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Improvements in social functioning and family relations among clients in methadone maintenance treatment clinics in China: a systematic review and meta-analysis

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ABSTRACT

Objective: Methadone maintenance treatment (MMT) has been implemented in China since 2004. It was initiated in eight pilot clinics and subsequently expanded into a nationwide program. The study aims to evaluate the changes in social functioning and family relations among drug addicts in (MMT) clinics in China through a systematic review and meta-analysis.

Methods: Chinese and English databases of literature were searched thoroughly for studies reporting the changes in social functioning and family relations among MMT clients from 2004 to 2011.

Results: Twenty-six articles were eligible in this review (1 in English and 25 in Chinese). The self-reported arrest rate reduced from 13.7% (95% CI: 9.1-20.0%) at baseline, to 3.5% (95% CI: 1.1-10.5%), and to 4.3% (95% CI: 1.6-11.4%) after 6, and 12-month MMT intervention, respectively. The rate for drug-selling reduced from 7.6% (95% CI: 3.8-14.8%) at baseline, to 1.9% (95% CI: 0.6-6.2%), and to 3.0% (95% CI: 1.0-8.9%) after 6, and 12-month of intervention, respectively. In addition, the employment rate of clients increased dramatically from 26.4% (95% CI: 22.9-30.1%) at baseline, to 41.6% (95% CI: 36.6-48.0%) at 6-month, and further increased to 59.8% (95% CI: 52.4-66.8%) at 12-month intervention. The proportion of clients having a good relationship with family also increased from 37.9% (95% CI: 32.0-44.2%) at baseline, to 59.6% (95% CI: 48.1-70.2%) at 6-month, to 75.0% (95% CI: 69.0-80.2%) at 12-month intervention, respectively. In addition, 31.0% (95% CI: 25.7-36.8%) of clients contacted with former drug-user friends daily, but this rate reduced 7.7% (95% CI: 1.4-33.2%), and to 1.0% (95% CI: 0.1-6.6%) after 6, and 12-month of intervention.

Conclusions: MMT has significant reduced the criminal activities and improved employment rate and the family relationship among the clients. MMT is an effective measure in reducing addiction-related crimes and help to resume societal and familial functions for drug users in China.

KEY WORDS

Criminal activities, Social functioning and family relations, Changes, Methadone maintenance treatment, Meta-analysis, China

Strengths and limitations of this study

This is the first study to review how MMT intervention could influence the changes of social functioning and family relations among drug users in MMT clinics in China.

This study evaluated the changes in drug-related criminal behaviours, improvements in social functioning and family relations among drug users before and after entering the MMT interventions through a meta-analysis of published literature since 2004 in China.

The number of available reports was small which could be a limitation of the study.

INTRODUCTION

Illicit drug abuse has become a social problem and public health issue internationally since the last decade, it not only increases the risks of disease transmission such as HIV and hepatitis C virus (HCV), [1 2] but also enhances the problems in drug-related criminal activities, family problems, and excessive health care expenditures. [3 4] Heroin is the most common drug used among drug users in both developed and developing countries. [5-7] Methadone maintenance treatment (MMT) has been found to be an effective harm reduction program for drug users since 1949, [8-10] and it has been rapidly scaled up around the world. Methadone is a relatively safe, low-cost and convenient generic drug, it is also used in the treatment of opioid dependence [11 12] for solving medical and clinical issues such as reducing the death rates, improving the clients' health and so on, [13-15] reducing addiction-related crimes and helping to resume social and familial functions in drug users. [16-25]

In 2004, eight out-patient MMT clinics were established in China [26 27] and lately expanded into a nationwide program encompassing more than 696 clinics covering 27 provinces by 2010. [28] It is shown that the implementation of these eight MMT clinics has significantly improved the social functioning among MMT clients, for example, the annual employment rate increased from 22.9% to 40.6%; and the proportion of clients having a harmonious relationship with families increased from 49.6% to 65.8% after receiving the MMT programs for 12 months. Additionally, the self-reported criminal behaviour of clients has also reduced from 20.7% to 3.8%. [24] Tens of thousands of drug users and their families are benefited from the positive outcomes with participating in the MMT in China. [24 29] The effectiveness of MMT was also observed in other countries. For instance, the employment rate of the participants in Malaysia increased from 70.1% to 77.6% after two years of treatment. [30] A retrospective study in UK showed that the total convictions and cautions per year, theft and fraud convictions and cautions per year, weeks spent in prison per year were reduced by 39.3% (95% CI: 0.05-0.98), 82.17% (95% CI: 0.11-0.89), 82% (95% CI: 0.66-3.47), respectively. [31]

Improvements among MMT clients have been reported across China, [32-38] for example, the self-reported arrest rate decreased from 3.2-44.4% to 1.0-2.6%, [32 34 36] employment rate increased from 22.61-28.3% to 55.1-90.9% [39-41] and family relationship improved from 40.2-59.8% to 78.8-82.4%. [32 42] This study aims to evaluate the changes in drug-related criminal behaviours, improvements in social functioning and family relations among drug users before and after entering the MMT interventions through a meta-analysis of published literature since 2004 in China.

METHODS

Data sources

Two independent investigators (HMS, XYL) conducted a systematic review of published peer-reviewed research articles by searching the following databases: PubMed, Chongqing VIP Chinese Science and Technology Journals Database (CQVIP), China National Knowledge Infrastructure (CNKI) and Wanfang Data from January 2004 to December 2011. Keywords used in the database search included ("Methadone" OR "Methadone Maintenance Treatment" OR "Methadone Maintenance Therapy" OR "Methadone Maintenance" OR "MMT") AND ("Crime" OR "Criminal rates" OR "Employment" OR "Family relationship" OR "Social functions") AND ("China" OR "China Mainland" OR "Chinese"). We also performed a manual search on the reference lists of published articles. This review was reported according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Statement issued in 2009. [43]

Study selection

Studies were eligible for inclusion in this systematic review if they met the following criteria: (1) articles published in Chinese or English language; (2) study reported social functioning or family relations among clients in MMT at baseline and follow-up; and (3) reported the study design such as study location, investigation period, duration of intervention, and sample size. Pre-and-post intervention studies among MMT clients were also included. Exclusion criteria were: (1) review papers; (2) non peer–reviewed local/government reports; (3) conference abstracts and presentations; and (4) dissertations. If the same data source were published in both English and Chinese sources, the articles published in Chinese language were excluded from this study.

Qualitative assessment

The quality of studies was assessed using a validated quality assessment tool for observational studies. [44] The following eight items were assessed to calculate a total quality score: (1) clear definition of the target population; (2) representativeness of probability sampling; (3) sample characteristics matching the overall population; (4) adequate response rate; (5) method of data collection methods; (6) reliability of survey measures/instruments; (7) validity of survey measures/instruments; and (8) appropriate statistical methods. Each item was scored 0 for 'No' and 1 for 'Yes', respectively. The total quality score ranged from 0 to 8 (Table S1).

Data abstraction

We extracted the following information from all eligible studies: first author, year of publication, study location, investigation period, gender composition, age, sample size, duration of intervention, proportion of drug-related criminal activities, employment rate, and relationship with family among clients in MMT at baseline and follow-up of treatment. Due to limited studies available, meta-analysis was not performed to investigate the contribution of MMT to the changes of clients involved in drug-related crime and selling sex for drugs. And the result was given with the range.

Statistical Analysis

Meta-analyses were carried out with the Comprehensive Meta-Analysis software (V2.0, Biostat, Englewood, New Jersey). The effect rates of pooled estimates and 95% confidence intervals (CIs) were determined based on random effect models. Heterogeneity tests were performed using the Cochran Q-test ($P< 0.10$ represents statistically significant heterogeneity) and I^2 statistic. Potential publication bias was measured by the Begg and Mazumdar rank correlation ($P< 0.05$ represents statistically significant publication bias.

RESULTS

Trial Flow/Flow of included studies

According to our initial search strategies, 226 articles were identified from four electronic databases (11 in PubMed, 116 in CNKI, 10 in CQVIP, 86 in Wanfang database and 3 in other sources). We excluded 86 irrelevant articles after the title screening. The remaining 140 abstracts were screened, and 83 articles were excluded (41 were irrelevant to the topic, 41 were non peer-reviewed articles, and 1 study was not conducted in China). 57 articles were eligible for full-text screening, of these, 31 articles were excluded (12 were not original studies, 6 did not report the outcome variables, 6 did not report follow-up period, 3 studies were duplicated from same data sources, 2 were not conducted in MMT clinics, and 1 study covered multiple provinces). A total of 26 articles were eligible and included (1 in English, 25 in Chinese) in this review. 11 studies reported the changes in criminal behaviours associated with illegal drug uses (11 reported arrest rate, 6 reported drug-sold), and 26 studies reported the changes in family and friends relations (23 reported employment, 18 reported relationship with family, 8 reported relationship with friends). The selection process is illustrated in Figure 1.

Study characteristics

The sample size of MMT clients reported in the eligible studies ranged from 65 to 13310 (median: 233, IQR:115-554). A total of 22854 participants were included in this review, and about 83.7% were male. The mean age of the total MMT clients was 34.6 years (range: 18-62 years). Of the 26 eligible articles, almost half of the studies (42.3%) were conducted in the provinces with high HIV prevalence (>20%) [45] [46] including Yunnan, Sichuan, Guangzhou, Xinjiang, Guizhou and Guangxi. The follow-up period of MMT intervention ranged from 6 to 36 months, and the majority were followed up within 12 months (84.6%). Half of the studies (n=13) were prospective cohort studies, and others were retrospective studies.

The criminal activities

The criminal activities among the MMT clients had significantly reduced after receiving MMT intervention. The self-reported arrest rate reduced from 13.7% (95% CI: 9.1-20.0%) at baseline (Table 1, Figure 2), to 3.5% (95% CI: 1.1-10.5%), to 4.3% (95% CI: 1.6-11.4%) and to 1.4% (95% CI: 0.5-3.7%) at 6-, 12- and 36-months follow-up. About 7.6% (95% CI: 3.8-14.8%) of the clients who had sold drugs before receiving MMT intervention (Table 1, Figure 3), this rate was reduced to 1.9% (95% CI: 0.6-6.2%) after 6 months, to 3.0% (95% CI: 1.0-8.9%) after 12 months and 1.0% (95% CI: 0.1-6.6%) after 36 months. 10 studies reported the rate of drug-related crime decreased from 1.1-30.34% to 0.5-3.7%. [24] [32 34 39 42 47-51] In addition, 6 studies reported the rate of selling sex for drugs reduced from 1.9-24.0% to 0.5-1.5% after MMT intervention. [32 34 42 47 49 52]

Social functioning

Employment rate among clients had been improved after receiving MMT. The overall employment rate increased from 26.4% (95% CI: 22.9-30.1%) at baseline (Table 1, Figure 4), to 41.6% (95% CI: 36.6-48.0%) after 6 months of treatment, and further increased to 59.8% (95% CI: 52.4-66.8%) after 12 months, but slightly decreased to 55.4% (95% CI: 48.2-62.3%) over 12 months.

Family relations

Family relations among clients had also been improved after receiving MMT. In addition, only 37.9% (95% CI: 32.0-44.2%) (Table 1, Figure 5) drug users reporting having a good relationship with their family before receiving MMT interventions; however, this rate significantly increased to 59.6% (95% CI: 48.1-70.2%) after 6 months, to 75.0% (95% CI: 69.0-80.2%) after 12 months, and to 83.2% (95% CI: 77.8-87.6%) after >12 months of treatment.

Contacting with former drug-user friends

Furthermore, about 31.0% of clients (95% CI: 25.7-36.8%) (Table 1, Figure 6) met their former drug-user friends every day at baseline; however, the rate of contacting with former drug-user friends reduced to 6.5% (95% CI: 4.4-9.4%), 7.7% (95% CI: 1.4-33.2%), 1.0% (95% CI: 0.1-6.6%) after 6, 12, >12 months of intervention, respectively.

