

## Protective effect of *yoga* against tuberculosis in people living with HIV

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The leading cause of death in people living with HIV (PLH) is tuberculosis. Since some studies report a beneficial effect of *yoga* on respiratory problems and considering that the first cause of death in PLH is tuberculosis we decide as the aim of this study: Analyzing the association of the practice of *yoga* and the incidence of tuberculosis in PLH. A sample of 195 PLH was invited to participate in this study. We only included people who reported performing *Asana*, *Pranayama* and *Asana-Pranayama* combinations. They were stratified according to *yogic* exercises and univariate logistic regression analysis was performed to model the relationship between *yogic* exercises and TB. We found a significant association between *yoga* and tuberculosis ( $p < 0.05$ ) the people who did not do *yogic* exercise the last 12 months seem to have been 2.24 times more likely to pulmonary TB within the last 12 months than those who did *yogic* exercise; i.e., a protective effect of *yoga* against TB in PLH (aOR = 0.44,  $p = 0.047$ ). When participants were stratified according to the *yogic* exercises it is shown that the protective effect is due to the practice of *pranayama* (aOR = 0.17,  $p = 0.004$ ). All the PLH were simultaneously receiving ART; thus, we conclude that the *yoga* practice has an adjuvant protective effect against TB in this PLH group.

**Keywords:** Protective effect, *Yoga*, Tuberculosis, HIV

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The Human Immunodeficiency Virus (HIV) is the causative agent of acquired immunodeficiency syndrome (AIDS)<sup>1</sup>. This virus is a retrovirus with a diameter of about 100 nanometers which mainly infects CD4 T lymphocytes in humans. HIV transmission occurs through unprotected sexual intercourse, through Sharps mainly by sharing syringes among injecting drug users and vertical transmission from a mother living with HIV to her child<sup>2,3</sup>.

The natural history of disease is characterized by acute HIV infection, where the person living with HIV (PLH) has symptoms similar to those of a strong flu, while CD4 T lymphocytes count fall and increases the viral load (HIV particles circulating in the blood of the PLH) resulting from the massive infection of lymphocytes. Later the body of the PLH controls and stabilizes the viral load and substantially

recovers its CD4 T lymphocytes count, after a period of time between 5 and 10 yrs viral load starts to rise and inversely down the count of CD4 T lymphocytes until lymphocyte count fall below 200 cells per milliliter of blood is when PLH has entered a stage of AIDS and is susceptible to opportunistic infections that can cause death<sup>2</sup>.

In Mexico HIV prevalence is estimated at approximately 0.22 % in people of all ages and major cities with more HIV cases are Veracruz, Tijuana and the metropolitan area of Mexico city. Once the PLH has developed AIDS the leading cause of death is Tuberculosis (TB), followed by infection with Cytomegalovirus and Toxoplasma<sup>4</sup>.

Tuberculosis is one of the leading causes of death worldwide. TB is a chronic infectious disease usually caused by *Mycobacterium* species, particularly *M. tuberculosis* in humans and *M. bovis* in animals, it is transmitted from the patient to a healthy subject by

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inhalation of infectious material or through ingestion of cow's milk contaminated, respectively<sup>5</sup>.

The World Health Organization (WHO) reports that between 2 and 3 billion of the world's population is infected with *Mycobacterium tuberculosis*<sup>6</sup>. In humans TB is transmitted through coughing aerosols from an infected person to a previously healthy patient. *Mycobacterium* is deposited in lower sections of the lungs where the immune response of an immune competent person leads to the formation of an inflammatory area for control or elimination of the *mycobacteria*; however, in some cases, particularly in immune compromised persons, infection will progress to the damage of lung tissue, the formation of cavities or spread of infection<sup>4,5</sup>. In recent decades this disease has been enhanced by the emergence of multi-drug-resistant (MDR) strains of *M. tuberculosis* and co-infection with HIV<sup>7,8</sup>.

TB was declared as a global health emergency by the WHO in 1994 that despite efforts in basic research and public health the number of cases continues to rise<sup>9</sup>; besides, the emergence of MDR strains complicate TB<sup>10</sup>. Since around a third of world population is infected by the causal agent of tuberculosis, *M. tuberculosis* should be transmitted through a good mechanism in order to reach this extraordinary prevalence.

