Tuberculosis prevalence in renal transplant recipients: systematic review and meta-analysis

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ABSTRACT

Intruduction: Tuberculosis (TB) prevalence in subjects with kidney transplantation (KTX) is greater than in general population. We aimed to realize a systematic review and meta-analysis of prevalence of TB in KTX (TB-KTX). **Methods:** We searched by the texts in electronic databases and references were reviewed. We estimated the pooled prevalence of TB-KTX subjects and we also conducted analysis by meta-regression. TB prevalence in general population (0.18%; 95% IC = 0.16-0.20) was reference to comparison. **Results:** We screened 253 papers, which 41 studies entered in analysis. The pooled prevalence of TB-KTX was 2.51% (95% CI = 2.17-2.85). In the meta-regression sample size > 2.501 subjects and high prevalence of TB in general population remained associated with TB-KTX. **Conclusion:** TB prevalence in KTX was 14 times greater than in general population. Thus, we highlighted the necessity that planning of measures for prevention and control of TB for this population should be agenda in discussions of health sector.

Keywords: kidney transplantation; meta-analysis; prevalence; tuberculosis.

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INTRODUCTION

In the last decades, chronic diseases have gained the attention of the scientific community and society in general. Technological development has helped elucidate the pathophysiology and the risk factors connected to many chronic ailments, in addition to allowing the introduction of diagnostic methods, treatment modes, and prevention strategies. However, reductions on the number of new cases of disease did not occur at the same pace of such developments.[1,2] This fact, when considered in conjunction with increases in life expectancy, brings about a new context in which two or more diseases coexist in one individual.[3]

Tuberculosis (TB) is an infectious disease described in humans since classical antiquity, whose detection and treatment are subjects of the interest of health care workers. Yet, it remains today as a public health issue, particularly in developing countries.[4-6]

Additionally, in the specific case of subjects with AIDS, problems with alcohol abuse, malignant diseases, and on immunosuppressants - as organ transplant patients, the risk of developing TB is increased.[5] Thus, the prevalence of TB among individuals submitted to organ transplants is higher than in the general population.[7] The prevalence of TB is determined mainly by the epidemiological risk of each country, and has been estimated to be 37 times higher among kidney transplant patients than in the general population living in endemic areas.7-9 This systematic review and meta-analysis aimed to assess the prevalence of tuberculosis in renal transplant patients.

METHOD

The following search strategy was adopted to find studies on the prevalence of TB in individuals submitted to kidney transplant: databases

MedLine and LILACS were searched for papers published between January of 2000 and December of 2011 with the following string: tuberculosis AND kidney transplantation (term "Medical Subject Headings" (MESH) and free text) for MedLine; and '*tuberculose E transplante renal*' (term '*Descritores em Ciências da Saúde*' (DeCS) and words) on LILACS. No restrictions were applied to the languages in which the studies were written.

The references of the selected papers were also reviewed.

Studies including only individuals under the age of 18 years, patients managed with renal replacement therapies (RRT) other than kidney transplantation, and subjects who had other organ transplants were excluded.

The search and selection of papers was carried out by two reviewers and differences of opinion were resolved by a third reviewer. Figure 1 describes the number of included papers in each step of the selection process:

- 1st step: papers listed in search results were reviewed for duplicates and organized by a reviewer (R.B.);
- 2nd step: two reviewers (R.B. and G.T.) independently analyzed the titles of the papers and excluded the studies meeting the exclusion criteria described above (non-original papers or studies enrolling only subjects under the age of 18 years, individuals on RRT other than kidney transplant, and subjects who had other organ transplants);
- 3rd step: two reviewers (R.B. and G.T.) independently analyzed the abstracts of the papers selected after the second step and excluded the ones not mentioning descriptions of characteristics/adverse events experienced by the studied population after kidney transplantation. Disagreements between the two reviewers were resolved by a third reviewer (M.E.);
- 4th step: the papers selected on the third step were retrieved and reviewed independently (R.B. and G.T.). Papers reporting prevalence of TB in individuals submitted to kidney transplants and studies reporting data that allowed the calculation of prevalence rates were selected. Disagreements between the two reviewers were resolved by a third reviewer (M.E.).