DISCUSSION

To our best knowledge, this is the first study to review how MMT intervention could influence the changes of social functioning and family relations among drug users in MMT clinics in China. Our results showed MMT could significantly reduce the self-reported arrest rate, sold drugs, drug-related crime activities, selling sex for drugs and met their former drug-user friends every day and improve employment rate and family relations, these results are consistent with some studies in other countries such as England, Lithuania and Israel. [53-56] However, some researchers might remain to have strong moral reservations about MMT. They usually focused on the physically dependent nature of methadone and the possibility that the MMT programs would have to depend on the support of the government or public funds. [57] Thus, further studies are required to evaluate methadone maintenance treatment, and it is necessary to have a comprehensive evaluation of its cost-effectiveness, which can assist and inform the policy makers in decision making in the future.

Many drug users attempted to use different illegal activities (i.e. robbery, theft) for the exchange of drugs. MMT can reduce drug-related criminal behaviours. [58] Consistent with our results, a meta-analysis conducted by Marsch showed that 85% of drug users who attended MMT have reduced drug-related crime. [59] A systematic review conducted by Holloway and his colleagues also showed that clients in MMT program had less criminal behaviour than the non-MMT drug users. [60]

In our study, the employment rate increased after receiving MMT intervention in China. Similarly, a study in Sweden showed that approximately 80% of severe heroin addicts received new jobs or learned opportunities to get rid of drug abuse and return to society after receiving MMT intervention. [61] Another study conducted in the USA also indicated a significant improvement in employment outcomes with an integrated drug counseling and employment intervention for methadone clients. [62] In Sweden, Blix [61] conducted a 24-year follow-up study among 345 heroin addicts during 1966-1989 and found that 70%-80% of the clients have a fixed or temporary work after 5-year follow-up. However, it is interesting that with the prolongation of the treatment, the employment rate after 12 months treatment was even

higher than that after more than 12 months treatment. And the same results appeared in another survey of first eight pilot methadone maintenance treatment clinics in China. [63] A reasonable explanation can be that client drop-out is very common issue in MMT clinics, and the highest drop-out rate happed between 12 and 18 months. [64] Heroin users also reported improved relations with their families after enrolling in the MMT program. [65]

It is suggested MMT program should not only focus on the reduction of drug abuse, other advisory services such as providing Voluntary Counseling and Testing (VCT) of HIV, nursing intervention, psychological intervention, family intervention should also be complemented in the program simultaneously. [66 67] At the same time, clients should be encouraged to take advantage of these rehabilitation facilities to improve the consciousness of safeguarding their own rights and interests. It is completely possible for the drug users to get rid of drug abuse in the MMT program with these interventions, so that they can return to society as individuals with productive and worthwhile skills in the community.

Several limitations in this study should be noted. First, by the end of November 2010, there were totally 696 MMT clinics in China, covering 27 Chinese provinces, [28] however, out of which, 14 provinces did not publish any reports on the related characteristics of social and familial relationship and this limits our analysis in these regions. Second, only six studies reported clients who sold drugs and only eight studies reported the proportion of drug users who met former drug-user friends every day. Small number of studies could lead to information bias in our study. Third, We merged about 15.4% studies which had more than 12 months (i.e. 24 months, 36 month) of follow-up in this study. However, it may affect the long-term follow-up information. Fourth, our study results may have publication bias because some data may exist but have not been published or detected by our search strategy. Fifth, substantial heterogeneity existed between studies due to different study methodologies, method of recruitment and sampling sizes in different studies. Our meta-analyses could not take all of these variations across individual studies into account. Sixth, limited reports about the related characteristics of social and familial relationship in recent years and the reports' delay in publication are also the potential factor affecting our results.

Ethics An ethics statement was not required for this work.

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Contributors EPFC, LZ and XZ designed the study. HMS and XYL performed the data collection and provided the first draft of manuscript. YHL and TT performed data analysis. LZ and EPFC assisted with data interpretation. EPFC, LZ and XZ provided critical revision for important intellectual content. All authors read and approved the final version of manuscript.

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Table 1 The comparison of social functioning and family relations before and after entering MMT

	Baseline (admission to MMT)	Post-intervention period		
		6 months	12 months	>12 months
Arrested rate	13.7% (9.1%-20.0%)	3.5% (1.1%-10.5%)	4.3% (1.6%-11.4%)	1.4% (0.5%-3.7%)
Proportion of selling drugs	7.6% (3.8%-14.8%)	1.9% (0.6%-6.2%)	3.0% (1.0%-8.9%)	1.0% (0.1-6.6%)
Employment rate	26.4% (22.9%-30.1%)	41.6% (36.6%-48.0%)	59.8% (52.4%-66.8%)	55.4% (48.2%-62.3%)
Had a good family relation	37.9% (32.0%-44.2%)	59.6% (48.1%-70.2%)	75.0% (69.0%-80.2%)	83.2% (77.8%-87.6%)
Contacting with former drug-user friends everyday	31.0% (25.7%-36.8%)	6.5% (4.4%-9.4%)	7.7% (1.4%-33.2%)	1.0% (0.1%-6.6%)

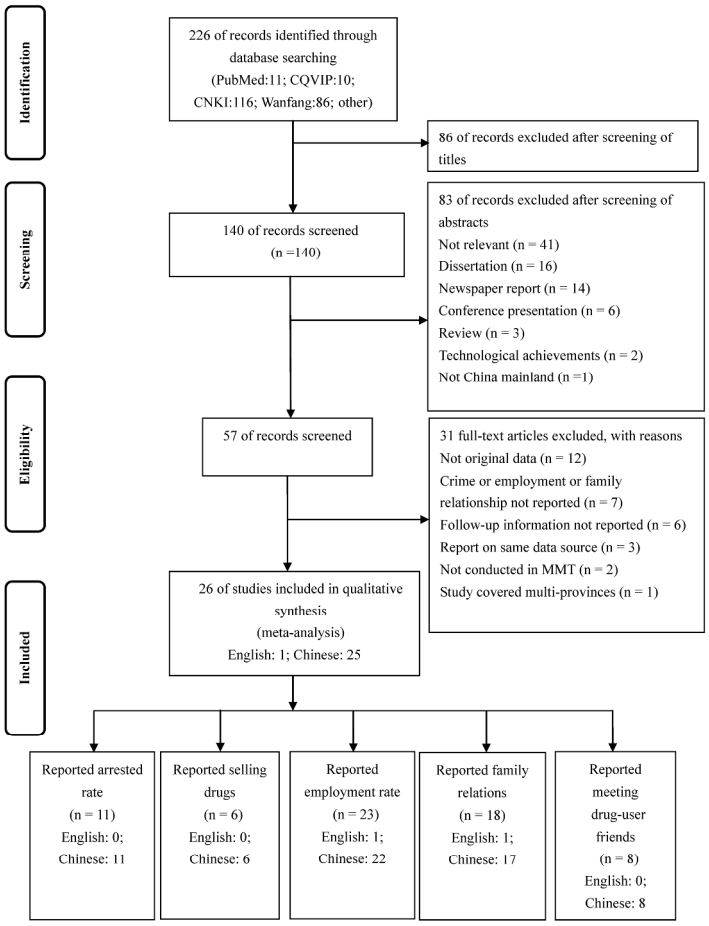

Figure 1 Flow chart showing the meta-analysis studies selection.

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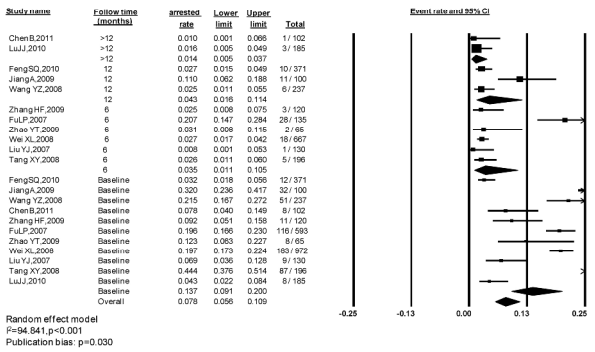

Figure 2 The rate for arrested situation among MMT clients at different intervention periods.

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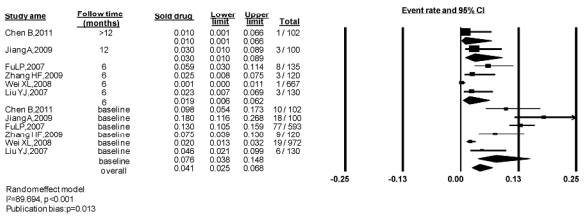

Figure 3 The rate for drug-selling among MMT clients at different intervention periods.

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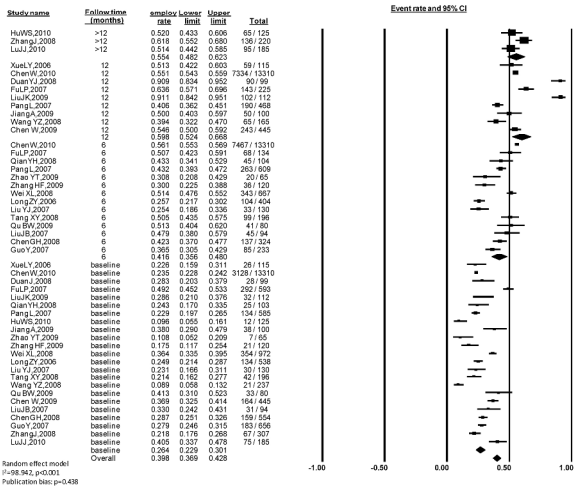

Figure 4 The employment rate among MMT clients at different intervention periods.

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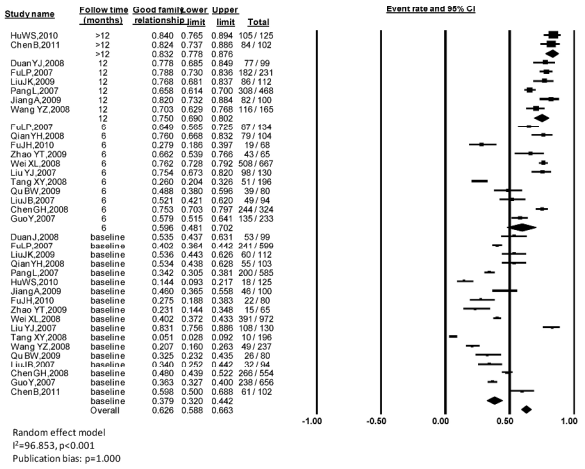

Figure 5 The rate for good relationship with family among MMT clients at different intervention periods.

MMT-Figure 5
297x420mm (300 x 300 DPI)

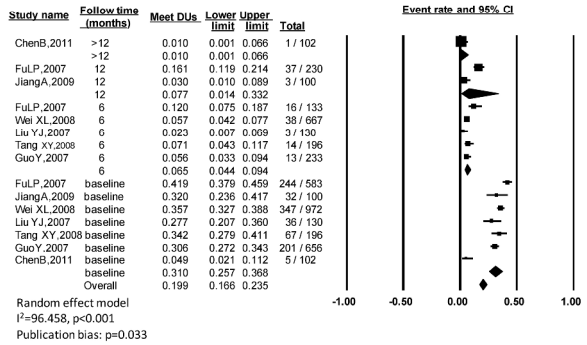

Figure 6 The clients contacting with former drug-user friends everyday at different intervention periods.

