# Cost-effectiveness of a group psychological intervention for postnatal depression in British south Asian women: an economic evaluation from the ROSHNI-2 trial

*Akbar Ullah\*, Farah Lunat\*, Traolach Brugha, Matthias Pierce, Richard Morriss, Deepali Sharma, Atif Rahman, Kamaldeep Bhui, Peter Bower, Nusrat Husain*

## Summary

**Background** Minority ethnic groups often face ethnocultural barriers in accessing mental health treatments. The ROSHNI-2 trial compared culturally adapted cognitive behavioural therapy (Positive Health Programme [PHP]) with treatment as usual for postnatal depression in British south Asian women. We aimed to assess the cost-effectiveness of the PHP intervention.

**Methods** The ROSHNI-2 trial was a multicentre, two-arm, assessor-blinded, randomised controlled trial; we conducted an economic evaluation over a 12-month period to assess the cost-effectiveness of PHP plus treatment as usual versus treatment as usual alone from the perspective of the English National Health Service and personal social services. In the trial, British south Asian women aged 16 years or older with a child aged up to 12 months, and meeting DSM-5 criteria for depression, were recruited from northwest England, Yorkshire, the East Midlands, and London. The PHP intervention involved 12 group sessions delivered by two trained bilingual facilitators, held once per week for 2 months and once per fortnight thereafter, each lasting 60–90 min. Questionnaires on depression symptoms, quality of life, and resource use were completed at baseline, 4 months (end of intervention), and 12 months after random assignment. Quality-adjusted life-years (QALYs) were used for the cost-utility analysis, and recovery from depression at 4 months (the primary clinical outcome), assessed using the Hamilton Rating Scale for Depression, informed the cost-effectiveness analysis. After the onset of the COVID-19 pandemic, the intervention was adapted for online delivery for the remaining participants. A stratified analysis compared the cost-effectiveness of online versus in-person delivery. The trial involved researchers with lived experience, and all methods, including health economic measures, were developed in consultation with service users, community members, and faith leaders. This is a preplanned analysis of the ROSHNI-2 trial, registered with ISRCTN (ISRCTN10697380).

**Findings** From Feb 8, 2017, to March 29, 2020, 732 eligible women were enrolled: 368 participants were randomly assigned to the PHP arm and 364 to the treatment as usual arm. The base-case intention-to-treat analysis showed that PHP significantly increased costs (£712, 95% CI 311 to 1113) and QALYs (0·036, 95% CI 0·006 to 0·067), with an incremental cost-effectiveness ratio of £19601 (7622 to 83772). Based on the UK National Institute for Health and Care Excellence (NICE) maximum willingness-to-pay threshold of £30000 per QALY, the likelihood of PHP being cost-effective was 77% from a health and social care perspective. Cost per remission from depression at the 4-month follow-up was £5509 (2916 to 17860). In a stratified analysis of 34 participants attending online sessions during the pandemic, incremental QALY effects were 0·125 (0·048 to 0·203), resulting in costs of £202 (–3906 to 10918) per additional QALY gained.

**Interpretation** The average cost of PHP for postpartum women was below the lower end of the NICE threshold of £20000–30000 per QALY, excluding benefits to the child or potential gains such as reduced lost productivity from early remission. PHP, a culturally adapted group cognitive behavioural therapy-based intervention, might be a cost-effective intervention for postnatal depression in British south Asian women. Online PHP delivery showed promising clinical and cost-effective results for this group but requires a large-scale study.

