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Cost-utility analysis of screening and cognitive behavioral therapy compared to usual care for postpartum depression

Bohan Wang[1], Shuyuan Shen[1], Kris YW Lok[2], Jingxia Lin[3] and Robert David Smith[1*]

Abstract

Background Postpartum depression is common and leads to an increase in the risk of poorer maternal outcomes and suicide. Implementing effective screening and treatment for postpartum depression is an international public health priority.

Objective This study aims to estimate the cost-effectiveness of implementing a strategy of Whooley screening followed by referral to Cognitive Behavioral Therapy (CBT) for women screened positive compared with the current Treatment as Usual (TAU) for women with postpartum depression in Hong Kong.

Methods A decision tree model was constructed to estimate the potential cost and utility benefits for Whooley screening followed by referral to CBT for women screened positive compared to TAU in Hong Kong. The model used healthcare costs, in Hong Kong Dollars (HKD), and quality-adjusted life years (QALYs) to estimate economic and health utility outcomes. We used two states (no depression/remission, and depression) modeled over the postpartum period. Deterministic, probabilistic sensitivity analyses and scenario analyses were conducted to explore the robustness of the results under the uncertainty around the model input parameters.

Results The base-case analysis suggested that Whooley screening followed by referral to CBT for women screened positive yielded an additional 0.014 QALYs compared to TAU and added HKD3193.15 to the cost per patient. Deterministic sensitivity analysis indicated that cost-effectiveness results were robust to utilities associated with depression, utilities associated with no depression/remission, and the probability of no improvement in depression for CBT. Probabilistic sensitivity analysis showed that Whooley screening followed by referral to CBT for women screened positive had a 100% likelihood of being more cost-effective than TAU at a willingness-to-pay (WTP) threshold of HKD422,191/QALY. Scenario analysis showed the important influence of patients' acceptability and adherence to CBT on outcomes and revealed the impact of subsequent treatment costs on model results after considering subsequent treatment of false negative patients.

Conclusions Whooley screening followed by referral to CBT for women screened positive is estimated to be cost-effective in identifying and treating women with postpartum depression at an early stage compared to TAU. More research is required to assess this strategy's feasibility, cost-benefit, and clinical effectiveness.

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Keywords Postpartum depression, Cost-utility analysis, Whooley questionnaire, Cognitive behavioral therapy, Hong Kong, Monte carlo simulation

Introduction

Postpartum depression typically develops within the first few weeks after giving birth [1]. It affects approximately 10–20% of mothers globally [1, 2]. An epidemiology study of 385 women in Hong Kong found that 19.8% of women suffered from postpartum depression [3]. Postpartum depression is a significant contributor to the burden of illness in mothers and newborns. It can significantly increase the risk of maternal suicide and result in a range of adverse health outcomes, such as risk of poorer physical health, increased risk of smoking addiction or alcohol abuse. Postpartum depression can also impair the offspring's cognitive development [4]. The emotional problems of mothers with postpartum depression may affect the care of their infants, directly affecting family functioning and may increase the demand for social services, leading to a significant increase in social costs [5]. Therefore, identifying and treating postpartum depression in the early stage is crucial for mothers and infants.

The Whooley questionnaire consists of two short questions, with the third question being enabled if the patients answer yes to either of the first two questions [6]. This tool can be used in detecting likely cases of postpartum depression; a recent meta-analysis found that, compared with other screening tools, the advantage of the Whooley questionnaire is that it requires less time and resources to administer, making it more accessible to the healthcare system when time and resources are limited [7]. A study conducted in Hong Kong on the diagnostic properties of the Whooley questionnaire found that it was reliable in identifying pregnant women at high risk of depression [8]. Additionally, the National Institute for Health and Care Excellence (NICE) also recommended using the Whooley questionnaire to identify postpartum depression [9].

Cognitive Behavioral Therapy (CBT) is a form of psychotherapy that helps people modify negative thought patterns and behaviors [10]. Several studies support the effectiveness of CBT for the treatment of perinatal depression in clinical settings [10–12]. In one randomized controlled trial (RCT), internet-delivered CBT might prevent perinatal depression among pregnant women with subthreshold depressive symptoms [13]. In addition, a study noted [12] that CBT-based interventions also have significant effects on other symptoms, such as anxiety and stress. Compared to pharmacotherapy, CBT reduces depression through psychological counseling and spiritual comforting, has fewer side effects, and is, therefore, more easily accepted. Although the clinical effectiveness of CBT has been widely reported, the cost-effectiveness of CBT for postpartum depression in healthy economic areas has not yet been explored.

Cost-utility analysis (CUA) is a specific form of cost-effectiveness analysis that compares the relative costs and outcomes (measured in quality-adjusted life years (QALYs)) of different treatment strategies [14]. Several studies have assessed the cost-effectiveness of screening and CBT for a wide range of conditions [15–17]. However, none of the studies combined the screening with the treatment to assess the cost-effectiveness in postpartum depression or based on a Hong Kong setting. To bridge this gap in research and provide relevant stakeholders with information to help decision-making, we conducted this CUA based on a decision-tree model. We have developed this model to evaluate the cost-effectiveness of Whooley screening followed by referral to CBT for women screened positive compared to the current TAU. Additionally, we incorporated the incidence rate of postpartum depression in the Hong Kong region as a key parameter to simulate the specific context.