MMT-Figure 6
297x420mm (300 x 300 DPI)

Table S1 Studies reporting the changes in social functioning and family relations before and after entering MMT*(Continued)*

First Author, Published Year	Study Period	Study Location (Province)	Sample size	Post-intervention period (month)	Change of social functioning and family relations					Quality Assessment Score
					Arrested rate	Selling drugs	Employment status	Good relationship with family	Contacting with former drug-user friends everyday	
Chen B (2011) [32]	2009	Guangdong	102	36	B:8/102 A:1/102	B:10/102 A:1/102		B:61/102 A:84/102	B:5/102 A:1/102	4
Chen GH (2008) [47]	2006	Jiangsu	554	6			B:159/554 A:137/324	B:266/554 A:244/324		3
Chen W (2009) [51]	2008	Guangdong	445	12			B:164/445 A:243/445			5
Chen W (2010) [39]	2008	Guangdong	13310	6			B:3128/13310 A:7467/13310			4
Chen W (2010) [39]	2008	Guangdong	13310	12			B:3128/13310 A:7334/13310			4
Duan YJ (2008) [33]	2006	Yunnan	99	12			B:28/99 A:90/99	B:53/99 A:7799		3
Fu LP (2007) [42]	2006	Xinjiang	958	6	B:116/593 A:28/135	B:77/593 A:8/135	B:292/593 A:68/134	B:241/599 A:87/134	B:244/583 A:16/133	3
Fu LP (2007) [42]	2006	Xinjiang	958	12			B:292/593 A:143/225	B:241/599 A:182/231	B:244/583 A:37/230	3
Fu JH (2010) [68]	2008	Jiangxi	80	6				B:22/80 A:19/68		4
Feng SQ (2010) [34]	2008	Jiangsu	371	12	B:12/371 A:10/371					4
Guo Y (2007) [48]	2006	Yunnan	656	6			B:183/656 A:85 /233	B:238/656 A:135/233	B:201/656 A:13/233	5
Hu WS (2010) [69]	2008	Guangdong	125	22			B:12/125 A:65/125	B:18/125 A:105/125		4

MMT-Table S1(1)
209x148mm (300 x 300 DPI)

Table S1 Studies reporting the changes in social functioning and family relations before and after entering MMT *(Continued)*

First Author, Published Year	Study Period	Study Location (Province)	Sample size	Post-intervention period (month)	Change of social functioning and family relations					Quality Assessment Score
					Arrested rate	Selling drugs	Employment status	Good relationship with family	Contacting with former drug-user friends everyday	
Jiang A (2009) [52]	2007	Ningxia	100	12	B:32/100 A:11/100	B:18/100 A:3/100	B:38/100 A:50/100	B:46/100 A:82/100	B:32/100 A:3/100	4
Liu JB (2007) [70]	2005	Xinjiang	170	6			B:31/94 A:45/94	B:32/94 A:49/94		4
Liu JK (2009) [41]	2006	Sichuan	112	12			B:32/112 A:102/112	B:60/112 F86/112		3
Liu YJ (2007) [71]	2007	Beijing	130	6	B:9/130 A:1/130	B:6/130 A:3/130	B:30/130 A:33/130	B:108/130 A:98/130	B:36/130 A:3/130	3
Lu JJ (2010) [35]	2010	Jiangsu	185	36	B:8/185 A:3/185		B:75/185 A:95/185			5
Long ZY (2006) [72]	2005	Guizhou	538	6			B:134/538 A:104/404			4
Pang L (2007) [24]	2004	Guizhou	609	6			B:134/585 A:263/609			5
Pang L (2007) [24]	2004	Beijing	468	12			B:134/585 A:190/468	B:200/585 A:308/468		5
Qian YH (2008) [73]	2007	Jiangsu	965	6			B:25/103 A:45/104	B:55/103 A:79/104		4
Qu BW (2009) [49]	2007	Guangdong	80	6			B:33/80 A:41/80	B:26/80 A:39/80		6
Tang XY (2008) [36]	2006	Hunan	196	6	B:87/196 A:5/196		B:42/196 A:99/196	B:10/196 A:51/196	B:67/196 A:14/196	3
Wang YZ (2008) [74]	2007	Zhejiang	237	12	B:51/237 A:6/237		B:21/237 A:65/165	B:49/237 A:116/165		3

MMT-Figures and Table S1(2)
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Table S1 Studies reporting the changes in social functioning and family relations before and after entering MMT *(Continued)*

First Author, Published Year	Study Period	Study Location (Province)	Sample size	Post-intervention period (month)	Change of social functioning and family relations					Quality Assessment Score
					Arrested rate	Selling drugs	Employment status	Good relationship with family	Contacting with former drug-user friends everyday	
Wei XL (2008) [50]	2007	Shaanxi	972	6	B:183/972 A:18/667	B:19/972 A:1/667	B:354/972 A:343/667	B:391/972 A:508/667	B:347/972 A:38/667	5
Xue LY (2006) [40]	2006	Shanghai	115	12			B:26/115 A:59/115			4
Zhao YT (2009) [38]	2006	Guangdong	65	6	B:8/65 A:2/65		B:7/65 A:20/65	B:15/65 A:43/65		6
Zhang HF (2009) [75]	2008	Shaanxi	120	6	B:11/120 A:3/120	B:9/120 A:3/120	B:21/120 A:36/120			4
Zhang J (2008) [37]	2007	Jiangsu	307	20			B:67/307 A:136/220			5

Note: B=Before entering MMT program; A=After entering MMT program

Table S1(3)
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BMJ Open

Methadone maintenance treatment programme reduces criminal activities and improve social wellbeing of drug users in China: a systematic review and meta-analysis

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Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology, Public health
Keywords:	PUBLIC HEALTH, Epidemiology < INFECTIOUS DISEASES, HIV & AIDS < INFECTIOUS DISEASES

Methadone maintenance treatment programme reduces criminal activities and improve social wellbeing of drug users in China: a systematic review and meta-analysis[1]

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ABSTRACT

Objective: Methadone maintenance treatment (MMT) has been implemented in China since 2004 and has expanded into a nationwide program. The study aims to evaluate the changes in social functioning, family relations and drug-related criminal behaviours among MMT clients in China.

Design: Systematic review and meta-analysis.

Methods: Both English and Chinese literature databases, including PubMed, Chongqing VIP Chinese Science and Technology Journals Database (CQVIP), China National Knowledge Infrastructure (CNKI) and Wanfang Data, were comprehensively searched over the period 2004-2014 for studied indicators. Study selection, quality assessment and data extraction were conducted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses. Meta-analyses were conducted using Comprehensive Meta-Analysis Biostat software.

Results: Thirty-eight articles were included in this review (1 in English and 37 in Chinese). The self-reported arrest rate reduced from 13.7% (95% CI: 9.1-20.0%) at baseline, to 3.5% (1.1-10.5%), and to 4.3% (1.6-11.4%) after 6, and 12-month MMT intervention, respectively. The rate for drug-selling reduced from 7.6% (3.8-14.8%) at baseline, to 1.9% (0.6-6.2%), and to 3.0% (1.0-8.9%) after 6, and 12-month of intervention, respectively. Similarly, the rates of selling sex for drugs and drug-related crime reduced from 5.3% (2.4%-11.1%) and 9.9% (6.8%-14.2%) at baseline, to 1.1% (0.5%-2.3%) and 3.4% (2.5%-4.5%) at 6-month, then to 0.8% (0.3%-1.9%) and 3.4% (0.8%-13.1%) at 12-month after treatment initiation, respectively. In contrast, employment rate of clients and proportion of clients having a good relationship with family increased substantially from 26.4% (22.9-30.1%) and 37.9% (32.0-44.2%), to 41.6% (36.6-48.0%) and 59.6% (48.1-70.2%) at 6-month, then to 59.8% (52.4-66.8%) and 75.0% (69.0-80.2%) at 12-month after treatment initiation.

Conclusions: MMT has significantly reduced the criminal activities and improved employment rate and social wellbeing of MMT clients. MMT is an effective measure to help drug users to resume

societal and familial functions in China.

KEY WORDS

Criminal activities, Social functioning and family relations, Changes, Methadone maintenance treatment, Meta-analysis, China

Strengths and limitations of this study

- This is the first study to review how MMT intervention could influence the changes of social functioning and family relations among drug users in MMT clinics in China.
- This study evaluated the changes in drug-related criminal behaviours, improvements in social functioning and family relations among drug users before and after entering the MMT interventions through a meta-analysis of published literature since 2004 in China.
- The number of studies is limited and may lead to issues on representativeness of the large drug user population in China.

INTRODUCTION

Illicit drug abuse is a social and public health issue internationally. It not only increases the risks of disease transmission such as HIV and hepatitis C virus (HCV), [1 2] but also enhances drug-related criminal activities, family issues, and excessive health care expenditures. [3 4] Heroin is the most common drug used among drug users in both developed and developing countries. [5-7] Methadone maintenance treatment (MMT) has been found to be an effective harm reduction program for drug users. [8-10] Methadone is a safe, low-cost and convenient generic drug for treatment of opioid dependence. [11 12] It effectively reduced drug-related mortality [13-15] drug-related crimes and help drug users to resume social and familial functions .[16-25]

In 2004, eight out-patient MMT clinics were established in China [26 27] and lately expanded into a nationwide program encompassing more than 756 MMT clinics in China, covering 28 Chinese provinces by 2012. It has been shown that the pilot of these eight MMT clinics has significantly improved the social functioning among MMT clients. Annual employment rate were reportedly increased from 22.9% to 40.6% ($P < 0.01$, compared with the baseline survey); and the proportion of clients having a harmonious relationship with families increased from 49.6% to 65.8% ($P < 0.01$) after receiving the MMT programs for 12 months. Self-reported criminal behaviour of clients has also reduced from 20.7% to 3.8% ($P < 0.01$). [24] Similar benefits of MMT were also reported in other countries. For instance, the employment rate of MMT clients Malaysia increased from 70.1% to 77.6% after two years of treatment. [28] A retrospective study in UK also showed that the total number of convictions, theft and fraud convictions, weeks spent in prison per year were reduced by 39.3% ($P = 0.03$), 52.17% ($P<0.001$), 82.8% ($P = 0.002$), respectively. [29]

Numerous studies have reported improvements in social and family wellbeing among MMT clients

in China, but a systematic review that synthesises all these impacts remained absent. This study aims to evaluate the changes in drug-related criminal behaviours, improvements in social functioning and family relations among drug users before and after entering the MMT interventions through a meta-analysis of published literature since 2004 in China.

METHODS

Data sources

We conducted a systematic review of published peer-reviewed research articles by searching the following databases: PubMed, CQVIP, CNKI and Wanfang Data from January 2004 to October 2014. Keywords used in the database search included ("Methadone" OR "Methadone Maintenance Treatment" OR "Methadone Maintenance Therapy" OR "Methadone Maintenance" OR "MMT") AND ("Crime" OR "Criminal rates" OR "Employment" OR "Family relationship" OR "Social functions") AND ("China" OR "China Mainland" OR "Chinese"). We also performed a manual search on the reference lists of published articles. This review was reported according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Statement issued in 2009. [30]

Inclusion/exclusion criteria

Studies were eligible for inclusion in this systematic review if they met the following criteria: (1) articles published in Chinese or English language; (2) study reported social functioning or family relations among clients in MMT at baseline and follow-up; and (3) reported the study characteristics such as study location, investigation period, duration of intervention, and sample size. Pre-and-post intervention studies among MMT clients were also included. Exclusion criteria were: (1) review papers; (2) non peer–reviewed local/government reports; (3) conference abstracts and presentations; and (4) dissertations. If the same data source were published in both English and Chinese sources, the articles published in Chinese language were excluded from this study.

Study selection

Selected studies were evaluated by two independent investigators (HMS, XYL) according to the inclusion and exclusion criteria. Disagreement in evaluation was resolved by discussion among the investigators. If the same study data were published in both English and Chinese sources, the articles published in Chinese language were excluded from this study. In cases where multiple studies were found to use the same data source, we selected the first published study for inclusion in the meta-analysis.

Quality assessment

Two independent investigators used a validated quality assessment tool for observational studies [31] to assess the quality of studies. The following eight items were assessed to calculate a total quality score: (1) clear definition of the target population; (2) representativeness of probability sampling; (3) sample characteristics matching the overall population; (4) adequate response rate; (5) method of data collection methods; (6) reliability of survey measures/instruments; (7) validity of survey measures/instruments; and (8) appropriate statistical methods. Each item was scored 0 for 'No' and 1 for 'Yes', respectively. The total quality score ranged from 0 to 8 (Table S1).

Data abstraction

Two independent investigators extracted the following information from all eligible studies: first author, year of publication, study location, investigation period, gender composition, age, sample size, duration of intervention, proportion of drug-related criminal activities (including drug-trafficking, selling, robbery and theft for drug), employment rate, and relationship with family among clients in MMT at baseline and follow-up of treatment.

Statistical Analysis

Meta-analyses were carried out with the Comprehensive Meta-Analysis software (V2.0, Biostat, Englewood, New Jersey). The effect rates of pooled estimates and 95% confidence intervals (CIs) were determined based on random effect models. Heterogeneity tests were performed using the Cochran Q-test ($P< 0.10$ represents statistically significant heterogeneity) and I^2 statistic. Potential publication bias was measured by the Begg and Mazumdar rank correlation ($P< 0.05$ represents statistically significant publication bias.

