&LAN=EN&outtype=html. Date last accessed: November 16, 2018.
6 Revised National Tuberculosis Control Programme. National Strategic Plan for Tuberculosis Elimination 2017–2025. New Delhi, Ministry of Health with Family Welfare, 2017.
7 Nagar V, Prasad P, Gour D, *et al.* Screening for diabetes among tuberculosis patients registered under revised national tuberculosis control program, Bhopal, India. *J Family Med Prim Care* 2018; 7: 1401–1405.
8 Jackson C, Stagg HR, Doshi A, *et al.* Tuberculosis treatment outcomes among disadvantaged patients in India. *Public Health Action* 2017; 7: 134–140.
9 Subbaraman R, Nathavitharana RR, Satyanarayana S, *et al.* The tuberculosis cascade of care in India's public sector: a systematic review and meta-analysis. *PLoS Med* 2016; 13: e1002149.