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## Introduction

Postnatal depression is a major global health issue, affecting 17% of women in the postpartum period (ie, first year after childbirth), with significant negative effects on both mother and infant.[1] Approximately 30% of affected women continue to have depression beyond the postpartum period, with a 40% risk of relapse.[2] For the mother, postnatal depression increases the likelihood of chronic disease, substance misuse, breastfeeding difficulties, relationship problems, job loss, and suicide.[3,4] Postnatal depression can also affect children through impaired bonding and attachment (ie, mother-to-infant

## Research in context

**Evidence before this study**

The Medline library was searched via the Ovid MEDLINE database using MeSH terms: "depression" OR "postpartum" AND "cost-effectiveness analysis" OR "cost-utility analysis" OR "economic evaluation" from database inception to Oct 21, 2024, with no language restrictions. Google searches using the same terms and time period were also done. We identified two systematic reviews on the cost-effectiveness of pharmacological and non-pharmacological depression treatments in high-income and low-income countries (covering 2000–22). The Thinking Healthy Programme, a low-intensity therapy-based intervention, and its group delivery adaptations, showed a high clinical effectiveness for prenatal depression when delivered by trained non-specialists in south Asia or to British south Asian women. Two trial-based studies assessed the cost-effectiveness of the Thinking Healthy Programme for maternal depression in Pakistan and India when delivered by peers. In Pakistan, the Thinking Healthy Programme intervention cost $236 (2015 US dollars) per individual recovery from depression at 6 months postpartum, and in India, it was cost-saving (dominating treatment as usual). Both studies were rated high quality. In high-income countries, only two studies assessed therapy-based interventions in disadvantaged populations. One study evaluated the effectiveness of enhanced home visit engagement using motivational interviewing and brief cognitive behavioural therapy or interpersonal therapy for 25 low-income, minority ethnic pregnant and postpartum women, but this did not include an economic evaluation. Another study found that in-home cognitive behavioural therapy for low-income women with major depressive disorder in a home visiting programme (n=93) was cost-saving in the USA, reducing expected depression days compared with usual care. None of the other identified studies included economic evaluations of interventions targeting specific minority ethnic or socioeconomic groups. To address this evidence gap, the National Institute for Health and Care Research Health Technology Assessment Programme commissioned the ROSHNI-2 trial to generate further evidence.

**Added value of this study**

This study evaluated the cost-effectiveness, alongside a large-scale randomised controlled trial, of a programme specifically designed for British south Asian women, who have a higher prevalence of postnatal depression, higher birth rates, live in low-income areas, and are less likely to seek professional help. To our knowledge, it is the first evaluation of culturally adapted group therapy, delivered by non-professional bilingual facilitators (in five languages) for women with ethnolinguistic barriers, with facilitators matched to participants' language preferences. The cost-effectiveness analysis suggests that the therapy improves the quality of life for British south Asian women at a justifiable cost (£19 601 per QALY). The higher QALYs observed among those attending full or partial online sessions indicate that future costs could be reduced by exploring online or blended delivery models.

**Implications of all the available evidence**

With each episode of perinatal depression in the UK estimated to have a lifetime cost of £75 000 for the mother and child, and considering the cultural and linguistic needs of minority ethnic groups, PHP might be a cost-effective intervention for postnatal depression in minority ethnic women. Mental health research and services risk excluding minority ethnic groups if they overlook cultural, social, and language barriers. Emerging evidence suggests that culturally adapted cognitive behavioural therapy, delivered individually or in groups by trained non-professional facilitators, can provide an acceptable, effective, and cost-efficient first-line treatment for postnatal depression in these populations. Future research should investigate the acceptance, effectiveness, and broader effects of online interventions, including their effects on children and families of women with depression.

or infant-to-mother), maternal withdrawal, maternal hostility, and developmental delays at school age.[4] In the UK, each case of perinatal depression incurs an estimated lifetime cost of £75 000, with two-thirds attributed to the child's adverse outcomes.[5]

In the UK, minority ethnic groups, particularly the British south Asian group, face a higher burden of mental disorders, including postnatal depression, compared with the White population.[6,7] Owing to cultural and language barriers, these conditions are less likely to be detected or treated in minority ethnic groups.[7,8] Primary care services are also less likely to recognise mental health symptoms in south Asian individuals, resulting in fewer referrals to specialist care.[7]

Although antidepressants are effective for treating postpartum depression, new mothers might hesitate to use them owing to concerns about side-effects for themselves and their babies.[9] Therefore, cognitive behavioural therapy (CBT) is recommended as a first-line treatment and has proven to be effective for postnatal depression.[9,10]