RESULTS

Trial Flow/Flow of included studies

According to our initial search strategies, 345 articles were identified from four electronic databases. We excluded 128 irrelevant articles after the title screening. The remaining 217 abstracts were screened by two independent investigators (HMS, XYL), and 136 articles were excluded. 81 articles were eligible for full-text screening, of these, 43 articles were excluded. A total of 38 articles were eligible and included (1 in English, 37 in Chinese) in this review. 22 studies reported the changes in criminal activities (14 reported arrested rate , 8 reported drug-sold, 7 reported selling sex for drugs and 12 reported rate for drug-related crime), and 37 studies reported the changes in family and friends relations (37 reported employment, 28 reported relationship with family and 11 reported relationship with friends) (Figure 1).

Study characteristics

The sample size of MMT clients reported in the eligible studies ranged from 65 to 13,310 (median: 320.5, IQR:120-651.5). A total of 30,239 participants were included in this review, and about 76.2% were male. The mean age of the total MMT clients was 34.42 years (range: 18-62 years). Of the 38 eligible articles, almost half of the studies (44.8%) were conducted in the provinces with high HIV prevalence (>20%) [32 33] including Yunnan, Sichuan, Guangdong, Xinjiang, Guizhou and Guangxi. The follow-up period of MMT intervention ranged from 6 to 48 months, and the majority were followed up within 12 months (86.8%). Twenty studies were prospective cohort studies, whereas others were retrospective.

Criminal activities

The criminal activities among the MMT clients had significantly reduced after receiving MMT intervention. The self-reported arrest rate reduced from 13.7% (95% CI: 9.1-20.0%) at baseline (Table 1, Figure 2A), to 3.5% (95% CI: 1.1-10.5%), to 4.3% (95% CI: 1.6-11.4%) and to 1.4% (95% CI: 0.5-3.7%) at 6-, 12- and 36-months follow-up. About 7.6% (95% CI: 3.8-14.8%) of the clients who had sold drugs before receiving MMT intervention (Table 1, Figure 2B), this rate was reduced to 1.9% (95% CI: 0.6-6.2%) after 6 months, to 3.0% (95% CI: 1.0-8.9%) after 12 months and 1.0% (95% CI: 0.1-6.6%) after 36 months. The proportion of selling sex for drugs reduced from 5.3% (2.4%-11.1%) at baseline, to 1.1% (0.5%-2.3%) at 6-month, to 0.8% (0.3%-1.9%) at 12-month intervention, respectively (Table 1, Figure 2C). The proportion of drug-related crime also reduced from 9.9% (6.8%-14.2%) at baseline, to 3.4% (2.5%-4.5%) at 6-month, to 3.4% (0.8%-13.1%) at 12-month intervention, respectively (Table 1, Figure 2D). 10 studies reported the rate of drug-related crime decreased from 1.1-30.34% to 0.5-3.7%. In addition, 6 studies reported the rate of selling sex for drugs reduced from 1.9-24.0% to 0.5-1.5% after MMT intervention.

Social functioning

Employment rate among clients had been improved after receiving MMT. The overall employment rate increased from 26.4% (95% CI: 22.9-30.1%) at baseline (Table 1, Figure 2E), to 41.6% (95% CI: 36.6-48.0%) after 6 months of treatment, and further increased to 59.8% (95% CI: 52.4-66.8%) after 12 months, but slightly decreased to 55.4% (95% CI: 48.2-62.3%) over 12 months.

Family relations

Family relations among clients had also been improved after receiving MMT. In addition, only 37.9% (95% CI: 32.0-44.2%) (Table 1, Figure 2F) drug users reporting having a good relationship with their family before receiving MMT interventions; however, this rate significantly increased to 59.6% (95% CI: 48.1-70.2%) after 6 months, to 75.0% (95% CI: 69.0-80.2%) after 12 months, and to 83.2% (95% CI: 77.8-87.6%) after >12 months of treatment.

Contacting with former drug-user friends

Furthermore, about 31.0% of clients (95% CI: 25.7-36.8%) (Table 1, Figure 2G) met their former drug-user friends every day at baseline; however, the rate of contacting with former drug-user friends reduced to 6.5% (95% CI: 4.4-9.4%), 7.7% (95% CI: 1.4-33.2%), 1.0% (95% CI: 0.1-6.6%) after 6, 12, >12 months of intervention, respectively.

Quality assessment

All studies reported study period, study location and sample size**.** All studies reached a total quality score of three or higher (out of a total of eight). The mean quality score was 3.97, indicating a reasonably good quality of our selected studies (Table S1).

DISCUSSION

To our best knowledge, this is the first study that reviews the impacts of MMT treatment on the changes in criminal activities, social functioning and family relations among MMT clients in China. Our findings indicated that MMT have significantly reduced self-reported arrest rate, frequencies of selling drugs, drug-related crime activities, selling sex for drugs and likelihood of meeting former drug-user friends. In contrast, it improved employment rate and family relations of MMT clients. These findings are consistent with other international studies in England, Lithuania and Israel. [34-37] In particular, a meta-analysis conducted by Marsch et.al. showed that 85% of drug users who attended MMT have reduced drug-related crime. [38] A systematic review conducted by Holloway et.al., also showed that MMT clients have less criminal behaviour than the non-MMT drug users. [39] Despite these, policy makers who retain strong moral reservations about MMT would emphasise the physically dependent nature of methadone and ongoing spending of public funds on a population that is deemed as 'social evils' in many settings. [40] Further studies are necessary to evaluate other aspects of MMT, including structural barriers and cost-effectiveness of the program, in order to help policy makers to inform relevant polices in the future.

We demonstrated improved employment rates and family relations among MMT clients in China. Consistently, a study conducted in the United States also indicated a significant improvement in employment outcomes with an integrated drug counselling and employment programme for MMT clients. [41] In addition, a Swedish study showed that over 80% severe heroin addicts received new jobs and re-integrated into the society after receiving MMT. [42] In a separate study, Blix followed 345 heroin users for 24 years over the period 1966-1989 in Sweden. In which, a 70-80% employment rate among MMT clients was reported. [42] Interestingly, our meta-analysis indicated the best employment outcome

at 12-month of treatment initiation and the rate started to decline when treatment continues beyond 12 months. This finding is echoed with findings from an early survey of first eight pilot MMT clinics in China. [43] A plausible explanation may be that employed clients are more likely to drop-out of treatment, which leads to a declining employment rate among those who sustain treatment. Further, family relations of clients improved during the course of MMT. With reduced symptoms of addiction, clients would be able to resume family duties and re-establish relationship with their family members. [44 45]

Several limitations in this study should be noted. First, by the end of 2012, there were totally 756 MMT clinics in China, covering 28 Chinese provinces, however, out of which, 13 provinces did not publish any reports on the related characteristics of social and familial relationship and this limits our analysis in these regions. Second, only eight studies reported clients who sold drugs. Small number of studies could lead to information bias in our study. Third, due to the small number of available studies, we pooled all study estimate beyond 12 months of follow-up in this analysis. Fourth, substantial heterogeneity existed between studies due to different study methodologies, method of recruitment and sampling sizes in different studies. Our meta-analyses could not take all of these variations across individual studies into account. Fifth, limited number of studies reported relevant characteristics of social and familial relationship in recent years and the reports' delay in publication may also bias our findings.

Conclusions

Conclusively, MMT programme in China has been shown to be effective in reducing criminal activities and improving employment outcome and social wellbeing of its clients. MMT programme should not only focus on the reduction of drug abuse, other advisory and intervention services, such as Voluntary

Counselling and Testing (VCT) of HIV, psychological therapy, family intervention may be integrated into the program simultaneously. [46 47] In parallel, clients should be encouraged to make use of rehabilitation facilities to improve their own awareness in safeguarding their own rights and interests. MMT may serve as a valuable opportunity to reduce drug-related harm among drug users and enable them to return to society as healthy and productive individuals.

Ethics An ethics statement was not required for this work.

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Contributors EPFC, LZ and XZ designed the study. HMS and XYL performed the data collection and provided the first draft of manuscript. TL, XY, YHL and TT performed data analysis. LZ and EPFC assisted with data interpretation. EPFC, LZ and XZ provided critical revision for important intellectual content. All authors read and approved the final version of manuscript.

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Competing interests None

Data Sharing Statement: No additional data are available.

Figure legends:

Figure 1 Flow chart of selection of studies.

Figure 2 Changes in criminal activities, social wellbeing and family relations before and after MMT initiation: **(A)** rate of being arrested by police; **(B)** rate of drug-selling; **(C)** rate for selling sex for drugs; **(D)** rate for drug-related crime, **(E)** employment rate; **(F)** rate of having good relationship with family; **(G)** proportion of clients having contacts with former drug-user friends on a daily basis, among Chinese MMT clients at various intervention periods.

Table 1 The comparison of social functioning and family relations before and after entering MMT

	Baseline (admission to MMT)	Post-intervention period		
		6 months	12 months	>12 months
Arrested rate	13.1% (9.1%-18.5%)	3.4% (1.5%-7.7%)	4.3% (1.6%-11.4%)	1.4% (0.5%-3.7%)
Proportion of selling drugs	6.5% (3.4%-12.0%)	1.4% (0.5%-3.9%)	3.0% (1.0%-8.9%)	1.0% (0.1-6.6%)
Proportion of selling sex for drugs	5.3% (2.4%-11.1%)	1.1% (0.5%-2.3%)	0.8% (0.3%-1.9%)	1.0% (0.1%-6.6%)
Proportion of drug-related crime	9.9% (6.8%-14.2%)	3.4% (2.5%-4.5%)	3.4% (0.8%-13.1%)	3.3% (2.1%-5.3%)
Employment rate	26.1% (23.6%-28.8%)	47.3% (40.9%-53.8%)	54.7% (47.4%-61.9%)	45.5% (37.2%-54.1%)
Had a good family relation	39.7% (35.1%-44.6%)	63.3% (54.7%-71.1%)	72.1% (65.1%-78.2%)	83.2% (77.8%-87.6%)
Having contact with former drug-user friends everyday	25.3% (18.9%-33.0%)	4.0% (2.4%-6.4%)	7.7% (1.4%-33.2%)	1.0% (0.1%-6.6%)

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Methadone maintenance treatment programme reduces criminal activities and improve social wellbeing of drug users in China: a systematic review and meta-analysis

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ABSTRACT

Objective: Methadone maintenance treatment (MMT) has been implemented in China since 2004 and has expanded into a nationwide program. The study aims to evaluate the changes in social functioning, family relations and drug-related criminal behaviours among MMT clients in China.

Design: Systematic review and meta-analysis.

Methods: Both English and Chinese literature databases, including PubMed, Chongqing VIP Chinese Science and Technology Journals Database (CQVIP), China National Knowledge Infrastructure (CNKI) and Wanfang Data, were comprehensively searched over the period 2004-2014 for studied indicators. Study selection, quality assessment and data extraction were conducted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses. Meta-analyses were conducted using Comprehensive Meta-Analysis Biostat software.

Results: Thirty-eight articles were included in this review (1 in English and 37 in Chinese). The self-reported arrest rate reduced from 13.7% (95% CI: 9.1-20.0%) at baseline, to 3.5% (1.1-10.5%), and to 4.3% (1.6-11.4%) after 6, and 12-month MMT intervention, respectively. The rate for drug-selling reduced from 7.6% (3.8-14.8%) at baseline, to 1.9% (0.6-6.2%), and to 3.0% (1.0-8.9%) after 6, and 12-month of intervention, respectively. Similarly, the rates of selling sex for drugs and drug-related crime reduced from 5.3% (2.4%-11.1%) and 9.9% (6.8%-14.2%) at baseline, to 1.1% (0.5%-2.3%) and 3.4% (2.5%-4.5%) at 6-month, then to 0.8% (0.3%-1.9%) and 3.4% (0.8%-13.1%) at 12-month after treatment initiation, respectively. In contrast, employment rate of clients and proportion of clients having a good relationship with family increased substantially from 26.4% (22.9-30.1%) and 37.9% (32.0-44.2%), to 41.6% (36.6-48.0%) and 59.6% (48.1-70.2%) at 6-month, then to 59.8% (52.4-66.8%) and 75.0% (69.0-80.2%) at 12-month after treatment initiation.

Conclusions: MMT has significantly reduced the criminal activities and improved employment rate and social wellbeing of MMT clients. MMT is an effective measure to help drug users to resume societal and familial functions in China.