Methods

Study population

This study utilized a hypothetical cohort of the target population for this study, postpartum women in Hong Kong. To reflect this, where possible, this study used data from Hong Kong-based studies or publicly available data from Hong Kong. In this hypothetical cohort, some participants may experience depression based on previous reports on the occurrence of postpartum depression in Hong Kong [18].

Model perspective and outcomes

The analysis was conducted from the health system perspective, with costs expressed in 2024 Hong Kong Dollars (HKD) and health outcomes represented in QALYs.

Treatment as usual arm

The content of the TAU arm was constructed following the current standard procedures for screening, diagnosing, and treating postpartum depression in Hong Kong. In the TAU arm, participants were screened using the Edinburgh Postnatal Depression Scale (EPDS) at 42 days postpartum, when a regular health check-up and vaccination were scheduled for all newborns in Hong Kong. If the EPDS screening result is positive, or if the suicidal ideation item was positive, the case would be referred to the psychiatry department for further evaluation [18]. Consequently, patients with false positive results would be identified during the diagnostic process to avoid

incurring additional costs, while patients with true positive results would receive routine supportive treatment. This treatment included three 20-minute appointments with a psychiatrist every 2.5 months, four 45-minute home visits by a community psychiatric nurse every two months, and a one-hour community allied health service near the end of treatment. After treatment, patients may remain depressed or may remit. However, patients who were screened negative with EPDS for depression would not receive any further treatment in the base-case analysis. There is a lack of TAU studies reporting on postpartum depression in Hong Kong, and we engaged experts in the fields of midwifery and psychiatry to design this arm.

Whooley screening followed by referral to cognitive behavior therapy for women screened positive arm

Regarding the content of the Whooley screening followed by referral to CBT for the women screened positive arm, due to the lack of corresponding guidelines in Hong Kong, we referred to the NICE guidelines [19] and combined them with the current situation of postpartum depression treatment in Hong Kong. In this arm, participants were screened using the Whooley questionnaire 42 days postpartum. If the screening result was positive, the case would be referred to the psychiatry department for further evaluation. Patients identified as having false positive results would be addressed in the psychiatry department, while those with true positive results would receive follow-up CBT. Given the medical resources in Hong Kong, CBT included eight 50-minute CBT sessions conducted by a clinical psychologist once a month, three 20-minute psychiatrist appointments every 2.5 months, four 45-minute home visits by a community psychiatric nurse every two months, and a one-hour community allied health service near the end of treatment [19]. After the treatment, the patient's states may remit or remain depressed. Patients with negative depression screening with Whooley will not receive any subsequent treatment in the base-case analysis.

Model structure and assumptions

We developed an economic model to evaluate the costs and health outcomes associated with TAU and Whooley screening, followed by referral to CBT for women screened positive arms. The model was structured as a decision tree and encompassed the entire pathway from screening to treatment of postpartum depression. In this hypothetical cohort, all participants followed in the model were tested for either the TAU or Whooley screening, followed by referral for CBT when they screened positive. Given that screening and case-finding tools are imperfect diagnostic instruments, screening yields four possible outcomes: true positive, true negative, false positive, and false negative. If false negative patients exhibited persistent symptoms such as low mood, fatigue, insomnia, and excessive anxiety, they might seek another appointment with a psychiatrist for re-diagnosis and treatment. Due to the limited research data currently available, we did not account for the subsequent treatment cost of false negative situations and spontaneous remission in the model. Furthermore, we assumed that women without depression and those in remission would remain in that state until the model's endpoint, regardless of the possibility that they might develop depression or have a relapse, respectively. We also defined two possible health outcomes: no depression/remission and depression. The time horizon in the decision model was set from 42 days to 10 months postpartum, representing the end of treatment in both arms. Given the short time frame of the decision tree model, we did not consider the discounting or risk of patient mortality. This research model has been validated by two clinical experts in Hong Kong and complies with the framework set by the Hong Kong Centre for Health Protection, Department of Health and Advisory Committee on Mental Health [18, 20], and the model structure is shown in Fig. 1. We used TreeAge Pro 2022 software to complete the health economics analysis component, including developing a decision tree model and conducting base-case, sensitivity and scenario analysis.

Parameter estimated

Clinical effectiveness

Due to the lack of clinical research on the effectiveness of face-to-face CBT treatment for postpartum depression in Hong Kong, we extracted data from international research. We referred to the latest evidence in the clinical guideline released by NICE [19]. All data corresponds to the results of a guideline meta-analysis, reported in the full NICE guideline [19]. The extracted data included the estimated probability of no improvement in depression after getting routine supportive treatment (0.650) and CBT (0.312) for postpartum mothers.