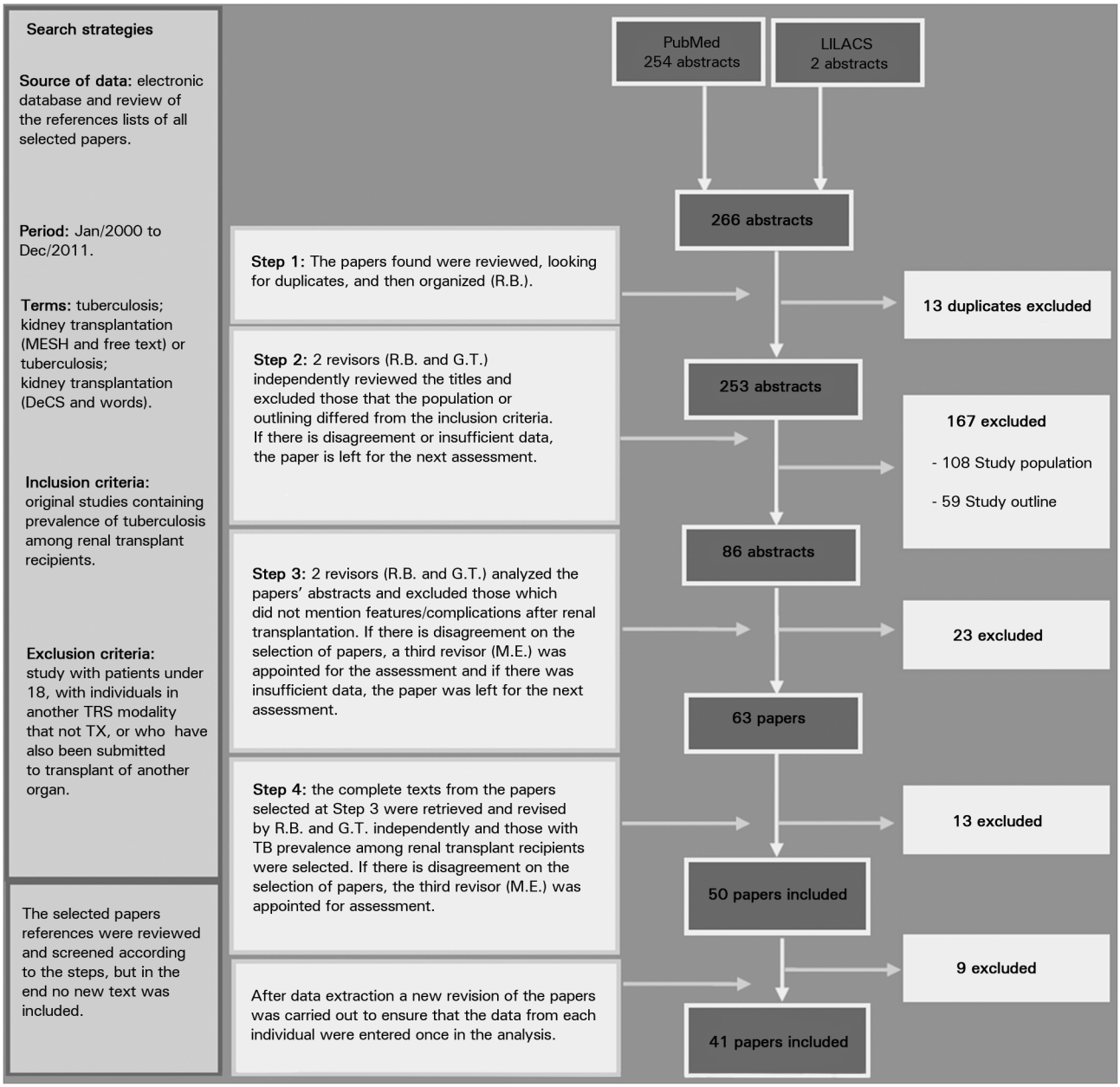
The references of the papers selected on the fourth step were reviewed, and studies featuring keywords tuberculosis, kidney transplantation, tuberculosis, renal transplant were screened based on the steps described above.

A protocol was defined to extract data from the full texts of the papers. Data extraction was performed by two reviewers (R.B. and G.T.) and disagreements were resolved by a third reviewer (M.E.). The following data were extracted: year of publication; period of data collection; site where study was carried out; study design; data sources; number of centers included; sample size; number of cases of TB and/or prevalence of TB. The prevalence of tuberculosis in the population in general of each country represented in the review was obtained from the registers of the World Health Organization (WHO).[4] The authors of the selected studies did not have to be contacted for additional information.