The ROSHNI-2 trial was a multicentre randomised controlled trial that tested the effectiveness of the Positive Health Programme (PHP), a culturally adapted group CBT, combined with treatment as usual versus treatment as usual alone in British south Asian women with postnatal depression.[11–13] The primary outcome was remission from depression, defined as a Hamilton Depression Rating Scale score of less than 8 at 4 months after random assignment. Further details of the trial are available in the published studies.[12,13]

Although several studies have assessed CBT's effectiveness in terms of depression remission, few have evaluated its cost-effectiveness in terms of quality-of-life

gains, particularly among minority ethnic groups.[14,15] Health economic evaluations estimate the relative costs and benefits of interventions and summarise these by the incremental cost-effectiveness ratio (ICER). In the UK, interventions are typically considered cost-effective if the ICER is less than £20 000–30 000 per quality-adjusted life year (QALY).[16] This study aims to assess the cost-effectiveness of PHP added to treatment as usual compared with treatment as usual alone in the ROSHNI-2 trial.

## Methods

### Study design and participants

This health economic evaluation was conducted for a multicentre, two-arm, rater-blinded, randomised controlled trial, with ethics approval from the Northwest Health Research Authority (Integrated Research Application System 187851). A detailed study protocol and the effectiveness of the PHP intervention have been reported elsewhere.[12,13] The prespecified economic analysis plan is available upon request. The methods and analyses for the economic evaluation follow CHEERS reporting guidelines and previous economic evaluation papers.[17,18] All procedures comply with the ethical standards of national and institutional human experimentation committees and the Helsinki Declaration.

The trial was conducted in UK regions with large south Asian populations, including northwest England, Yorkshire, East Midlands, and London. The inclusion criteria comprised: British south Asian women aged 16 years or older, with a child aged up to 12 months, and meeting DSM-5 criteria for depression. The exclusion criteria comprised: a diagnosed physical or intellectual disability preventing informed consent, postpartum or other psychosis, and active suicidal ideation. Baseline assessments were completed within 6–8 weeks of random assignment, with follow-ups completed at 4 months after randomisation (end of PHP intervention) and 12 months. Full details are provided in the published protocol.[12]

In terms of patient and public involvement, the project included a co-applicant with lived experience who contributed to selecting processes, methods, and measures, and supported dissemination and impact activities. A service user researcher provided lived experience input into developing methods and measures. Health economics measures were shaped by insights from community, family, and faith leaders.[13]

### Intervention

The PHP intervention comprised 12 group sessions delivered by two trained bilingual facilitators over 4 months. The PHP focused on identifying the pressures of being a south Asian mother, the ABC model of depression, religion and spirituality, managing self-esteem, exercise, relaxation, assertiveness and

confidence, reducing social isolation, building social networks, and developing relapse prevention plans. Facilitators, National Health Service (NHS) band 4–6 researchers with degrees in psychology, social science, or related fields, completed a 2-day train-the-trainer course. Sessions were held once per week for the first 2 months and once per fortnight thereafter, with each session lasting 60–90 min. The PHP manual was available in English and the participants' preferred languages (including Urdu, Bengali, Gujarati, Punjabi, Hindi, and Tamil) with facilitators matched to the group's language preferences. PHP supervisors attended one to two sessions to ensure fidelity. Sessions were delivered at children's centres and other neutral community venues, based on participant preference.

All participants had access to treatment as usual, typically accessed through general practitioner services. They received primary care management for postnatal depression and were referred to other social or secondary care services as needed, including routine appointments, NHS Talking Therapies (formerly Improving Access to Psychological Therapies) for anxiety and depression, antidepressant prescriptions, and traditional healing services such as engagement with community and faith healers. The primary outcome measure for clinical effectiveness, reported elsewhere,[13] was remission or recovery from depression post-intervention, defined by a Hamilton Depression Rating Scale (HDRS) score of 7 or lower at 4 months.