Incidence rate of postpartum depression

The probability of postpartum mothers suffering from depression was assumed to be the same as that of the incidence rate in Hong Kong reported in survey data studies. In Hong Kong, postpartum depression is estimated to affect 20% of women [3, 21–27]. According to this information, we adjusted the model parameters to reflect this scenario. We collected 8 relevant literature sources reporting the incidence rate and used the median as the base-case analysis parameter [3, 21–27]. The screening method was structural psychological interviews administered by healthcare providers. After excluding literature that did not report patient dropout

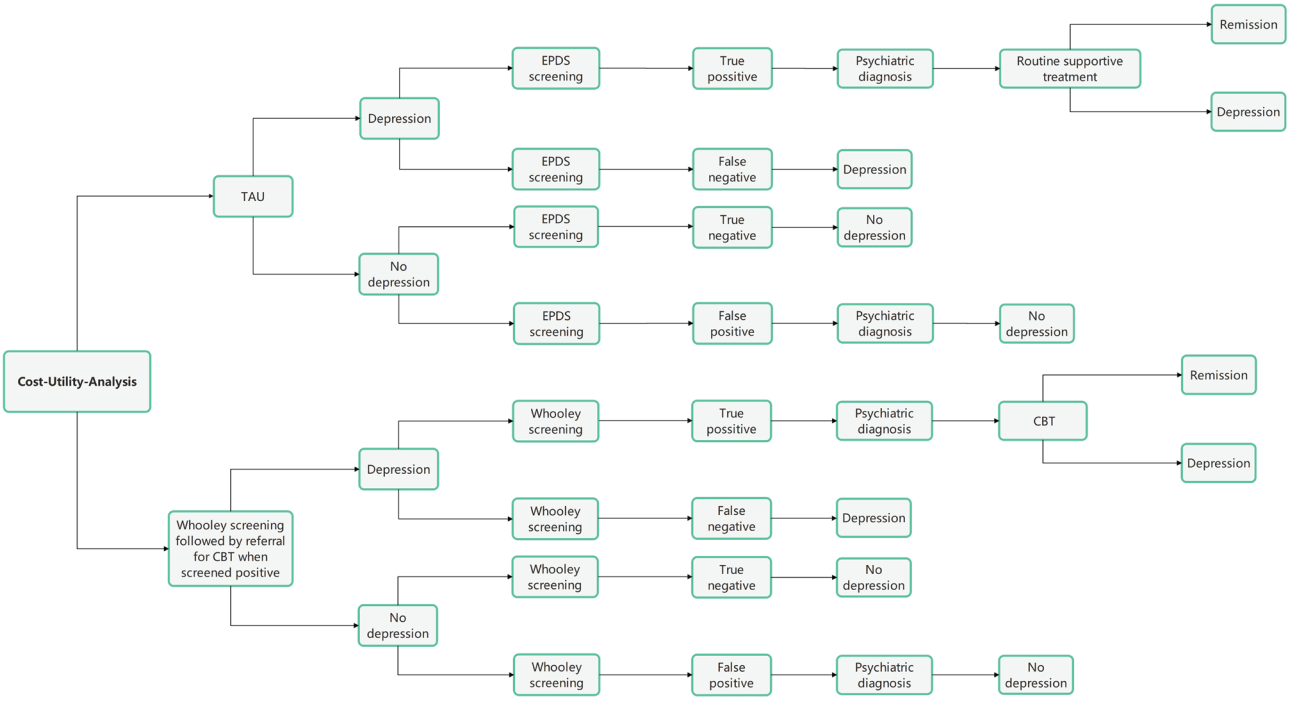

Fig. 1 Decision tree model structure for cost-utility analysis

rates and mothers with severe comorbidities, we identified an incidence rate of postpartum depression of 0.197.

Sensitivity and specificity of screening tools

For the sensitivity and specificity of the EPDS in the TAU arm and the Whooley questionnaire in the Whooley arm, we used the results of two meta-analyses that examined the diagnostic validity of postpartum depression [7, 28]. In the first study, we determined the pooled sensitivity (0.950) and specificity (0.650) of the Whooley questionnaire (the contents of the Whooley questionnaire are simple and do not require a specific cutoff score) [7]. In the second study, we determined the pooled sensitivity (0.810) and specificity (0.880) of the EPDS when the cutoff score was 11, using a semi-structured reference standard [28]. These data were used to estimate true positive, false positive, true negative, and false negative parameters in the model. The parameters were derived from the pooled results of two meta-analyses, and we did not consider the correlation between the sensitivity and specificity of the two screening tools.

Measurement of costs

We were unable to obtain cost data for postpartum depression directly from studies conducted in Hong Kong that met the model requirements. Consequently, the cost parameters of the model were developed based on the healthcare resources required for EPDS screening, Whooley screening, routine supportive treatment, and CBT. For the costs associated with conducting EPDS and Whooley screenings, we referenced data from a UK study that estimated the screening durations to be 3.54 min and 1.71 min, respectively [29]. The healthcare resource) and corresponding unit costs involved in the model included diagnosis with psychiatrists (HKD1260), 50-minute CBT sessions by a clinical psychologist (HKD2000), 20-minute psychiatrist appointments (HKD1260), 45-minute home visits by community psychiatric nurses (HKD1550), one-hour community allied health service (HKD1730) and conducting EPDS and Whooley screening by a professional nurse (EPDS: HKD121.93, Whooley: HKD58.9) [29–31]. Screening, diagnosis, appointments, and CBT sessions were conducted in professional hospitals and psychology clinics. Community-allied health services and psychiatric nursing services were conducted in patients' homes. The specific medical unit cost comes from the medical fee standard by the Hong Kong Hospital Authority and Hong Kong Psychological Counselling Centre, which has been used since the update in 2017 [30, 31].

Health utility

The key to the cost-effectiveness of screening and case finding for postpartum depression lies in the impact of early identification and management on women's quality of life. To estimate health utility, we derived quality of life preference weights associated with various health states based on published pharmacoeconomic evidence [32]. In our model, we assumed that women affected by postpartum depression experienced a quality of life corresponding to "moderate depression" (utility 0.630), while

mothers without depression (including those whose depression has remitted) experienced a quality of life associated with "no depression/remission" (utility 0.860) [32]. All model parameters in this study are shown in Table 1.