Studies using the following criteria to diagnose TB were included: demonstration of alcohol-acid resistant bacilli (AARB) in individuals with suspected disease; growth of bacilli in culture samples; histopathology tests showing AARB or granulomatous inflammation; satisfactory response to treatment in patients with typical findings in imaging or fever of unknown origin with negative results in other tests. No distinctions were made between the clinical manifestations of TB in the studies. Individuals with pulmonary, extra pulmonary, and concomitant pulmonary and extra pulmonary tuberculosis were included.

Case-control studies were not excluded from this review, as they presented reference population data which enabled the calculation of prevalence rates. A study10 described TB prevalences for two separate populations (individuals submitted to kidney transplant with registered live donor organs and illegally procured organs) and was thus included twice in the analysis.

Figure 1. Paper selection flowchart.



After data extraction, another review was carried out on the selected papers to make sure the data for each individual was included only once in the analysis.

The estimated global prevalence of TB was calculated using a fixed and a random model. When heterogeneity was statistically significant, the random model was used. Meta-regression was used to identify possible sources of heterogeneity between studies. Initially, univariate analysis was performed and all variables associated with TB prevalence rates in individuals submitted to kidney transplantation ($p \leq 0.2$) in univariate analysis were included in the final multivariate meta-regression model. Level of significance of was set at 5%.

Studies were divided into three groups based on the prevalence of TB in the general population of each country, as follows: high

prevalence countries (> 40/100,000), medium prevalence countries (20-40/100,000), and low prevalence countries (< 20/100,000).4 The combined TB prevalence rates in individuals submitted to renal transplant was also determined for each group of countries.

References were managed with the aid of software EndNote X4 and statistical analyses were carried out on STATA 11.0 (Stata Corp, College Station, Tex.).

This study was carried out as per the recommendations of the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) group.11

There were no conflicts of interest from the authors of this study. Permits from the Research Ethics Committee were not needed for this study, as it used data from previously published papers.

Results

A total of 253 papers published since 2000 were screened. Although the databases allowed searches for older papers, the authors opted to select papers published since 2000 because immunosuppressants still in use today were introduced then. After the initial assessment, 86 abstracts were analyzed, 63 full papers were read, and 41 were included in this systematic review, representing a population of 73,808 individuals (Figure 1). Ten other studies listed in the references of the selected papers were analyzed, but none was included in the review.

Chart 1 lists the papers selected in this meta-analysis.

Table 1 summarizes the main characteristics of the studies included in this review.

The combined prevalence of TB among individuals submitted to renal transplant was 2.51% (95% CI = 2.17-2.85) in the random model and heterogeneity between studies was statistically significant ($p \leq 0.001$).

Univariate analysis showed that the variables significantly correlated with differences in TB prevalence rates in individuals submitted to kidney transplants ($p < 0.2$) were year of publication, study design, sample size, use of secondary data source, and prevalence of TB in the general population. Therefore, these variables were included in the final meta-regression model, in which sample size > 2501 ($p = 0.011$) and high prevalence of TB in the general population ($p < 0.001$) sustained the association (Table 2).

Figure 2 shows the combined TB prevalence rates for individuals submitted to renal transplants based on the categorization of countries by prevalence of TB. This figure shows that in low prevalence countries the TB prevalence rate was 0.56% (95% CI = 0.40-0.73), in medium prevalence countries it was 2.61% (95% CI = 1.75-3.46), and in high prevalence countries the rate was 6.88% (95% CI = 5.11-8.65).

Discussion

This systematic review included observational studies on the prevalence of TB in individuals submitted to kidney transplants. Papers from different geographic areas were identified, including countries with high, medium, and low TB prevalence rates. Despite the greater number of studies conducted in high prevalence countries, possibly due to the higher risks of disease dissemination, there has been equal concern with describing the prevalence of TB in individuals submitted to renal transplants in countries with low and medium TB prevalence.[10,12-51]

The combined prevalence of TB in individuals submitted to kidney transplant of 2.51% (95% CI = 2.17-2.85) is 14 times greater than the prevalence rate of 0.18% (95% CI = 0.16-0.20)[4] seen in the general population. However, the analysis of countries with high TB prevalence rates revealed that the prevalence of TB in kidney transplant patients was 43 times greater than in the general population (6.88% *vs.* 0.16%,[4] respectively); in medium prevalence countries, the prevalence of TB in transplant patients was 83 times greater than in the general population (2.61% *vs.* 0.03%,[4]