KEY WORDS

Criminal activities, Social functioning and family relations, Changes, Methadone maintenance treatment, Meta-analysis, China

Strengths and limitations of this study

- This is the first study to review how MMT intervention could influence the changes of social functioning and family relations among drug users in MMT clinics in China.
- This study evaluated the changes in drug-related criminal behaviours, improvements in social functioning and family relations among drug users before and after entering the MMT interventions through a meta-analysis of published literature since 2004 in China.
- The number of studies is limited and may lead to issues on representativeness of the large drug user population in China.

INTRODUCTION

Illicit drug abuse is a social and public health issue internationally. It not only increases the risks of disease transmission such as HIV and hepatitis C virus (HCV), [1 2] but also enhances drug-related criminal activities, family issues, and excessive health care expenditures. [3 4] Heroin is the most common drug used among drug users in both developed and developing countries. [5-7] Methadone maintenance treatment (MMT) has been found to be an effective harm reduction program for drug users. [8-10] Methadone is a safe, low-cost and convenient generic drug for treatment of opioid dependence. [11 12] It effectively reduced drug-related mortality [13-15] drug-related crimes and help drug users to resume social and familial functions .[16-25]

In 2004, eight out-patient MMT clinics were established in China [26 27] and lately expanded into a nationwide program encompassing more than 756 MMT clinics in China, covering 28 Chinese provinces by 2012. It has been shown that the pilot of these eight MMT clinics has significantly improved the social functioning among MMT clients. Annual employment rate were reportedly increased from 22.9% to 40.6% (P < 0.01, compared with the baseline survey); and the proportion of clients having a harmonious relationship with families increased from 49.6% to 65.8% (P < 0.01) after receiving the MMT programs for 12 months. Self-reported criminal behaviour of clients has also reduced from 20.7% to 3.8% (P < 0.01). [24] Similar benefits of MMT were also reported in other countries. For instance, the employment rate of MMT clients Malaysia increased from 70.1% to 77.6% after two years of treatment. [28] A retrospective study in UK also showed that the total number of convictions, theft and fraud convictions, weeks spent in prison per year were reduced by 39.3% (P = 0.03), 52.17% (P<0.001), 82.8% (P = 0.002), respectively. [29]

Numerous studies have reported improvements in social and family wellbeing among MMT clients in China, but a systematic review that synthesises all these impacts remained absent. This study aims to evaluate the changes in drug-related criminal behaviours, improvements in social functioning and family relations among drug users before and after entering the MMT interventions through a meta-analysis of published literature since 2004 in China.

METHODS

Data sources

We conducted a systematic review of published peer-reviewed research articles by searching the following databases: PubMed, CQVIP, CNKI and Wanfang Data from January 2004 to October 2014. Keywords used in the database search included ("Methadone" OR "Methadone Maintenance Treatment" OR "Methadone Maintenance Therapy" OR "Methadone Maintenance" OR "MMT") AND ("Crime" OR "Criminal rates" OR "Employment" OR "Family relationship" OR "Social functions") AND ("China" OR "China Mainland" OR "Chinese"). We also performed a manual search on the reference lists of published articles. This review was reported according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Statement issued in 2009. [30]

Inclusion/exclusion criteria

Studies were eligible for inclusion in this systematic review if they met the following criteria: (1) articles published in Chinese or English language; (2) study reported social functioning or family relations among clients in MMT at baseline and follow-up; and (3) reported the study characteristics such as study location, investigation period, duration of intervention, and sample size. Pre-and-post intervention studies among MMT clients were also included. Exclusion criteria were: (1) review papers; (2) non peer–reviewed local/government reports; (3) conference abstracts and presentations; and (4) dissertations. If the same data source were published in both English and Chinese sources, the articles published in Chinese language were excluded from this study.

Study selection

Selected studies were evaluated by two independent investigators (HMS, XYL) according to the inclusion and exclusion criteria. Disagreement in evaluation was resolved by discussion among the investigators. If the same study data were published in both English and Chinese sources, the articles published in Chinese language were excluded from this study. In cases where multiple studies were found to use the same data source, we selected the first published study for inclusion in the meta-analysis.

Quality assessment

Two independent investigators used a validated quality assessment tool for observational studies [31] to assess the quality of studies. The following eight items were assessed to calculate a total quality score: (1) clear definition of the target population; (2) representativeness of probability sampling; (3) sample characteristics matching the overall population; (4) adequate response rate; (5) method of data collection methods; (6) reliability of survey measures/instruments; (7) validity of survey measures/instruments; and (8) appropriate statistical methods. Each item was scored 0 for 'No' and 1 for 'Yes', respectively. The total quality score ranged from 0 to 8 (Table S1).

Data abstraction

Two independent investigators extracted the following information from all eligible studies: first author, year of publication, study location, investigation period, gender composition, age, sample size, duration of intervention, proportion of drug-related criminal activities (including drug-trafficking, selling, robbery and theft for drug), employment rate, and relationship with family among clients in MMT at baseline and follow-up of treatment.

Statistical Analysis

Meta-analyses were carried out with the Comprehensive Meta-Analysis software (V2.0, Biostat, Englewood, New Jersey). The effect rates of pooled estimates and 95% confidence intervals (CIs) were determined based on random effect models. Heterogeneity tests were performed using the Cochran Q-test ($P< 0.10$ represents statistically significant heterogeneity) and I^2 statistic. Potential publication bias was measured by the Begg and Mazumdar rank correlation ($P< 0.05$ represents statistically significant publication bias.

RESULTS

Trial Flow/Flow of included studies

According to our initial search strategies, 345 articles were identified from four electronic databases. We excluded 128 irrelevant articles after the title screening. The remaining 217 abstracts were screened by two independent investigators (HMS, XYL), and 136 articles were excluded. 81 articles were eligible for full-text screening, of these, 43 articles were excluded. A total of 38 articles were eligible and included (1 in English, 37 in Chinese) in this review. 22 studies reported the changes in criminal activities (14 reported arrested rate, 8 reported drug-sold, 7 reported selling sex for drugs and 12 reported rate for drug-related crime), and 37 studies reported the changes in family and friends relations (37 reported employment, 28 reported relationship with family, 11 reported relationship with friends) (Figure 1).

Study characteristics

The sample size of MMT clients reported in the eligible studies ranged from 65 to 13,310 (median: 320.5, IQR:120-651.5). A total of 30,239 participants were included in this review, and about 76.2% were male. The mean age of the total MMT clients was 34.42 years (range: 18-62 years). Of the 38 eligible articles, almost half of the studies (44.8%) were conducted in the provinces with high HIV prevalence (>20%) [32 33] including Yunnan, Sichuan, Guangdong, Xinjiang, Guizhou and Guangxi. The follow-up period of MMT intervention ranged from 6 to 48 months, and the majority were followed up within 12 months (86.8%). Twenty studies were prospective cohort studies, whereas others were retrospective.

Criminal activities

The criminal activities among the MMT clients had significantly reduced after receiving MMT intervention. The self-reported arrest rate reduced from 13.7% (95% CI: 9.1-20.0%) at baseline (Table 1, Figure 2A), to 3.5% (95% CI: 1.1-10.5%), to 4.3% (95% CI: 1.6-11.4%) and to 1.4% (95% CI: 0.5-3.7%) at 6-, 12- and 36-months follow-up. About 7.6% (95% CI: 3.8-14.8%) of the clients who had sold drugs before receiving MMT intervention (Table 1, Figure 2B), this rate was reduced to 1.9% (95% CI: 0.6-6.2%) after 6 months, to 3.0% (95% CI: 1.0-8.9%) after 12 months and 1.0% (95% CI: 0.1-6.6%) after 36 months. The proportion of selling sex for drugs reduced from 5.3% (2.4%-11.1%) at baseline, to 1.1% (0.5%-2.3%) at 6-month, to 0.8% (0.3%-1.9%) at 12-month intervention, respectively (Table 1,

Figure 2C). The proportion of drug-related crime also reduced from 9.9% (6.8%-14.2%) at baseline, to 3.4% (2.5%-4.5%) at 6-month, to 3.4% (0.8%-13.1%) at 12-month intervention, respectively (Table 1, Figure 2D). 10 studies reported the rate of drug-related crime decreased from 1.1-30.34% to 0.5-3.7%. In addition, 6 studies reported the rate of selling sex for drugs reduced from 1.9-24.0% to 0.5-1.5% after MMT intervention.

Social functioning

Employment rate among clients had been improved after receiving MMT. The overall employment rate increased from 26.4% (95% CI: 22.9-30.1%) at baseline (Table 1, Figure 2E), to 41.6% (95% CI: 36.6-48.0%) after 6 months of treatment, and further increased to 59.8% (95% CI: 52.4-66.8%) after 12 months, but slightly decreased to 55.4% (95% CI: 48.2-62.3%) over 12 months.

Family relations

Family relations among clients had also been improved after receiving MMT. In addition, only 37.9% (95% CI: 32.0-44.2%) (Table 1, Figure 2F) drug users reporting having a good relationship with their family before receiving MMT interventions; however, this rate significantly increased to 59.6% (95% CI: 48.1-70.2%) after 6 months, to 75.0% (95% CI: 69.0-80.2%) after 12 months, and to 83.2% (95% CI: 77.8-87.6%) after >12 months of treatment.

Contacting with former drug-user friends

Furthermore, about 31.0% of clients (95% CI: 25.7-36.8%) (Table 1, Figure 2G) met their former drug-user friends every day at baseline; however, the rate of contacting with former drug-user friends reduced to 6.5% (95% CI: 4.4-9.4%), 7.7% (95% CI: 1.4-33.2%), 1.0% (95% CI: 0.1-6.6%) after 6, 12, >12 months of intervention, respectively.

Quality assessment

All studies reported study period, study location and sample size**.** All studies reached a total quality score of three or higher (out of a total of eight). The mean quality score was 3.97, indicating a reasonably good quality of our selected studies (Table S1).

DISCUSSION

To our best knowledge, this is the first study that reviews the impacts of MMT treatment on the changes in criminal activities, social functioning and family relations among MMT clients in China. Our findings indicated that MMT have significantly reduced self-reported arrest rate, frequencies of selling drugs, drug-related crime activities, selling sex for drugs and likelihood of meeting former drug-user friends. In contrast, it improved employment rate and family relations of MMT clients. These findings are consistent with other international studies in England, Lithuania and Israel. [34-37] In particular, a meta-analysis conducted by Marsch et.al. showed that 85% of drug users who attended MMT have reduced drug-related crime. [38] A systematic review conducted by Holloway et.al., also showed that MMT clients have less criminal behaviour than the non-MMT drug users. [39] Despite these, policy makers who retain strong moral reservations about MMT would emphasise the physically dependent nature of methadone and ongoing spending of public funds on a population that is deemed as 'social evils' in many settings. [40] Further studies are necessary to evaluate other aspects of MMT, including structural barriers and cost-effectiveness of the program, in order to help policy makers to inform relevant polices in the future.

We demonstrated improved employment rates and family relations among MMT clients in China. Consistently, a study conducted in the United States also indicated a significant improvement in employment outcomes with an integrated drug counselling and employment programme for MMT clients. [41] In addition, a Swedish study showed that over 80% severe heroin addicts received new jobs and re-integrated into the society after receiving MMT. [42] In a separate study, Blix followed 345 heroin users for 24 years over the period 1966-1989 in Sweden. In which, a 70-80% employment rate among MMT clients was reported. [42] Interestingly, our meta-analysis indicated the best employment outcome at 12-month of treatment initiation and the rate started to decline when treatment continues beyond 12 months. This finding is echoed with findings from an early survey of first eight pilot MMT clinics in China. [43] A plausible explanation may be that employed clients are more likely to drop-out of treatment, which leads to a declining employment rate among those who sustain treatment. Further, family relations of clients improved during the course of MMT. With reduced symptoms of addiction, clients would be able to resume family duties and re-establish relationship with their family members. [44 45]

Several limitations in this study should be noted. First, by the end of 2012, there were totally 756 MMT clinics in China, covering 28 Chinese provinces, however, out of which, 13 provinces did not

publish any reports on the related characteristics of social and familial relationship and this limits our analysis in these regions. Second, only eight studies reported clients who sold drugs. Small number of studies could lead to information bias in our study. Third, due to the small number of available studies, we pooled all study estimate beyond 12 months of follow-up in this analysis. Fourth, substantial heterogeneity existed between studies due to different study methodologies, method of recruitment and sampling sizes in different studies. Our meta-analyses could not take all of these variations across individual studies into account. Fifth, limited number of studies reported relevant characteristics of social and familial relationship in recent years and the reports' delay in publication may also bias our findings.