Sensitivity analyses

This study involved synthesizing data from various sources, forms of error, and model uncertainty had to be assessed in a multivariate approach using various assumptions. To account for uncertainty in the model parameters, we conducted deterministic and probabilistic sensitivity analyses. For the deterministic model, we used 95% confidence intervals of reported specificity and sensitivity of the EPDS and Whooley questionnaire, patients' health utility and clinical effectiveness, as well as the reported minimum and maximum values for the incidence rate of postpartum depression. For the probabilistic sensitivity analysis, we conducted 10,000 Monte Carlo simulation repetitions. We randomly selected input parameters from the Beta distribution (sensitivity and specificity of the EPDS and Whooley questionnaire, health utility values, clinical effectiveness, and incidence rate of postpartum depression).

We calculated the incremental cost-effectiveness ratio (ICER) based on the combined costs and effectiveness derived from the sensitivity analyses. If there is a trade-off between cost and effectiveness, a threshold is needed; that is, how much society is willing to pay for additional health. The World Health Organization (WHO) suggested that interventions costing less than three times GDP per capita for each DALY averted represented good value for money. Given the lack of a set threshold for Hong Kong, we refer to this standard as the basis for the formulation of WTP. In this study, the threshold was calculated using the method proposed by the WHO, which suggests a range of 1 to 3 times the GDP per capita [33]. This study adopted the lower end of the range, amounting to HKD422,191 per QALY in 2024 [34]. In addition, we generated tornado diagrams, incremental cost-effectiveness scatter plots, and cost-effectiveness acceptability curves to assess the likelihood of the strategy being cost-effective.

Scenario analyses

Different percentages of patients completing cognitive behavior therapy

In the original cohort, we assumed that all patients with true positive screening results would be identified in subsequent psychiatric diagnoses and would receive further routine supportive treatment or CBT. Due to the extensive sessions of CBT, patients' acceptability and adherence may be lower compared to routine supportive treatment. However, due to the lack of relevant data, we were unable to accurately simulate the actual situation and extract the necessary parameters. To intuitively illustrate the impact of patients' acceptability and adherence with CBT on the model results, we established the following scenario analysis: all patients in the TAU arm were able to complete the subsequent treatment, while

Table 1 Input parameters used in the cost-utility model

Model Parameter	Baseline	Standard Deviation	Distribution Type	Deterministic		Source
				Low	High	
Clinical effectiveness						
Probability of no improvement (CBT)	0.312	0.008	Beta	0.280	0.346	[19]
Probability of no improvement (supportive treatment)	0.650	0.009	Beta	0.618	0.686	[19]
Incidence rate in Hong Kong	0.197	0.015	Beta	0.155	0.262	[3, 21–27]
Sensitivity and specificity of screening tools						
Sensitivity of EPDS	0.81	0.015	Beta	0.750	0.870	[28]
Specificity of EPDS	0.88	0.008	Beta	0.850	0.910	[28]
Sensitivity of the Whooley questionnaire	0.95	0.014	Beta	0.880	0.970	[7]
Specificity of the Whooley questionnaire	0.65	0.025	Beta	0.560	0.740	[7]
Cost parameters (HKD)						
Diagnosis with psychiatrists	1260	-	Fixed	-	-	[30]
CBT sessions by clinical psychologists (50 min)	2000	-	Fixed	-	-	[31]
Psychiatrist appointments (20 min)	1260	-	Fixed	-	-	[30]
Home visits by community psychiatric nurses (45 min)	1550	-	Fixed	-	-	[30]
Community allied health service (1 h)	1730	-	Fixed	-	-	[30]
EPDS screening (3.54 min)	121.93	-	Fixed	-	-	[29, 30]
Whooley screening (1.71 min)	58.9	-	Fixed	-	-	[29, 30]
Health utility						
Depression	0.63	0.015	Beta	0.576	0.684	[32]
No depression/remission	0.86	0.010	Beta	0.823	0.897	[32]

only 20% to 75% (in 20% intervals) of patients were able to complete the CBT.

Subsequent treatment for false-negative patients

When local cost data are not available, scenario analysis is recommended to simulate heterogeneity [35]. In the original cohort, we assumed that patients with false-negative screening results would not receive subsequent treatment and would incur no additional treatment costs. These patients were considered to have the utility of depression until the end of the model. Because these false-negative cases did not receive timely treatment, they potentially result in higher subsequent health costs [36]. However, due to a lack of relevant cost data, we were unable to accurately simulate the actual situation or extract the necessary parameters. If false negative patients exhibited persistent symptoms such as low mood, fatigue, insomnia, and excessive anxiety, they might seek another appointment with a psychiatrist for re-diagnosis and treatment. To illustrate the impact of false-negative patients on the model results, we established the following scenario: 25% of false-negative patients in both arms received routine supportive treatment, 50% received routine supportive treatment, 25% received CBT, and 50% received CBT.