Chart 1 List of papers selected for meta-analysis

Year	Authors	Country	Design	Sample	TB cases	PR
2009	Rizvi SA, *et al.*[10]	Pakistan	Prevalence	306	20	6.5%
2004	Agarwal SK, *et al.*[12]	India	Incidence	85	18	21.2%
2000	Apaydin S, *et al.*[13]	Turkey	Prevalence	274	16	5.8%
2005	Atasever A, *et al.*[14]	Turkey	Prevalence	443	20	4.5%
2008	Basiri A, *et al.*[15]	Iran	Prevalence	12820	44	0.3%
2000	Biz E, *et al.*[16]	Brazil	Prevalence	1264	30	2.4%
2011	Canet E, *et al.*[17]	France	Prevalence	16146	74	0.5%
2011	Rodrigo C, *et al.*[18]	Sri Lanka	Prevalence	43	5	11.6%
2006	Chen CH, *et al.*[19]	China	Prevalence	756	29	3.8%
2008	Chen SY, *et al.*[20]	China	Prevalence	2333	41	1.8%
2003	Dridi A, *et al.*[21]	Tunisia	Prevalence	368	5	1.3%
2003	el-Agroudy AE, *et al.*[22]	Egypt	Prevalence	1200	45	3.8%
2006	Ergun I, et al.[23]	Turkey	Prevalence	283	10	3.5%
2011	Ersan S, *et al.*[24]	Turkey	Prevalence	320	9	2.8%
2009	Garcia-Goez JF, *et al.*[25]	Spain	Prevalence	2766	13	0.5%
2009	Guida JP, *et al.*[26]	Brazil	Prevalence	1342	23	1.7%
2007	Hsu MS, *et al.*[27]	China	Prevalence	404	6	1.5%
2001	John GT, *et al.*[28]	India	Incidence	1251	166	13.3%
2004	Klote MM, *et al.*[29]	USA	Prevalence	15870	66	0.4%
2000	Koselj M, *et al.*[30]	Slovenia	Prevalence	273	8	2.9%
2001	Koseoglu F, *et al.*[31]	Turkey	Prevalence	935	19	2%
2001	Lezaic V, *et al.*[32]	Servia	Prevalence	511	16	3.1%
2004	Lui SL, *et al.*[33]	China	Prevalence	440	23	5.2%
2004	Matuck TA, *et al.*[34]	Brazil	Prevalence	982	44	4.5%
2002	Melchor JL, *et al.*[35]	Mexico	Prevalence	545	10	1.8%
2001	Naqvi A, *et al.*[36]	Pakistan	Prevalence	850	130	15.2%
2010	Naqvi R, *et al.*[37]	Pakistan	Incidence	388	17	4.4%
2002	Niewczas M, *et al.*[38]	Poland	Prevalence	1289	15	1.2%
2005	Prokopenko E, *et al.*[39]	Russia	Incidence	94	3	3.2%
2003	Queipo JA, *et al.*[40]	Spain	Prevalence	1261	20	1.6%
2007	Ram R, *et al.*[41]	India	Prevalence	202	27	13.4%
2008	Ruangkanchanasetr P, *et al.*[42]	Thailand	Prevalence	151	5	3.3%
2008	Rungruanghiranya S, *et al.*[43]	Thailand	Prevalence	270	9	3.8%
2007	Saber LT, *et al.*[44]	Brazil	Prevalence	103	2	1.9%
2000	Sharma AK, *et al.*[45]	India	Prevalence	163	21	13%
2008	Torres J, *et al.*[46]	Spain	Prevalence	2012	16	0.8%
2007	Tsai MK, *et al.*[47]	China	Incidence	30	2	6.7%
2000	Vachharajani T, *et al.*[48]	India	Prevalence	109	16	14.7%
2003	Vandermarliere A, *et al.*[49]	Belgium	Prevalence	2502	9	0.4%
2008	Zhang XF, *et al.*[50]	China	Prevalence	1947	25	1.3%
2008	Walsh R, *et al.*[51]	USA	Prevalence	477	2	0.4%