Conclusions

Conclusively, MMT programme in China has been shown to be effective in reducing criminal activities and improving employment outcome and social wellbeing of its clients. MMT programme should not only focus on the reduction of drug abuse, other advisory and intervention services, such as Voluntary Counselling and Testing (VCT) of HIV, psychological therapy, family intervention may be integrated into the program simultaneously. [46 47] In parallel, clients should be encouraged to make use of rehabilitation facilities to improve their own awareness in safeguarding their own rights and interests. MMT may serve as a valuable opportunity to reduce drug-related harm among drug users and enable them to return to society as healthy and productive individuals.

Ethics An ethics statement was not required for this work.

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Contributors EPFC, LZ and XZ designed the study. HMS and XYL performed the data collection and provided the first draft of manuscript. TL, XY, YHL and TT performed data analysis. LZ and EPFC assisted with data interpretation. EPFC, LZ and XZ provided critical revision for important intellectual content. All authors read and approved the final version of manuscript.

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Competing interests None.

Table 1 The comparison of social functioning and family relations before and after entering MMT

	Baseline (admission to MMT)	Post-intervention period		
		6 months	12 months	>12 months
Arrested rate	13.1% (9.1%-18.5%)	3.4% (1.5%-7.7%)	4.3% (1.6%-11.4%)	1.4% (0.5%-3.7%)
Proportion of selling drugs	6.5% (3.4%-12.0%)	1.4% (0.5%-3.9%)	3.0% (1.0%-8.9%)	1.0% (0.1-6.6%)
Proportion of selling sex for drugs	5.3% (2.4%-11.1%)	1.1% (0.5%-2.3%)	0.8% (0.3%-1.9%)	1.0% (0.1%-6.6%)
Proportion of drug-related crime	9.9% (6.8%-14.2%)	3.4% (2.5%-4.5%)	3.4% (0.8%-13.1%)	3.3% (2.1%-5.3%)
Employment rate	26.1% (23.6%-28.8%)	47.3% (40.9%-53.8%)	54.7% (47.4%-61.9%)	45.5% (37.2%-54.1%)
Had a good family relation	39.7% (35.1%-44.6%)	63.3% (54.7%-71.1%)	72.1% (65.1%-78.2%)	83.2% (77.8%-87.6%)
Having contact with former drug-user friends everyday	25.3% (18.9%-33.0%)	4.0% (2.4%-6.4%)	7.7% (1.4%-33.2%)	1.0% (0.1%-6.6%)

Table S1 Studies reporting the changes in criminal activities, social wellbeing and family relations before and after entering MMT

First Author, Published Year	Study Period	Study Location (Province)	Sample size	Post-intervention period (month)	Change of social functioning and family relations							Quality Assessment Score
					Arrested rate	Selling drugs	Selling sex for drugs	Drug-related criminal	Employment status	Good relationship with family	Contacting with former drug-user friends everyday	
Cai WB (2013) [48]	2013	Yunnan	365	6						B:117/239 A:178/234		3
Chen B (2011) [44]	2009	Guangdong	102	36	B:8/102 A:1/102	B:10/102 A:1/102	B:4/102 A:1/102	B:5/102 A:1/102		B:61/102 A:84/102	B:5/102 A:1/102	4
Chen GH (2008) [45]	2006	Jiangsu	554	6			B:54/554 A:2/324	B:12/554 A:12/324	B:159/554 A:137/324	B:266/554 A:244/324		3
Chen W (2009) [49]	2008	Guangdong	445	12				B:135/445 A:7/445	B:164/445 A:243/445			5
Chen W (2010) [50]	2008	Guangdong	13310	6				B:719/13310 A:426/13310	B:3128/13310 A:7467/13310			4
Chen W (2010) [50]	2008	Guangdong	13310	12				B: 719/13310 A: 452/13310	B:3128/13310 A:7334/13310			4
Duan YJ (2008) [51]	2006	Yunnan	99	12					B:28/99 A:90/99	B:53/99 A:7799		3
Fan LR (2012) [52]	2010	Jiangxi	124	12					B:9/67 A:51/124	B:51/124 A:87/124		3
Feng SQ (2010) [53]	2008	Jiangsu	371	12	B:12/371 A:10/371		B:7/371 A:2/371	B:4/371 A:2/371				4
Fu JH (2010) [54]	2008	Jiangxi	80	6						B:22/80 A:19/68		4
Fu LP (2007) [55]	2006	Xinjiang	958	6	B:116/593 A:28/135	B:77/593 A:8/135	B:25/593 A:2/135	B:69/593 A:8/135	B:292/593 A:68/134	B:241/599 A:87/134	B:244/583 A:16/133	3
Fu LP (2007) [55]	2006	Xinjiang	958	12			B:25/593 A:2/197	B:69/593 A:4/197	B:292/593 A:143/225	B:241/599 A:182/231	B:244/583 A:37/230	3
Guo Y (2007) [56]	2006	Yunnan	656	6				B:79/656 A:5 /233	B:183/656 A:85 /233	B:238/656 A:135/233	B:201/656 A:13/233	5

Table S1 Studies reporting the changes in criminal activities, social wellbeing and family relations before and after entering MMT *(Continued)*

First Author, Published Year	Study Period	Study Location (Province)	Sample size	Post-intervention period (month)	Change of social functioning and family relations							Quality Assessment Score
					Arrested rate	Selling drugs	Selling sex for drugs	Drug-related criminal	Employment status	Good relationship with family	Contacting with former drug-user friends everyday	
Han YB (2012) [57]	2009	Guangxi	1123	6					B:303/658 A:340/658			4
Hu WS (2010) [58]	2008	Guangdong	125	22					B:12/125 A:65/125	B:18/125 A:105/125		4
Huang YJ(2012) [59]	2010	Guangxi	150	6	B:31/150 A:5/150	B:21/150 A:3/150	B:9/150 A:2/150	B:46/150 A:8/150	B:39/150 A:98/150	B:78/150 A:116/150	B:63/150 A:8/150	5
Jiang A (2009) [60]	2007	Ningxia	100	12	B:32/100 A:11/100	B:18/100 A:3/100	B:24/100 A:1/100		B:38/100 A:50/100	B:46/100 A:82/100	B:32/100 A:3/100	4
Liu JB (2007) [61]	2005	Xinjiang	170	6					B:31/94 A:45/94	B:32/94 A:49/94		4
Liu JK (2009) [62]	2006	Sichuan	112	12					B:32/112 A:102/112	B:60/112 F86/112		3
Liu WY(2012) [63]	2010	Chongqing	650	6		B:1/640 A:1/645			B:184/605 A:536/648	B:318/639 A:508/643	B:84/637 A:1/640	3
Liu YJ (2007) [64]	2007	Beijing	130	6	B:9/130 A:1/130	B:6/130 A:3/130			B:30/130 A:33/130	B:108/130 A:98/130	B:36/130 A:3/130	3
Long ZY (2006) [65]	2005	Guizhou	538	6					B:134/538 A:104/404			4
Lu JJ (2010) [66]	2010	Jiangsu	185	36	B:8/185 A:3/185				B:75/185 A:95/185			5
Pang L (2007) [24]	2004	Beijing	609	6				B:121/585 A:22/609	B:134/585 A:263/609			5
Pang L (2007) [24]	2004	Beijing	468	12				B:121/585 A:178/468	B:134/585 A:190/468	B:200/585 A:308/468		5
Qian YH (2008) [67]	2007	Jiangsu	965	6					B:25/103 A:45/104	B:55/103 A:79/104		4

Table S1 Studies reporting the changes in criminal activities, social wellbeing and family relations before and after entering MMT *(Continued)*

First Author, Published Year	Study Period	Study Location (Province)	Sample size	Post-intervention period (month)	Change of social functioning and family relations							Quality Assessment Score
					Arrested rate	Selling drugs	Selling sex for drugs	Drug-related criminal	Drug-related criminal	Good relationship with family	Contacting with former drug-user friends everyday	
Qu BW (2009) [68]	2007	Guangdong	80	6			B:7/80 A:1/80	B:3/80 A:1/80	B:3/80 A:1/80	B:26/80 A:39/80		6
Tang XJ (2012) [69]	2010	Chongqing	1477	6						B:737/1458 A:864/1082	B:222/1456 A:2/1066	3
Tang RH (2012) [70]	2011	Yunnan	382	6				B:38/382 A:19/382	B:38/382 A:19/382			5
Tang RH (2012) [70]	2011	Yunnan	784	12				B:72/784 A:29/784	B:72/784 A:29/784			5
Tang RH (2012) [70]	2011	Yunnan	533	24				B:54/533 A:26/533	B:54/533 A:26/533			5
Tang RH (2012) [70]	2011	Yunnan	406	36				B:48/406 A:15/406	B:48/406 A:15/406			5
Tang RH(2012) [70]	2011	Yunnan	457	48				B:76/457 A:10/457	B:76/457 A:10/457			5
Tang XY (2008) [71]	2006	Hunan	196	6	B:87/196 A:5/196					B:10/196 A:51/196	B:67/196 A:14/196	3
Tang YX (2013) [72]	2012	Guangdong	120	6	B:24/120 A:10/120					B:1/120 A:7/120		3
Wang YZ (2008) [73]	2007	Zhejiang	237	12	B:51/237 A:6/237					B:49/237 A:116/165		3
Wei XL (2008) [74]	2007	Shaanxi	972	6	B:183/972 A:18/667	B:19/972 A:1/667		B:34/972 A:343/667	B:34/972 A:343/667	B:391/972 A:4/667	B:347/972 A:38/667	5
Xue LY (2006) [75]	2006	Shanghai	115	12								4
Yun Y(2014) [76]	2013	Henan	338	12						B:78/338 A:184/338		5

Table S1 Studies reporting the changes in criminal activities, social wellbeing and family relations before and after entering MMT *(Continued)*

First Author, Published Year	Study Period	Study Location (Province)	Sample size	Post-intervention period (month)	Change of social functioning and family relations							Quality Assessment Score
					Arrested rate	Selling drugs	Selling sex for drugs	Drug-related criminal	Employment status	Good relationship with family	Contacting with former drug-user friends everyday	
Zhang HF (2009) [77]	2008	Shaanxi	120	6	B:11/120 A:3/120	B:9/120 A:3/120			B:21/120 A:36/120			4
Zhang HY (2013) [78]	2011	Beijing	334	6	B:9/334 A:0/187				B:72/334 A:62/187	B:184/334 A:117/187		3
Zhang J (2008) [79]	2007	Jiangsu	307	20					B:67/307 A:136/220			5
Zhao YT (2009) [80]	2006	Guangdong	65	6	B:8/65 A:2/65				B:7/65 A:20/65	B:15/65 A:43/65		6
Zheng WX (2012) [81]	2007	Fujian	585	6					B:184/585 A:305/581	B:343/585 A:307/581	B:108/585 A:32/581	3
Zhu YH (2012) [82]	2012	Jiangxi	342	6						B:71/212 A:198/212		4

Note: B=Before entering MMT program; A=After entering MMT program

Figure legends:

Figure 1 Flow chart of selection of studies.

Figure 2 Changes in criminal activities, social wellbeing and family relations before and after MMT initiation: **(A)** rate of being arrested by police; **(B)** rate of drug-selling; **(C)** rate for selling sex for drugs; **(D)** rate for drug-related crime, **(E)** employment rate; **(F)** rate of having good relationship with family; **(G)** proportion of clients having contacts with former drug-user friends on a daily basis, among Chinese MMT clients at various intervention periods.