Results

Base-case analysis

In the probabilistic results for the base-case analysis (Table 2), compared with the TAU arm, the Whooley screening followed by referral to CBT for women screened positive sessions resulted in an additional 0.014 QALYs per patient. At the end of the model's time horizon, the average cost per patient per year in the TAU arm was HKD2242.14 with a mean QALY of 0.828, compared to an average cost of HKD5435.29 and a mean QALY of 0.842 in the Whooley screening followed by referral to CBT for women screened positive arm. In the probabilistic results for the base-case analysis, the cost and QALY of the Whooley arm were higher than those of the TAU arm, so the ICER must be calculated and compared with the threshold. The results showed that the ICER of the model was HKD228,082/QALY, which was lower than the willingness to pay (HKD422,191/QALY), so Whooley screening followed by referral to CBT for women screened positive arms was cost-effective compared with TAU.

Sensitivity analysis

The tornado diagram (Fig. 2) indicates the robustness of our findings. It suggests that with the range of values tested, the ICER is always below the cost-effectiveness threshold; therefore, there is no uncertainty around the cost-effectiveness of the intervention. The results showed that ICER was robust to the utilities associated with depression, the utilities associated with no depression/remission, and the probability of no improvement in depression for CBT over the model. These ranges provided for each parameter reflect the upper and lower bounds used in the sensitivity analysis to assess the stability of the ICER. Whooley screening followed by referral to CBT for women screened positive may result in improved patient outcomes.

The results of the probabilistic sensitivity analysis are shown in Figs. 3 and 4. Figure 3 illustrates the impact of parameter uncertainty on ICER, displaying a scatter plot depicting the outcomes of 10,000 Monte Carlo simulations. The scatter plots showed the difference in costs and utility per patient per simulation between Whooley screening followed by referral to CBT for women screened positive and the TAU arm. The results showed that 100% of the simulations are in the upper right quadrant, which means a trade-off between cost and effectiveness in health utility. Furthermore, all these simulations were below the threshold of HKD422,191 for incremental health. All simulations lie on the right side of the y-axis, so the certainty of improved health outcomes with Whooley screening followed by referral to CBT for women screened positive was high. For more information, please refer to Appendix 1 and Appendix 2.

Figure 4 illustrates the probability that Whooley screening followed by referral to CBT for women screened positive was cost-effective at various values of WTP. For the HKD100,000 threshold, the probability of TAU being cost-effective was 100%, while the probability of the Whooley arm was 0%. At a WTP of about HKD210,000, the likelihood of the two strategies being cost-effective was equal. The results suggested that if the WTP is set to HKD422,191 per QALY, there is about a 100% likelihood that Whooley screening followed by

Table 2 Probabilistic results for the base-case analysis for treatment as usual and whooley screening, followed by referral to cognitive behavior therapy for women screened positive arms

Treatment Strategy	Cost (HKD)	Health utility (QALYs)	Incremental		ICER (HKD/QALY)
			Cost (HKD)	Health utility (QALYs)	
TAU	2242.14	0.828	-	-	-
Whooley screening followed by referral to CBT for women screened positive arms	5435.29	0.842	3193.15	0.014	228,082