Table 1 Distribution of the main study characteristics

Variables	Number of studies
Year of publication (N = 41)	
2000-2005	21
2006-2011	20
Study period (N = 38)	
1970s, 1980s, 1990s, 2000s	1
1970s, 1980s, 1990s	1
1980s, 1990s, 2000s	12
1980s, 1990s	8
1990s, 2000s	8
1990s	4
2000s	4
Study design (N = 41)	
Prevalence study	36
Incidence study	5
Number of centers (N = 41)	
One center	35
Multiple centers	6
Sample size (N = 41)	
< 100	4
101-500	17
501-1000	6
1001-1500	6
1501-2000	1
2000-2500	4
> 2501	3
Secondary data source (41)	
No	8
Yes	33
Prevalence of TB in general population (N = 41)	
Low	9
Medium	14
High	18

respectively); in low prevalence countries, transplant patients had TB prevalence rates 56 greater than the general population (0.56% *vs.* 0.01%,[4] respectively). These findings were in agreement with previous population studies, but no papers were found to have carried out such global analysis.[7,8,52]

In meta-regression analysis, the prevalence of TB in individuals submitted to renal transplant was correlated with high TB prevalence rates in the general population ($p < 0.001$). Countries with high TB prevalence rates were found to have higher rates of infected individuals and individuals with disease. This correlation was expected, as transplant patients are given immunosuppressants and are thus at increased risk of infection by Mycobacterium tuberculosis.[5,36,53] Yet, the exponential growth of prevalences seen in transplant patients against the general population indicates management strategies must be tailored to specifically address the needs of each population group.[6]

However, the analysis of findings must consider the limitations inherent to this study. An important factor - TB prophylactic care - was not included in the meta-regression analysis, as only a few studies looked into this parameter.[13,26,35,37,42] Another limitation pertains to the adopted method - database search - which may have left out non-indexed, yet possibly eligible studies.

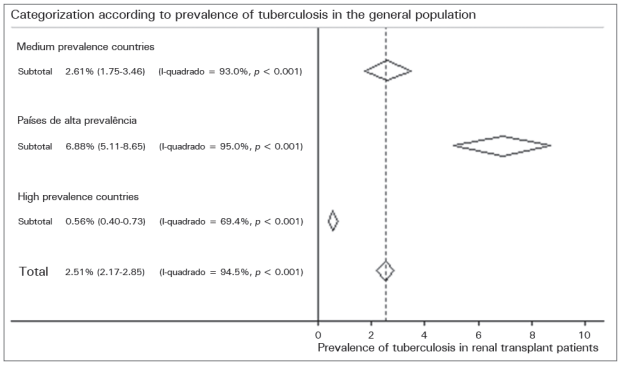
Despite the study's limitations, significant variability was seen in the prevalence rates of TB among individuals submitted to renal transplant, and there appears to be a strong correlation between general population and kidney transplant patient population TB prevalence rates. Additionally, the lack of a specific protocol to assess the quality of the studies was overcome by the stratification of the analyzed variables and the adopted regression model, in a way not to affect our results.

The growing number of transplants pushed by the chronic kidney disease pandemic, and consequently of individuals on immunosuppressants at a greater risk of contracting diseases such as TB,[54-56] combined with the less than effective strategies to reduce morbimortality from TB,6 call for the immediate planning of preventive efforts and specific disease control measures, so that the already high prevalence rates seen in this population do not grow even further in the coming years.

Table 2 Correlation between study variables and estimated prevalence of tuberculosis in individuals submitted to kidney transplant

			Meta-regression	
		Prevalence	Univariate	Multivariate
Variables		%	*p*	*p*
Year of publication			0.093	0.055
Study design	Prevalence	2.1	Ref.	Ref.
	Incidence	9.2	0.028	0.548
Number of centers	One center	3.4	Ref.	-
	Multiple centers	0.8	0.210	-
Sample size	< 100	10.2	Ref.	Ref.
	101-500	4.3	0.090	0.644
	501-1000	4.9	0.143	0.759
	1001-1500	3.8	0.038	0.496
	1501-2000	1.3	0.049	0.063
	2000-2500	0.8	< 0.001	0.070
	> 2501	0.4	< 0.001	0.011
Secondary data source	No	8.7	Ref.	Ref.
	Yes	2.2	0.028	0.345
Prevalence in general population	Low	0.6	Ref.	Ref.
	Medium	2.6	0.003	0.081
	HIGH	6.9	< 0.001	< 0.001

Figure 2. Combined prevalence of tuberculosis in renal transplant patients according to country categorization per levels of TB prevalence in the general population.