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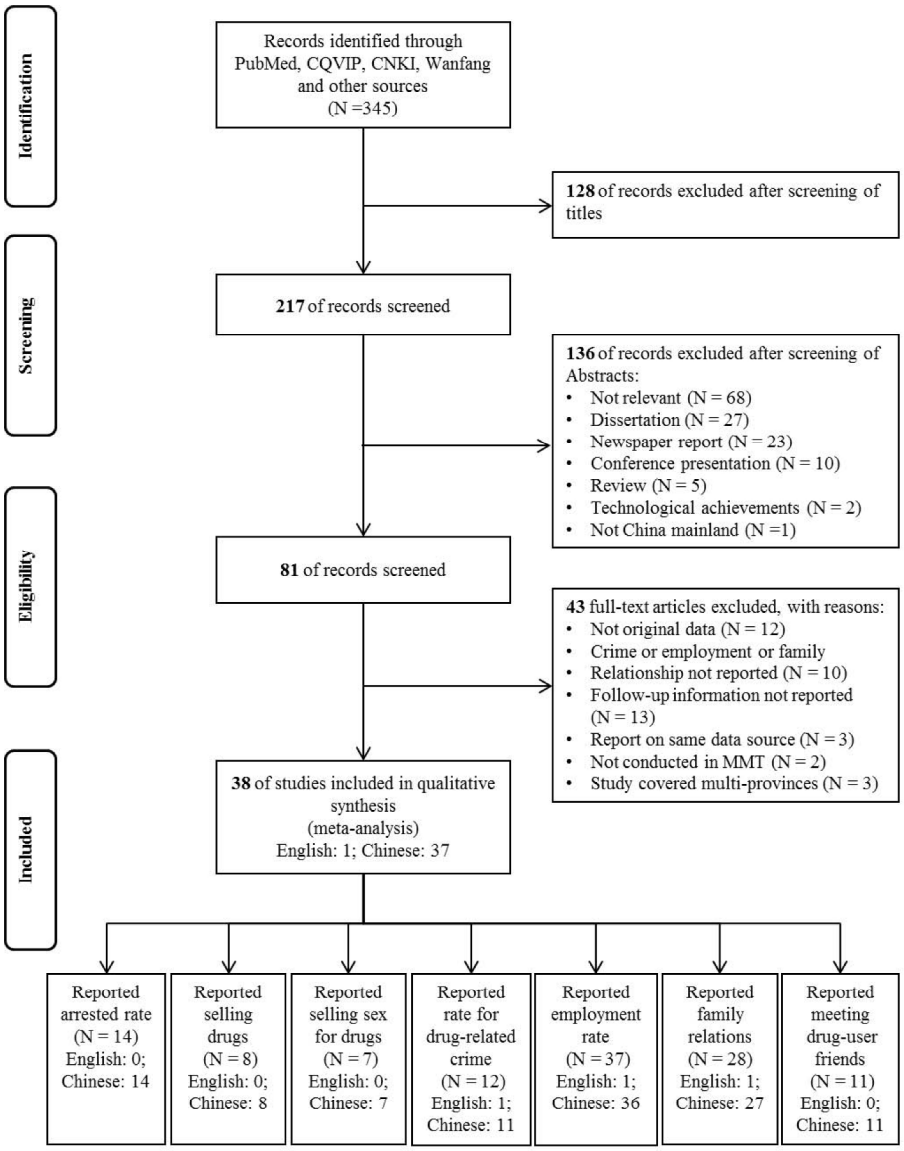

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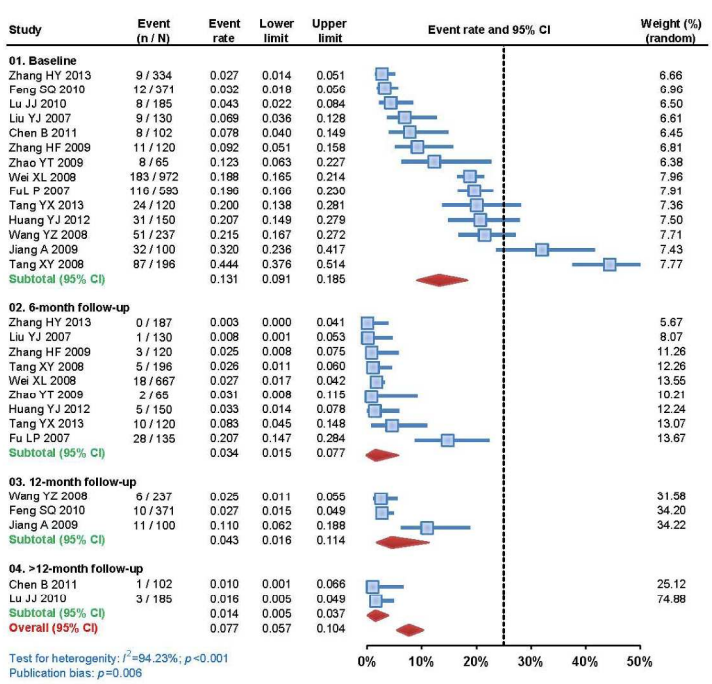

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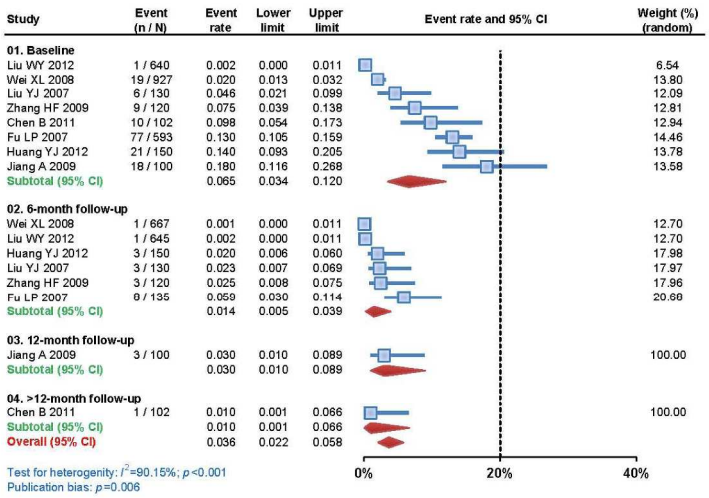

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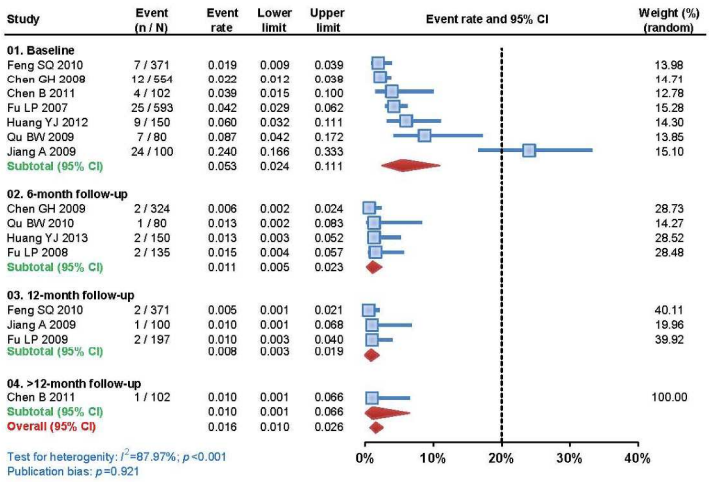

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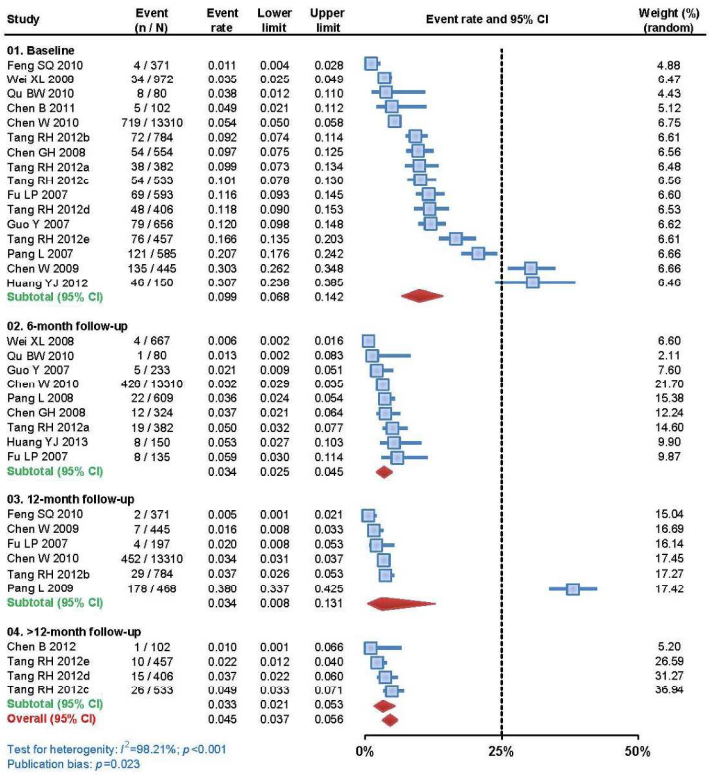

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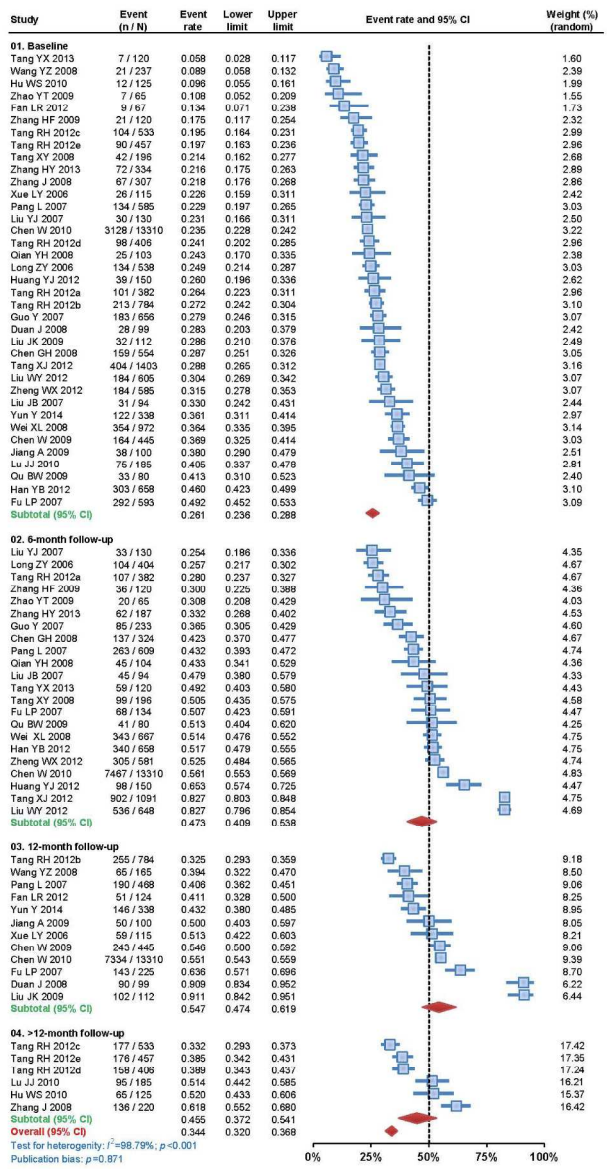