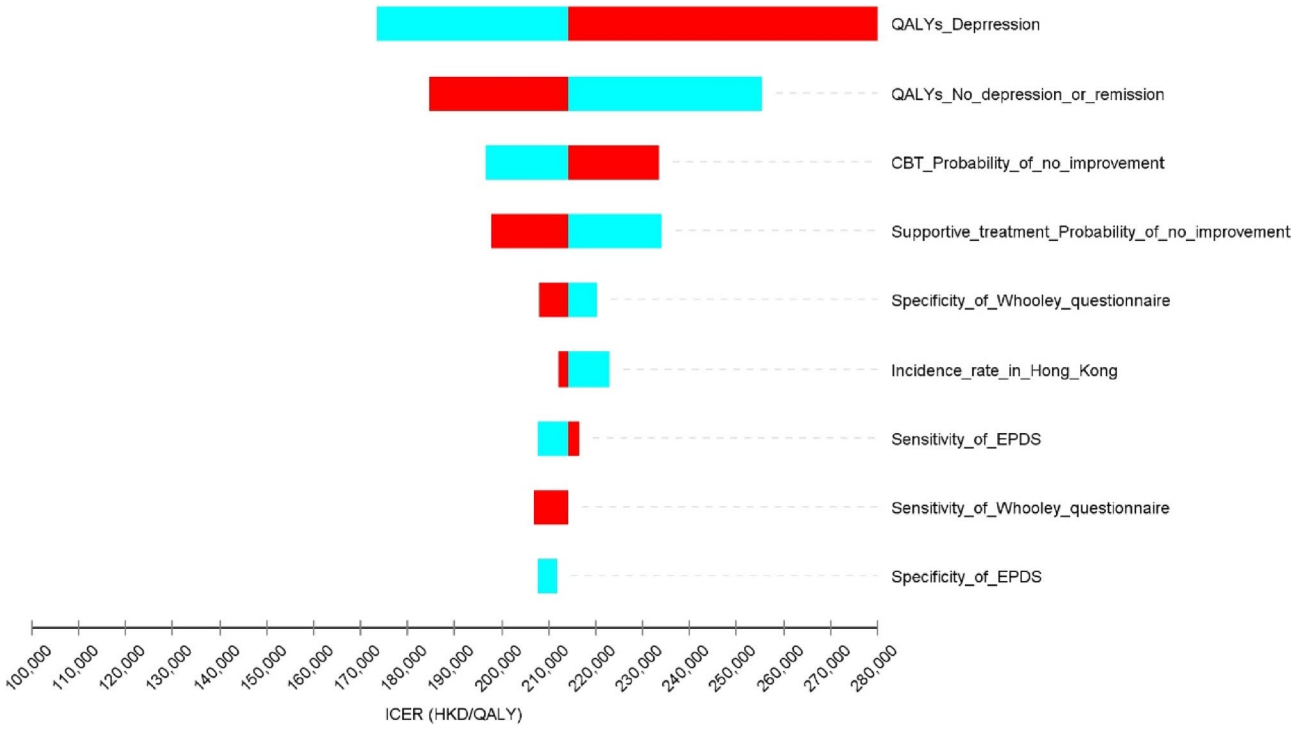

Fig. 2 Sensitivity analysis - tornado diagram

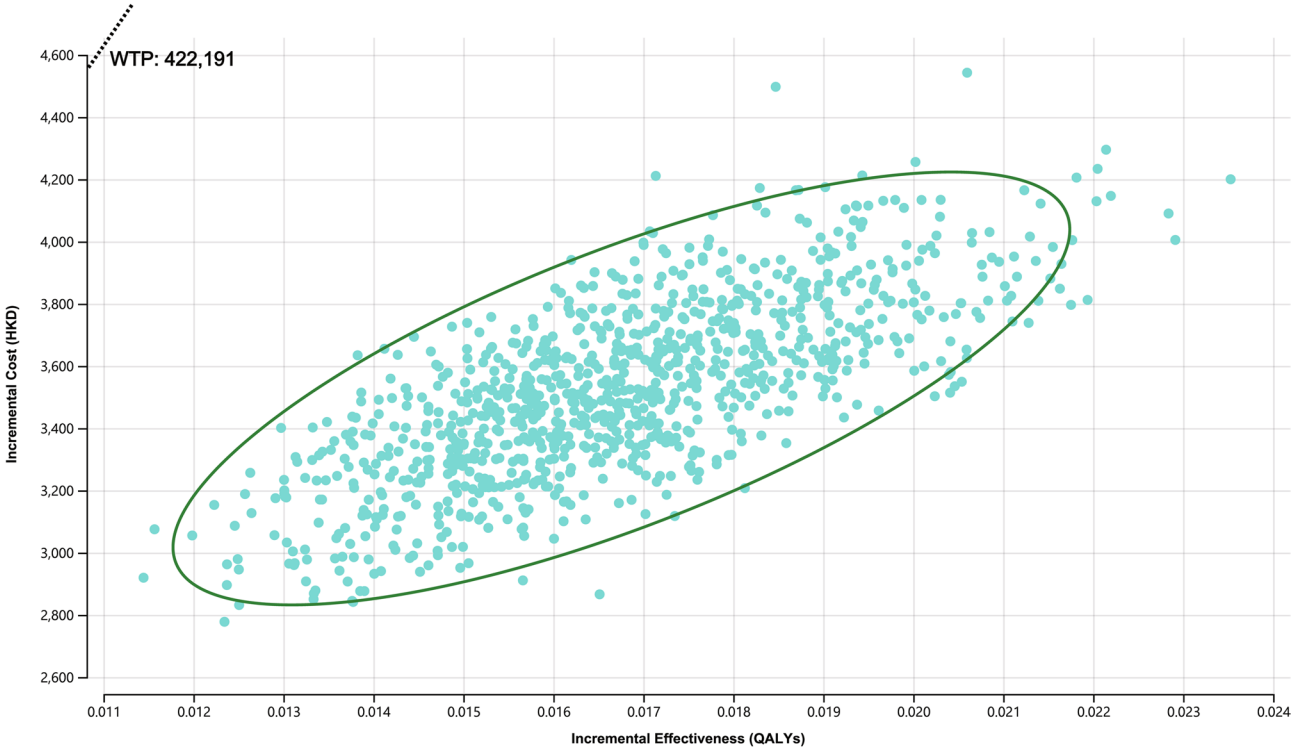

Fig. 3 Results of the probabilistic sensitivity analysis - incremental cost-effectiveness scatter plot