References

1. Puska P. Non-communicable diseases--neglected diseases in global health work? Eur J Public Health 2011;21:269.
2. Barros MB, Francisco PM, Zanchetta LM, César CL. Trends in social and demographic inequalities in the prevalence of chronic diseases in Brazil. PNAD: 2003- 2008. Cien Saude Colet 2011;16:3755-68.
3. Eggers PW. The aging pandemic: demographic changes in the general and end-stage renal disease populations. Semin Nephrol 2009;29:551-4.
4. World Health Organization. Global Tuberculosis Programme: Global tuberculosis control 2011. Geneva: World Health Organization; 2011.
5. Lawn SD, Zumla AI. Tuberculosis. Lancet 2011;378:57-72. PMID: 21420161
6. Raviglione M, Marais B, Floyd K, Lönnroth K, Getahun H, Migliori GB, et al. Scaling up interventions to achieve global tuberculosis control: progress and new developments. Lancet 2012;379:1902-13.
7. Torre-Cisneros J, Doblas A, Aguado JM, San Juan R, Blanes M, Montejo M, et al.; Spanish Network for Research in Infectious Diseases. Tuberculosis after solid-organ transplant: incidence, risk factors, and clinical characteristics in the RESITRA (Spanish Network of Infection in Transplantation) cohort. Clin Infect Dis 2009;48:1657-65. PMID: 19445585
8. Singh N, Paterson DL. Mycobacterium tuberculosis infection in solid-organ transplant recipients: impact and implications for management. Clin Infect Dis 1998;27:1266-77.
9. British Thoracic Society Standards of Care Committee and Joint Tuberculosis Committee.; Milburn H, Ashman N, Davies P, Doffman S, Drobniewski F, Khoo S, et al. Guidelines for the prevention and management of Mycobacterium tuberculosis infection and disease in adult patients with chronic kidney disease. Thorax 2010;65:557-70. PMID: 20522863
10. Rizvi SA, Naqvi SA, Zafar MN, Mazhar F, Muzaffar R, Naqvi R, et al. Commercial transplants in local Pakistanis from vended kidneys: a socio-economic and outcome study. Transpl Int 2009;22:615-21.
11. Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, et al. Meta-analysis of observational studies in epidemiology: a proposal for reporting. Meta-analysis Of Observational Studies in Epidemiology (MOOSE) group. JAMA 2000;283:2008-12. PMID: 10789670
12. Agarwal SK, Gupta S, Dash SC, Bhowmik D, Tiwari SC. Prospective randomised trial of isoniazid prophylaxis in renal transplant recipient. Int Urol Nephrol 2004;36:425-31. PMID: 15783119
13. Apaydin S, Altiparmak MR, Serdengeçti K, Ataman R, Oztürk R, Erek E. Mycobacterium tuberculosis infections after renal transplantation. Scand J Infect Dis 2000;32:501-5. PMID: 11055654
14. Atasever A, Bacakoglu F, Toz H, Basoglu OK, Duman S, Basak K, et al. Tuberculosis in renal transplant recipients on various immunosuppressive regimens. Nephrol Dial Transplant 2005;20:797-802.
15. Basiri A, Hosseini-Moghaddam SM, Simforoosh N, Einollahi B, Hosseini M, Foirouzan A, et al. The risk factors and laboratory diagnostics for post renal transplant tuberculosis: a case-control, country-wide study on definitive cases. Transpl Infect Dis 2008;10:231-5.