### Data collection

Costs and outcomes were gathered from all participants via self-administered questionnaires at baseline and follow-ups, facilitated by masked assessors. For the cost-utility analysis, the outcome was quality-adjusted life-years (QALYs) gained from baseline assessment to the 12-month follow-up. Health states were assessed using the three-level EuroQol 5-dimension measure of health-related quality of life (EQ-5D-3L), which is a widely used generic quality-of-life measure, delivered in the participants' preferred languages. The use of EQ-5D-3L was tested in this population during feasibility studies before the main trial and has been used in previous studies with these communities in both the UK and south Asia.[19–21] The UK general population tariff was applied to convert EQ-5D-3L scores into health utility values.[22] QALYs were calculated using time-weighted linear interpolation of utility scores at baseline, 4 months, and 12 months as follows:

$$QALY = [(U_{baseline} + U_{4\text{-months}})/2] \times 0 \cdot 333 + [(U_{4\text{-months}} + U_{12\text{-months}})/2] \times 0 \cdot 677$$

where U stands for EQ-5D-3L utility score. The effect measure for cost-effectiveness was depression remission at 4 months, defined as per the main trial as an HDRS score of 7 or less.[13]

Resource use data were collected using a bespoke economic patient questionnaire, which incorporates questions from the Client Service Receipt Inventory and was used in previous mental health trials.[23] The economic patient questionnaire was adapted to align with the practices of this population through input from service users and community, and the team's research experience with south Asian populations.[19,24] The economic patient questionnaire covered community, primary, and secondary health-care use, as well as other social support services and health and care services (including traditional or religious healing services). These services encompassed both mental and physical health-related visits and admissions. Because most PHP sessions occurred in 2018 and 2019, the 2018–19 unit costs were applied for secondary, primary, and community health-care resources. Costs were calculated using standard figures from NHS England, NHS Improvement, and the Personal Social Services Research Unit publications (appendix p 2).

The costs of the PHP intervention included facilitator or therapist payments (for preparation, delivery, and travel), supervisor fees, venue hire, crèche services, catering, printing of materials, participant travel expenses, and facilitator training. More than half of the sessions were held in children's centres, which did not charge for using their space. However, because these centres had opportunity costs, we assigned the average cost of using community venues at the relevant study sites. Since the economic evaluation is from the health and social care sectors' perspective, the £10 paid per session to each participant in the PHP group was excluded from the base-case analysis.

Overall mean values (single imputation) were used for missing baseline data. For categorical demographic variables, a missingness indicator was created.[25] Missing cost and effect data at 4 months and 12 months were imputed using multiple imputations (50 imputations). The imputation model included the intervention indicator, baseline values of costs, utilities scores, HDRS scores, demographic indicators, and group and study site indicators.[25] The predictive mean matching algorithm was applied, and estimates from the imputed data were averaged using Rubin's rule.[25]

## Data analysis

The cost-effectiveness of PHP was assessed using intention-to-treat analyses over the 12-month trial horizon, from the perspective of the NHS and personal social services. Data for the economic evaluation from a societal perspective were not collected due to possible cultural sensitivities around home production, unpaid adult care, and labour force participation (eg, home production and unpaid adult care are sometime viewed as religious or cultural duties), as well as to minimise the data collection burden. Previous studies have characterised these communities as hard to reach and sensitive about data sharing.[13,20]

The differences in costs and effects between PHP and treatment as usual were calculated using regression analysis. Incremental costs were estimated using a γ-distributed generalised linear model with a log-link, whereas incremental effects were estimated with a β-distributed generalised linear model with a logit-link to handle skewed data (right-skewed costs and left-skewed QALY distributions).[26] Similar to the clinical efficacy study, the models included intervention indicator, baseline cost, EQ-5D-3L utility score, age, qualifications, and study stratification indicators as fixed effects and PHP group indicators as random intercepts, with treatment as usual participants treated as clusters of size one, to account for the within-PHP-group clustering.[13,26] Cost and effect regressions were jointly estimated in Stata 17.0 using the Generalised Structural Equation Modelling suite of commands, with regression errors treated as independent. However, cost and effect equations were interdependent due to shared random intercepts, covariates, and the fact that Generalised Structural Equation Modelling jointly maximises the likelihood function.[26]