Our research group has reported that PLH often resort to the use of traditional and complementary medicine (T & CM) to supplement anti-retroviral therapy (ART)<sup>11,12</sup>, in order to maintain and improve their health and quality of life, this T & CM includes: Medicinal plants, Homeopathy, Microdosis, Bach flowers and *yoga*<sup>11</sup>.

*Yoga* is known for its beneficial effects of physiologic and psychological functions, besides it improves the quality of life of people<sup>13</sup>. Only a few studies focus on the use of *yoga* in improving the efficacy of treatment in tuberculosis. However, we have the empirical report that PLH who does *yogic* exercises improves its quality of life, immunity and pulmonary function (unpublished information). Since some studies report a beneficial effect of *yoga* on respiratory problems; such as increasing muscular efficiency, endurance time, aerobic capacity, improvement of breathing and response to medication, e.g. as adjuvant therapy in asthma patients<sup>13-15</sup>, and considering both that the first cause of death in PLH is tuberculosis besides our expertise with PLH we decide as the aim of this study:

Analyzing the association of the practice of *yoga* and the incidence of tuberculosis in PLH.

## Materials and methods

### Participants

This work took place according to the Helsinki declaration. A sample (n = 195) of PLH were invited to participate in this study. Those who agreed to participate in this work said they understood the purpose of the study and signed the informed-consent, later a semi-structured interview was performed, in which knowledge addressed was: a) Sexual and reproductive health, b) Sexually transmitted infections, c) HIV and AIDS, d) ART, e) Communicable diseases [Tuberculosis, Cytomegalovirus, Toxoplasmosis, etc.] and e) Using of alternative treatments. The sampling method was convenience-method since this population is a group considered as one of difficult access. The PLH group was between 26 and 54 yrs old, middle socio-economic level, with access to ART and medical care in public institutions. All the participants were men.

### Yogic exercises

People who have made systematic *yoga* exercises for 30 min 3 times a week in the last 12 months were included. We only included people who reported performing *Asana*, *Pranayama* and *Asana-Pranayama* combinations, other exercises like *yoga nidra* and *mudra* were excluded for being low frequency of sessions per week and the low number of participants.

### Procedure

It was a multicenter cross-sectional retrospective study that involved the participation of 4 non-governmental organizations (NGO) of Mexico City. These NGOs develop projects in the following issues: Human rights and sexual & reproductive health. These NGOs have self-support groups for PLH, counseling and *yoga* workshops.

People were grouped into those who reported having had TB in the last 12 months (n = 40) or those who reported having not had TB in the last 12 months (n = 155) according to the answers reported in the semi-structured interview. Then they were stratified in three mutually exclusive categories: *Asanas* (n = 26), *Pranayama* (n = 21) and combination of *Asanas-Pranayama* (n = 23) according to the answers reported in the semi-structured interview (more detail is stated in the above "Yogic exercises" section).

**Ethical considerations**

This research was a multicenter cross-sectional retrospective observational study that involved the participation of 4 non-governmental organizations of Mexico City. None intervention beyond an interview was done with the participants; thus, a clinical trial registry was not solicited; instead of this the interview took place according to the Helsinki declaration.

**Statistical analysis**

The analyses were performed using SPSS 21 for Windows software package. Univariate logistic regression was performed to model the relationship between *yogic* exercises and TB in the last 12 months by the backward method and the adjusted odds ratio (aOR) with their respective confidence intervals were calculated (95 % CI). The  $\chi^2$  test was performed to assess whether the frequencies of the people in both study groups were produced with the same odds; Fisher test was performed to calculate the p value when an either observed or expected frequency was < 5. Poisson distribution was performed to calculate the p value of the observed frequencies between *yogic* exercises and TB. All tests with a significance level of  $p < 0.05$ .