16. Biz E, Pereira CA, Moura LA, Sesso R, Vaz ML, Silva Filho AP, et al. The use of cyclosporine modifies the clinical and histopathological presentation of tuberculosis after renal transplantation. Rev Inst Med Trop São Paulo 2000;42:225-30. PMID: 10968886
17. Canet E, Dantal J, Blancho G, Hourmant M, Coupel S. Tuberculosis following kidney transplantation: clinical features and outcome. A French multicentre experience in the last 20 years. Nephrol Dial Transplant 2011;26:3773-8.
18. Rodrigo C, Sheriff R, Rajapakse S, Lanerolle RD, Sheriff R. A two-year retrospective analysis of renal transplant patients in Sri Lanka. Saudi J Kidney Dis Transpl 2011;22:174-8.
19. Chen CH, Lian JD, Cheng CH, Wu MJ, Lee WC, Shu KH. Mycobacterium tuberculosis infection following renal transplantation in Taiwan. Transpl Infect Dis 2006;8:148-56.
20. Chen SY, Wang CX, Chen LZ, Fei JG, Deng SX, Qiu J, et al. Tuberculosis in southern Chinese renal-transplant recipients. Clin Transplant 2008;22:780-4.
21. Dridi A, Kaaroud H, Boubaker K, Abdallah TB, El-Younsi F, Moussa FB, et al. Tuberculosis in renal transplant recipients. Transplant Proc 2003;35:2682-3.
22. el-Agroudy AE, Refaie AF, Moussa OM, Ghoneim MA. Tuberculosis in Egyptian kidney transplant recipients: study of clinical course and outcome. J Nephrol 2003;16:404-11.
23. Ergun I, Ekmekci Y, Sengul S, Kutlay S, Dede F, Canbakan B, et al. Mycobacterium tuberculosis infection in renal transplant recipients. Transplant Proc 2006;38:1344-5. PMID: 16797298
24. Ersan S, Celik A, Atila K, Aykut Sifil A, Cavdar C, Soylu A, et al. Tuberculosis in renal transplant recipients. Ren Fail 2011;33:753-7.
25. García-Goez JF, Linares L, Benito N, Cervera C, Cofán F, Ricart MJ, et al. Tuberculosis in solid organ transplant recipients at a tertiary hospital in the last 20 years in Barcelona, Spain. Transplant Proc 2009;41:2268-70.
26. Guida JP, Bignotto Rosane D, Urbini-Santos C, Alves-Filho G, Ribeiro Resende M, Mazzali M. Tuberculosis in renal transplant recipients: a Brazilian center registry. Transplant Proc 2009;41:883-4. PMID: 19376379
27. Hsu MS, Wang JL, Ko WJ, Lee PH, Chou NK, Wang SS, et al. Clinical features and outcome of tuberculosis in solid organ transplant recipients. Am J Med Sci 2007;334:106-10. PMID: 17700199
28. John GT, Shankar V, Abraham AM, Mukundan U, Thomas PP, Jacob CK. Risk factors for post-transplant tuberculosis. Kidney Int 2001;60:1148-53. PMID: 11532111
29. Klote MM, Agodoa LY, Abbott K. Mycobacterium tuberculosis infection incidence in hospitalized renal transplant patients in the United States, 1998-2000. Am J Transplant 2004;4:1523-8.
30. Koselj M, Kandus A, Ales A, Bren AF. Mycobacterial infection in renal transplant recipients. Transplant Proc 2000;32:152-4. PMID: 10701003
31. Köseoğlu F, Emiroğlu R, Karakayali H, Bilgin N, Haberal M. Prevalence of mycobacterial infection in solid organ transplant recipients. Transplant Proc 2001;33:1782-4. PMID: 11267510
32. Lezaic V, Radivojevic R, Radosavljevic G, Blagojevic R, Djukanovic L, Simic S, et al. Does tuberculosis after kidney transplantation follow the trend of tuberculosis in general population? Ren Fail 2001;23:97-106.
33. Lui SL, Tang S, Li FK, Choy BY, Chan TM, Lo WK, et al. Tuberculous infection in southern Chinese renal transplant recipients. Clin Transplant 2004;18:666-71.
34. Matuck TA, Brasil P, Alvarenga Mde F, Morgado L, Rels MD, da Costa AC, et al. Tuberculosis in renal transplants in Rio de Janeiro. Transplant Proc 2004;36:905-6. PMID: 15194311
35. Melchor JL, Gracida C, Ibarra A. Increased frequency of tuberculosis in Mexican renal transplant recipients: a single-center experience. Transplant Proc 2002;34:78-9. PMID: 11959194