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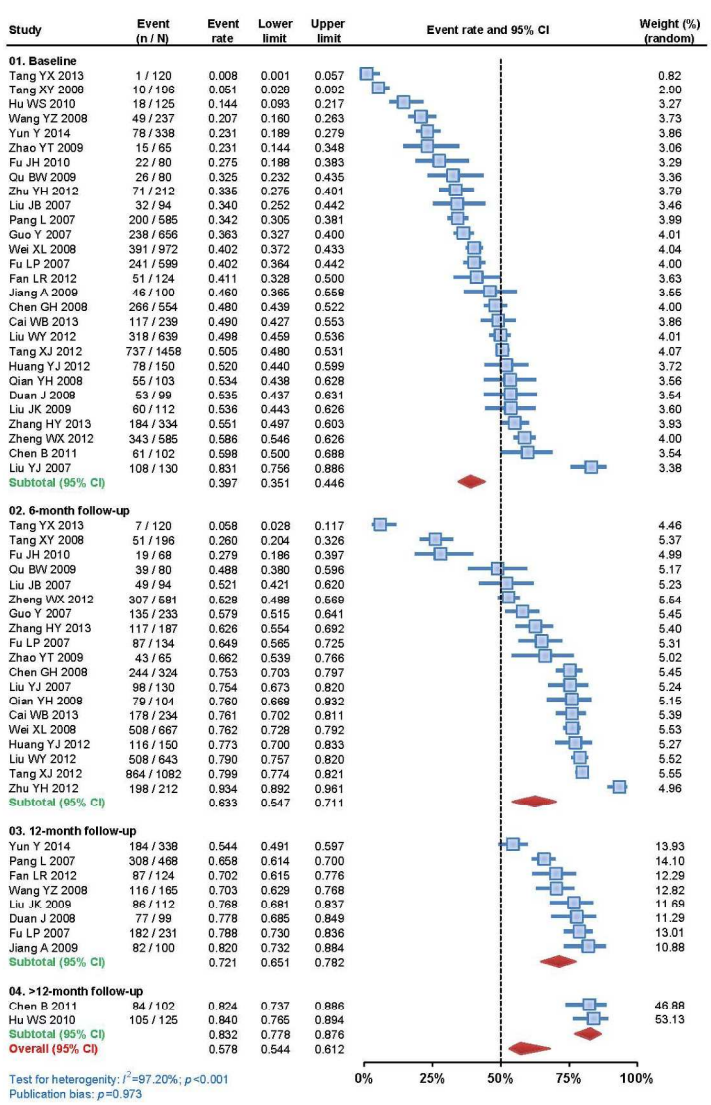

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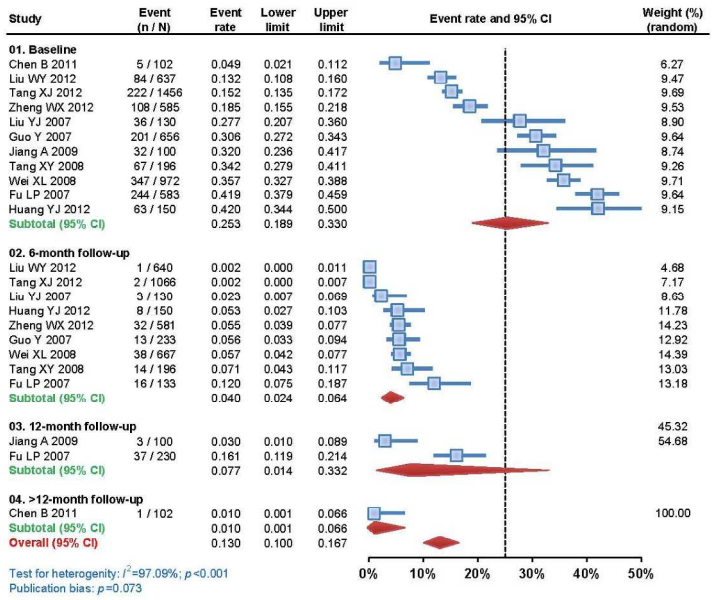

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Table S1 Studies reporting the changes in criminal activities, social wellbeing and family relations before and after entering MMT

First Author, Published Year	Study Period	Study Location (Province)	Sample size	Post-intervention period (month)	Change of social functioning and family relations							Quality Assessment Score
					Arrested rate	Selling drugs	Selling sex for drugs	Drug-related criminal	Employment status	Good relationship with family	Contacting with former drug-user friends everyday	
Cai WB (2013) [48]	2013	Yunnan	365	6						B:117/239 A:178/234		3
Chen B (2011) [44]	2009	Guangdong	102	36	B:8/102 A:1/102	B:10/102 A:1/102	B:4/102 A:1/102	B:5/102 A:1/102		B:61/102 A:84/102	B:5/102 A:1/102	4
Chen GH (2008) [45]	2006	Jiangsu	554	6			B:54/554 A:2/324	B:12/554 A:12/324	B:159/554 A:137/324	B:266/554 A:244/324		3
Chen W (2009) [49]	2008	Guangdong	445	12				B:135/445 A:7/445	B:164/445 A:243/445			5
Chen W (2010) [50]	2008	Guangdong	13310	6				B:719/13310 A:426/13310	B:3128/13310 A:7467/13310			4
Chen W (2010) [50]	2008	Guangdong	13310	12				B: 719/13310 A: 452/13310	B:3128/13310 A:7334/13310			4
Duan YJ (2008) [51]	2006	Yunnan	99	12					B:28/99 A:90/99	B:53/99 A:7799		3
Fan LR (2012) [52]	2010	Jiangxi	124	12					B:9/67 A:51/124	B:51/124 A:87/124		3
Feng SQ (2010) [53]	2008	Jiangsu	371	12	B:12/371 A:10/371		B:7/371 A:2/371	B:4/371 A:2/371				4
Fu JH (2010) [54]	2008	Jiangxi	80	6						B:22/80 A:19/68		4
Fu LP (2007) [55]	2006	Xinjiang	958	6	B:116/593 A:28/135	B:77/593 A:8/135	B:25/593 A:2/135	B:69/593 A:8/135	B:292/593 A:68/134	B:241/599 A:87/134	B:244/583 A:16/133	3
Fu LP (2007) [55]	2006	Xinjiang	958	12			B:25/593 A:2/197	B:69/593 A:4/197	B:292/593 A:143/225	B:241/599 A:182/231	B:244/583 A:37/230	3
Guo Y (2007) [56]	2006	Yunnan	656	6				B:79/656 A:5 /233	B:183/656 A:85 /233	B:238/656 A:135/233	B:201/656 A:13/233	5

Table S1 Studies reporting the changes in criminal activities, social wellbeing and family relations before and after entering MMT *(Continued)*

First Author, Published Year	Study Period	Study Location (Province)	Sample size	Post-intervention period (month)	Change of social functioning and family relations							Quality Assessment Score
					Arrested rate	Selling drugs	Selling sex for drugs	Drug-related criminal	Employment status	Good relationship with family	Contacting with former drug-user friends everyday	
Han YB (2012) [57]	2009	Guangxi	1123	6					B:303/658 A:340/658			4
Hu WS (2010) [58]	2008	Guangdong	125	22					B:12/125 A:65/125	B:18/125 A:105/125		4
Huang YJ(2012) [59]	2010	Guangxi	150	6	B:31/150 A:5/150	B:21/150 A:3/150	B:9/150 A:2/150	B:46/150 A:8/150	B:39/150 A:98/150	B:78/150 A:116/150	B:63/150 A:8/150	5
Jiang A (2009) [60]	2007	Ningxia	100	12	B:32/100 A:11/100	B:18/100 A:3/100	B:24/100 A:1/100		B:38/100 A:50/100	B:46/100 A:82/100	B:32/100 A:3/100	4
Liu JB (2007) [61]	2005	Xinjiang	170	6					B:31/94 A:45/94	B:32/94 A:49/94		4
Liu JK (2009) [62]	2006	Sichuan	112	12					B:32/112 A:102/112	B:60/112 F86/112		3
Liu WY(2012) [63]	2010	Chongqing	650	6		B:1/640 A:1/645			B:184/605 A:536/648	B:318/639 A:508/643	B:84/637 A:1/640	3
Liu YJ (2007) [64]	2007	Beijing	130	6	B:9/130 A:1/130	B:6/130 A:3/130			B:30/130 A:33/130	B:108/130 A:98/130	B:36/130 A:3/130	3
Long ZY (2006) [65]	2005	Guizhou	538	6					B:134/538 A:104/404			4
Lu JJ (2010) [66]	2010	Jiangsu	185	36	B:8/185 A:3/185				B:75/185 A:95/185			5
Pang L (2007) [24]	2004	Beijing	609	6				B:121/585 A:22/609	B:134/585 A:263/609			5
Pang L (2007) [24]	2004	Beijing	468	12				B:121/585 A:178/468	B:134/585 A:190/468	B:200/585 A:308/468		5
Qian YH (2008) [67]	2007	Jiangsu	965	6					B:25/103 A:45/104	B:55/103 A:79/104		4

Table S1 Studies reporting the changes in criminal activities, social wellbeing and family relations before and after entering MMT *(Continued)*

First Author, Published Year	Study Period	Study Location (Province)	Sample size	Post-intervention period (month)	Change of social functioning and family relations							Quality Assessment Score
					Arrested rate	Selling drugs	Selling sex for drugs	Drug-related criminal	Drug-related criminal	Good relationship with family	Contacting with former drug-user friends everyday	
Qu BW (2009) [68]	2007	Guangdong	80	6			B:7/80 A:1/80	B:3/80 A:1/80	B:3/80 A:1/80	B:26/80 A:39/80		6
Tang XJ (2012) [69]	2010	Chongqing	1477	6						B:737/1458 A:864/1082	B:222/1456 A:2/1066	3
Tang RH (2012) [70]	2011	Yunnan	382	6				B:38/382 A:19/382	B:38/382 A:19/382			5
Tang RH (2012) [70]	2011	Yunnan	784	12				B:72/784 A:29/784	B:72/784 A:29/784			5
Tang RH (2012) [70]	2011	Yunnan	533	24				B:54/533 A:26/533	B:54/533 A:26/533			5
Tang RH (2012) [70]	2011	Yunnan	406	36				B:48/406 A:15/406	B:48/406 A:15/406			5
Tang RH(2012) [70]	2011	Yunnan	457	48				B:76/457 A:10/457	B:76/457 A:10/457			5
Tang XY (2008) [71]	2006	Hunan	196	6	B:87/196 A:5/196					B:10/196 A:51/196	B:67/196 A:14/196	3
Tang YX (2013) [72]	2012	Guangdong	120	6	B:24/120 A:10/120					B:1/120 A:7/120		3
Wang YZ (2008) [73]	2007	Zhejiang	237	12	B:51/237 A:6/237					B:49/237 A:116/165		3
Wei XL (2008) [74]	2007	Shaanxi	972	6	B:183/972 A:18/667	B:19/972 A:1/667		B:34/972 A:343/667	B:34/972 A:343/667	B:391/972 A:4/667	B:347/972 A:38/667	5
Xue LY (2006) [75]	2006	Shanghai	115	12								4
Yun Y(2014) [76]	2013	Henan	338	12						B:78/338 A:184/338		5

Table S1 Studies reporting the changes in criminal activities, social wellbeing and family relations before and after entering MMT *(Continued)*

First Author, Published Year	Study Period	Study Location (Province)	Sample size	Post-intervention period (month)	Change of social functioning and family relations							Quality Assessment Score
					Arrested rate	Selling drugs	Selling sex for drugs	Drug-related criminal	Employment status	Good relationship with family	Contacting with former drug-user friends everyday	
Zhang HF (2009) [77]	2008	Shaanxi	120	6	B:11/120 A:3/120	B:9/120 A:3/120			B:21/120 A:36/120			4
Zhang HY (2013) [78]	2011	Beijing	334	6	B:9/334 A:0/187				B:72/334 A:62/187	B:184/334 A:117/187		3
Zhang J (2008) [79]	2007	Jiangsu	307	20					B:67/307 A:136/220			5
Zhao YT (2009) [80]	2006	Guangdong	65	6	B:8/65 A:2/65				B:7/65 A:20/65	B:15/65 A:43/65		6
Zheng WX (2012) [81]	2007	Fujian	585	6					B:184/585 A:305/581	B:343/585 A:307/581	B:108/585 A:32/581	3
Zhu YH (2012) [82]	2012	Jiangxi	342	6						B:71/212 A:198/212		4

Note: B=Before entering MMT program; A=After entering MMT program

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Both Page 1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Page 2 Abstract
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	Page 4 Paragraph 3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	N/A
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	N/A
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Page 5 Inclusion/exclusion criteria
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	Page 5 Paragraph 1
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Page 5 Paragraph 1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Page 5 Paragraph 1
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Page 6 Paragraph 2
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	Page 7 Paragraph 2
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	N/A
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	Page 6 Paragraph 2 The change of rate

PRISMA 2009 Checklist

Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	Page 6 Paragraph 3

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	Page 6 Paragraph 3
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Page 7 Paragraph 1 and Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Page 7 Paragraph 2
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	N/A
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Page 7 Paragraph 3, Page 8 Paragraph 2-4 and Figure 2
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Figure 2
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Figure 2
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	Page 9 Paragraph 1
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	Page 10 Paragraph 1
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Page 10 Paragraph 2
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Page 11 Funding

PRISMA 2009 Checklist

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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