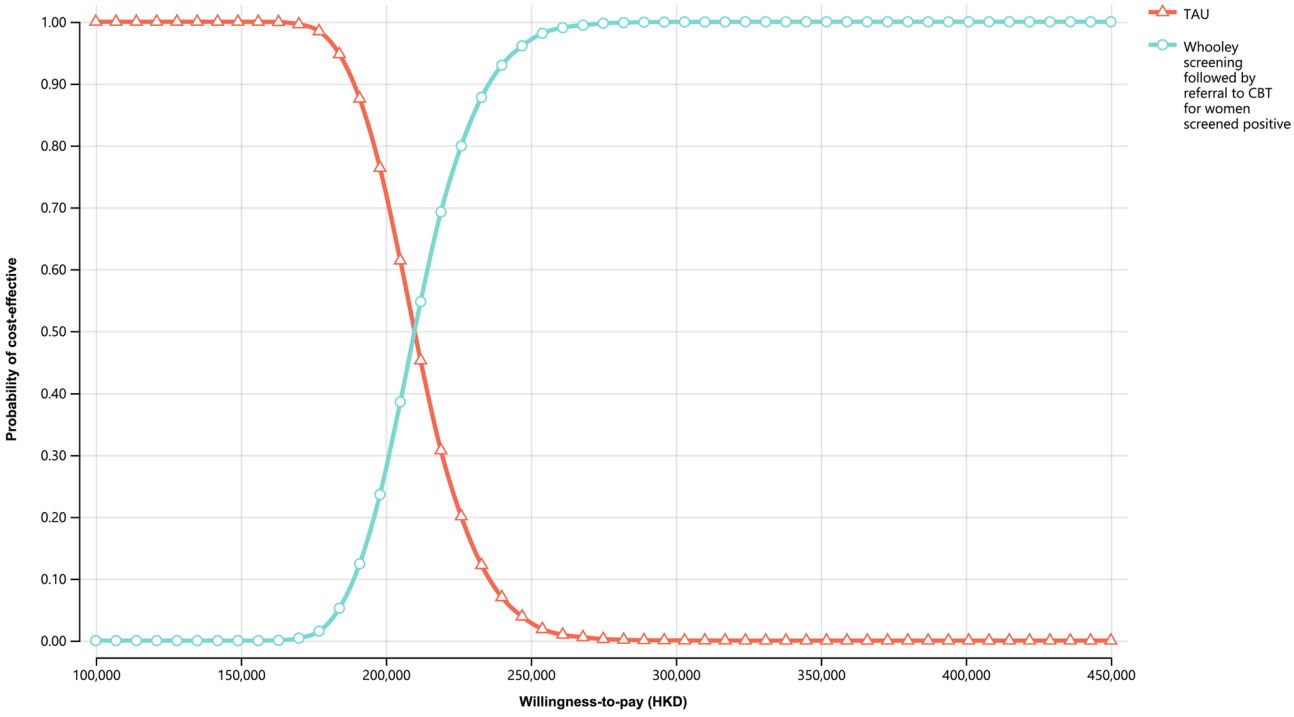

Fig. 4 Results of the probabilistic sensitivity analysis - cost-effectiveness acceptability curve

referral to CBT for women screened positive was more cost-effective than TAU. For more information, please refer to Appendix 3.

Scenario analysis

Different percentages of patients completing cognitive behavior therapy

Table 3 illustrates the impact of several scenarios (25% – 75%) on the ICER. When only 25% of patients were able to complete CBT, both the incremental cost and effectiveness were negative, and the corresponding ICER was HKD68,288/QALY. In this scenario, compared with TAU, Whooley screening followed by referral to CBT for women screened positive was cost-saving but less effective. When 50% of patients completed CBT, the new strategy improved patients' health utility but increased costs; the resulting ICER (HKD 791,240/QALY) exceeded the WTP threshold of HKD 422,191/QALY. As the percentage of patients completing CBT increased to 75%, the ICER fell to HKD 249,023 per QALY, below the WTP threshold. The new strategy was therefore considered cost-effective.

Subsequent treatment for false-negative patients

Our scenario analyses confirmed that Whooley screening followed by referral to CBT for women screened positive remains cost-effective compared with TAU even after accounting for the subsequent treatment costs of false-negative patients (Table 4). The new strategy consistently showed positive incremental costs and utility gains, regardless of the proportion of false-negative patients receiving routine supportive treatment or CBT. Furthermore, the ICER for the new strategy remained consistently below the WTP threshold of HKD422,191 per QALY.

Discussion

Principal findings

Postpartum depression represents a significant social and public health issue. In this study, we developed a decision-tree model to estimate the cost-effectiveness of

Table 3 Scenario analysis results - different percentages of patients completing cognitive behavior therapy

Scenarios	Incremental		ICER (HKD/QALY)	Type
	Cost (HKD)	Health utility (QALYs)		
Base case	3193.15	0.014	228,082	Cost-effective
25% of patients completed CBT	−409.73	−0.006	68,288	Cost-saving but less effective
50% of patients completed CBT	791.24	0.001	791,240	Not cost-effective
75% of patients completed CBT	1992.18	0.008	249,023	Cost-effective

Table 4 Scenario analysis results – subsequent treatment for false-negative patients

Scenarios	Incremental		ICER (HKD/QALY)	Type
	Cost (HKD)	Health utility (QALYs)		
Base case	3193.15	0.014	228,082	Cost-effective
25% of patients received routine supportive treatment	3148.41	0.014	224,886	Cost-effective
50% of patients received routine supportive treatment	3103.66	0.014	221,690	Cost-effective
25% of patients received CBT	3093.25	0.014	220,946	Cost-effective
50% of patients received CBT	2993.37	0.014	213,812	Cost-effective

postpartum depression screening in Hong Kong, using the Whooley questionnaire followed by referral to CBT for women screened positive. Compared with TAU, the new strategy is more likely to improve the health outcomes of women. Based on the results, the new strategy is estimated to provide an additional 0.014 QALYs per patient. Additionally, if the WTP of HKD422,191 per QALY is assumed, then the new strategy has a high probability of being cost-effective. In scenario analysis, after accounting for the subsequent treatment costs of false-negative patients, the new strategy remained cost-effective at a WTP threshold.

Considering the significant burden that postpartum depression places on the economy, several studies have explored the cost-effectiveness of screening and treatment for this disease. Heslin et al. [37] examined the cost-effectiveness of different screening tools for detecting perinatal depression. They considered tools for perinatal depression screening, including the Whooley questionnaire and EPDS. The results showed that the Whooley questionnaire was more cost-effective than no screening and saved more health resources than the EPDS. This advantage primarily stems from Whooley's brevity (only two items), which reduces administration time and training requirements compared to the 10-item EPDS.