36. Naqvi A, Rizvi A, Hussain Z, Hafeez S, Hashmi A, Akhtar F, et al. Developing world perspective of posttransplant tuberculosis: morbidity, mortality, and cost implications. Transplant Proc 2001;33:1787-8. PMID: 11267512
37. Naqvi R, Naqvi A, Akhtar S, Ahmed E, Noor H, Saeed T, et al. Use of isoniazid chemoprophylaxis in renal transplant recipients. Nephrol Dial Transplant 2010;25:634-7.
38. Niewczas M, Ziółkowski J, Rancewicz Z, Szymanska K, Kwiatkowski A, Gałazka T, et al. Tuberculosis in patients after renal transplantation remains still a clinical problem. Transplant Proc 2002;34:677-9.
39. Prokopenko E, Scherbakova E, Vatazin A, Pasov S, Budnikova N, Agafonova S. Does mycophenolate mofetil increase the incidence of infections in renal transplant recipients? Drugs Exp Clin Res 2005;31:199-205.
40. Queipo JA, Broseta E, Santos M, Sánchez-Plumed J, Budía A, Jiménez-Cruz F. Mycobacterial infection in a series of 1261 renal transplant recipients. Clin Microbiol Infect 2003;9:518-25.
41. Ram R, Swarnalatha G, Prasad N, Dakshinamurty KV. Tuberculosis in renal transplant recipients. Transpl Infect Dis 2007;9:97-101.
42. Ruangkanchanasetr P, Natejumnong C, Kitpanich S, Chaiprasert A, Luesutthiviboon L, Supaporn T. Prevalence and manifestations of tuberculosis in renal transplant recipients: a single-center experience in Thailand. Transplant Proc 2008;40:2380-1. PMID: 18790240
43. Rungruanghiranya S, Ekpanyaskul C, Jirasiritum S, Nilthong C, Pipatpanawong K, Mavichak V. Tuberculosis in Thai renal transplant recipients: a 15-year experience. Transplant Proc 2008;40:2376-9. PMID: 18790239
44. Saber LT, Ikeda MY, Almeida JM. Posttransplantation conversion to sirolimus-based immunosuppression: a single center experience. Transplant Proc 2007;39:3098-100.
45. Sharma AK, Tolani SL, Rathi GL, Gupta HP, Gupta R. Tuberculosis after renal transplantation. Transplant Proc 2000;32:1959. PMID: 11120019
46. Torres J, Aguado JM, San Juan R, Andrés A, Sierra P, López-Medrano F, et al. Hepatitis C virus, an important risk factor for tuberculosis in immunocompromised: experience with kidney transplantation. Transpl Int 2008;21:873-8.
47. Tsai MK, Lee CY, Hu RH, Lee PH. Conversion to combined therapy with sirolimus and mycophenolate mofetil improved renal function in stable renal transplant recipients. J Formos Med Assoc 2007;106:372-9. PMID: 17561472
48. Vachharajani T, Abreo K, Phadke A, Oza U, Kirpalani A. Diagnosis and treatment of tuberculosis in hemodialysis and renal transplant patients. Am J Nephrol 2000;20:273-7.
49. Vandermarliere A, Van Audenhove A, Peetermans WE, Vanrenterghem Y, Maes B. Mycobacterial infection after renal transplantation in a Western population. Transpl Infect Dis 2003;5:9-15.
50. Zhang XF, Lv Y, Xue WJ, Wang B, Liu C, Tian PX, et al. Mycobacterium tuberculosis infection in solid organ transplant recipients: experience from a single center in China. Transplant Proc 2008;40:1382-5. PMID: 18589112
51. Walsh R, Ortiz J, Foster P, Palma-Vargas J, Rosenblatt S, Wright F. Fungal and mycobacterial infections after Campath (alemtuzumab) induction for renal transplantation. Transpl Infect Dis 2008;10:236-9.
52. Currie AC, Knight SR, Morris PJ. Tuberculosis in renal transplant recipients: the evidence for prophylaxis. Transplantation 2010;90:695-704.
53. Rizvi SA, Naqvi SA, Hussain Z, Hashmi A, Akhtar F, Hussain M, et al. Renal transplantation in developing countries. Kidney Int Suppl 2003;(83):S96-100.
54. Schieppati A, Remuzzi G. Chronic renal diseases as a public health problem: epidemiology, social, and economic implications. Kidney Int Suppl 2005;(98):S7-S10.
55. Bello AK, Nwankwo E, El Nahas AM. Prevention of chronic kidney disease: a global challenge. Kidney Int Suppl 2005;(98):S11-7.
56. Saran R, Shahinian V. CKD: a pandemic calling for concerted public health action. Adv Chronic Kidney Dis 2010;17:213-4.