**Results and discussion**

We found a high proportion of PLH who perform *yoga* exercises ~ 36 % in contrast with previous reports of PLH where we reported a proportion ~ 20 % of PLH who resorted to other complementary therapies (including *yogic* exercises)<sup>11</sup>; however, this time the PLH regularly attended NGOs where they make frequent use of counseling services, workshops of self support and *yogic* workshops allowing us to speculate that this particular population might be more committed with their physical or emotional well-being. We found as seen in Table 1 a significant

association between *yoga* and tuberculosis ( $p < 0.05$ ). The PLH who did not do *yogic* exercise the last 12 months seem to have been 2.24 times more likely to pulmonary TB within the last 12 months than those who did *yogic* exercise; i.e., a protective effect of *yoga* against TB in PLH (aOR=0.44,  $p=0.047$ ). When PLH were stratified according to the exercises it is shown that the protective effect is due to the practice of *pranayama* (aOR = 0.17,  $p = 0.004$ ) in the Fig. 1 is possible to observe that the frequencies of PLH doing *yogic* exercises is lower in the group of PLH with TB antecedent in the last 12 months, this particular distribution of frequencies is unlikely to occur at random according to poisson distribution (p values can be seen in Table 1). The exact mechanism of action of *yoga* against TB is unknown; but we postulate that a regular practice of *yoga* improves the immunity<sup>16</sup> and *pranayama* increase respiratory stamina and expand the lungs leading to an improvement in pulmonary functions<sup>15</sup> thus avoiding the TB development. In humans TB is transmitted through coughed-aerosols from an infected person to a previously healthy patient. *Mycobacterium* is deposited in lower sections of the lungs so an improvement in pulmonary function seems as a plausible explanation for the protective effect of *pranayama* against TB. In recent years, there have been developed some studies to evaluate the therapeutic benefit of *yoga* (physical, physiological, psychological and endocrine) for the sake of the health of people<sup>14,17</sup>. Minimal investment and, simplicity of implementation and the lack of side effects<sup>14</sup> make *yoga* practice an extraordinary adjuvant to improve the quality of life of the patients<sup>13</sup>. HIV infection continues affecting very

Table 1 — Univariate logistic regression analysis between *yogic* exercises and TB in the last 12 months

<i>Yogic</i> exercises	PLH with TB antecedent (Poisson distribution p value)	aOR (95 % CI)	P Value
<i>Pranayama</i> (n=21)	n=1 (<0.001)	0.17 (0.02-1.33)	0.004 <sup>b</sup>
<i>Asanas</i> (n=26)	n=5 (<0.001)	0.91 (0.32-2.58)	0.250 <sup>b</sup>
<i>Asanas-Pranayama</i> (n=23)	n=3 (<0.001)	0.54 (0.15-1.94)	0.091 <sup>b</sup>
Any (n=70)	n=9 (<0.001)	0.44 (0.19-1.00)	0.047 <sup>a</sup>
None (n=125)	n=31 (<0.001)	2.24 (1.00-5.02)	0.048 <sup>a</sup>

a)  $\chi^2$  Test, b) Fisher Test

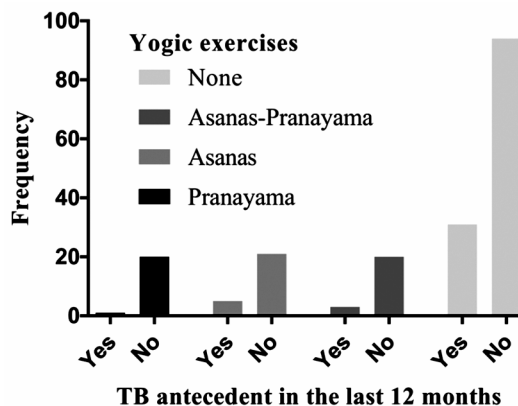


Fig. 1-PLH with and without TB antecedent stratified according to *yogic* exercises

specific groups of the world population (except in Africa where heterosexual population represents the major group of PLH), and are the most vulnerable groups: men who have sex with men (MSM), injecting drug users and sex workers<sup>18,19</sup>, therefore, it is not surprising that most PLH invited to participate were men, and as a result of the high proportion of men all participants in this study were only men.

### Conclusion

All the PLH were simultaneously receiving ART; thus, we conclude that the *yoga* practice has an adjuvant protective effect against TB in this PLH group. *Yoga* is a simple and inexpensive practice that can be easily adopted in most patients without any complication. It is noteworthy that within limitations of our work is that the information was self-reported by PLH.

### Conflicts of interest

The authors declare no conflict of interest.

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### Limitation of the study

Since this research was an observational cross-sectional study. The causality is not implied; i.e., there is no evidence that PLH can prevent tuberculosis by doing yogic exercises. A regular practice of *yoga* does improve the immunity and pulmonary function but it does not warranty the protective effect against TB.

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