A previous study [38] assessed the cost-effectiveness of CBT as an adjunct to pharmacotherapy for treatment-resistant depression. The results showed that the probability of CBT-based care being cost-effective under the WTP specified by NICE was 74% [38]. Several studies also indicated modest yet consistent benefits of CBT across a range of conditions [39, 40]. It has proven effective against various mental health issues, including anxiety, depression, and stress-related disorders, and has been associated with an improved quality of life related to health. Similarly, some studies have highlighted the benefits of timely screening and intervention of postpartum depression for both mothers and their infants [41, 42]. Therefore, given a reasonable WTP threshold, implementing Whooley screening followed by CBT could be a promising strategy for the future.

In our scenario analysis, we found that patient adherence to subsequent CBT significantly influenced the model results. When 75% of patients completed the subsequent CBT treatment, the combined Whooley screening and CBT strategy was likely to be cost-effective. This finding underscores the importance of improving patient acceptability and adherence to treatment to reduce costs and improve health outcomes. Therefore, healthcare practitioners in Hong Kong should focus on improving patient adherence to maximize the effectiveness of these new strategies.

Implications

Conducting health economic evaluations to integrate Whooley screening and CBT for postpartum depression is clinically important. Through Whooley screening, postpartum depression can be recognized at an early stage and intervened promptly, preventing the escalation of depressive symptoms. CBT has been effective in alleviating depressive symptoms among postpartum women, providing practical coping strategies that improve mood [10]. Our study suggests that using the Whooley questionnaire for screening and offering CBT as treatment can be a cost-effective approach to reducing the burden of postpartum. Further investigations are needed to confirm the cost-effectiveness of this strategy.

Currently, most health economics studies focus on drug treatment, and research on screening or other non-pharmacological therapies is scarce. One meta-analysis [43] has confirmed that screening pregnant and postpartum women for depression may reduce depressive symptoms. NICE has summarized clinical evidence from multiple RCTs showing that structured psychological interventions such as CBT can improve antenatal and postnatal women's depression, anxiety and other outcomes [19]. Our study combines the Whooley screening and CBT processes, applying an economic model based on the Hong Kong population to inform health policymakers. These findings provide insights into clinical guidelines and can help enhance the efficient utilization of healthcare resources. With further evidence, policymakers in regions with similar healthcare pricing structures and service delivery models may consider piloting this strategy, subject to local budget impact validation.

Strengths and limitations

This study has several strengths. First, we addressed an important issue by assessing the economic benefits of Whooley screening and CBT in treating postpartum depression. Despite the availability of several screening tools and treatments, postpartum depression remains a persistent public health concern with a rising prevalence. We utilized a decision tree model to simulate mothers' behaviors, enabling our findings to accurately represent the current situation of postpartum depression in Hong Kong, which is valuable for public health officials and healthcare providers. In addition, these data can be generalized to populations in other regions in the future and have the remarkable potential to optimize existing treatment strategies. Finally, we found that the Whooley screening tool, followed by referral to CBT for women screened positive, has a potential cost-benefit value compared to TAU.

This study also has some limitations that should be considered. First, we relied solely on secondary data and estimates rather than on direct measurements. This approach may affect the accuracy of our findings and may not fully reflect the actual situation of postpartum depression treatment in Hong Kong. Reliance on secondary data may introduce uncertainty or bias. Additionally, in estimating the sensitivity and specificity of the screening tools, we used pooled data from two meta-analyses without accounting for the correlation between these two measures. This oversight may have an impact on the model results. Additionally, we only measured direct health costs and no other indirect costs of the final status in the model. Finally, although we used a scenario analysis approach to consider the costs of patients with false-negative screening results, this still differs from the costs of these patients in the real world. This weakness limits the comprehensiveness of our economic evaluation and may misestimate the true economic burden.

Conclusions

To the best of our knowledge, this is the first health economic study to combine screening and treatment for postpartum depression based on the Hong Kong population. We evaluated the cost-utility of the Whooley screening tool, followed by referral to CBT for women screened positive compared to TAU, based on results from multiple research and meta-analyses. We incorporated various parameters into our model, unveiling the significant potential of this new strategy. This new strategy can provide greater benefits for postpartum mothers without incurring costs beyond the suggested WTP threshold, making it a promising addition to standard postpartum care.

Abbreviations

CBT	Cognitive Behavioral Therapy
CUA	Cost-utility analysis
EPDS	Edinburgh Postnatal Depression Scale
ICER	Incremental cost-effectiveness ratio
NICE	National Institute for Health and Care Excellence
QALY(s)	Quality-adjusted life years
RCT	Randomized controlled trials
TAU	Treatment as Usual
WTP	Willingness-to-pay

Supplementary Information

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Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

Supplementary Material 4.

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Authors' contributions

Concept and design: B.W., R.D.S., K.Y.W.L., J.L. Acquisition, analysis, or interpretation of data: B.W., S.S., R.D.S., K.Y.W.L., J.L. Drafting of the manuscript: B.W., S.S., R.D.S. Critical revision of the manuscript for important intellectual content: B.W., S.S., R.D.S., K.Y.W.L., J.L. Statistical analysis: B.W. Supervision: R.D.S. All authors read and approved the final manuscript.

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Data availability

All related data generated or analyzed during this study are included in this published article and its supplementary information files.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

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Competing interests

The authors declare no competing interests.

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