Uncertainty was addressed by extracting 10 000 non-parametric bootstrapped samples.[16,18] For each sample, we calculated incremental costs, incremental effects, and the incremental cost-effectiveness ratio (ICER), which indicates the mean additional cost in the PHP arm to produce one extra effect (QALY or remission from depression) compared with treatment as usual only. The incremental costs and incremental effects of the 10 000 bootstrapped samples were plotted on cost-effectiveness planes, displaying the differences in costs and effects between PHP and treatment as usual only. Cost-effectiveness acceptability curves were drawn based on the distribution of the ICERs on the cost-effectiveness planes. Cost-effectiveness acceptability curves show the likelihood that PHP is more cost-effective than treatment as usual only as a function of the willingness to pay for one additional QALY or remission. For the cost-utility analysis, the UK National Institute of Health and Care Excellence (NICE) willingness-to-pay threshold of £20 000–30 000 per QALY was used.[16] Since the willingness to pay for remission from depression is not established, we started with a willingness to pay value of zero, gradually increasing it until the likelihood of PHP effectiveness approached nearly 100%.[18]

Stratified analyses compared the incremental costs, effects, and ICERs of online or partly online and in-person sessions to treatment as usual only. This was a post-hoc analysis focusing on the online sessions that began in March, 2020, after the onset of the COVID-19 pandemic. Although not a robust economic evaluation, these analyses were added to offer an early indication of the potential for online PHP delivery and the likely success of a future large-scale evaluation.

Sensitivity analyses included: (1) complete case analysis; (2) complier average causal effects; (3) adding a £10 attendance cost per session to PHP delivery costs; (4) varying the published unit costs of health and social care by ±10%; (5) linear regression instead of generalised linear regressions; (6) introducing two deviations from the missing-at-random assumption used for imputing missing data; and (7) multiple imputations of missing baseline data. All of these sensitivity analyses were pre-planned, except the multiple imputation of missing baseline data which was added post-hoc after review.[27] These analyses examined the sensitivity of the base-case results to changes in key variables, such as missing data, violations of the missing-at-random assumption used for imputation, regression functional form specification, and any discrepancies between the actual and published national average unit costs of health-care resources. The complier average causal effects analysis assessed the actual causal effects of the therapy on those who attended at least one session, compared with the intention-to-treat analysis in the base case.

For the complier average causal effects analysis, as in the clinical efficacy study, compliance was defined as attending at least one PHP session.[13] The randomisation indicator was used as an instrument for the binary compliance indicator to estimate three-stage least-squares seemingly unrelated regression.[28]

### Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

### Results

From Feb 8, 2017, to March 29, 2020, 732 eligible women were enrolled: 368 participants were randomly assigned to the PHP arm and 364 to the treatment-as-usual arm. The participants were divided into 42 groups: 21 from the northwest of England, three from Yorkshire, three from the East Midlands, and 15 from London. The average group size was 18 participants, evenly split between the PHP and treatment-as-usual arms. At the 4-month follow-up, 297 (81%) participants in the PHP arm and 301 (83%) participants in the treatment-as-usual arm had completed all questionnaires. At 12 months, 220 (60%) participants in the PHP arm and 230 (63%) participants in the treatment-as-usual arm had provided data.

The mean age was 31·4 years (SD 5·2) and was similar between arms.[13] Of the 719 participants with ethnicity data, 397 (55%) were Pakistani, 176 (24%) Indian, 127 (18%) Bangladeshi, and 19 (3%) from other south Asian backgrounds. Of the 722 participants with language preference data, 316 (44%) preferred English, 232 (32%) Urdu, 71 (10%) Bengali, 51 (7%) Punjabi, 30 (4%) Gujarati, 4 (1%) Hindi, and 15 (2%) other languages.[13] Among 701 participants reporting qualifications, 26 (4%) had
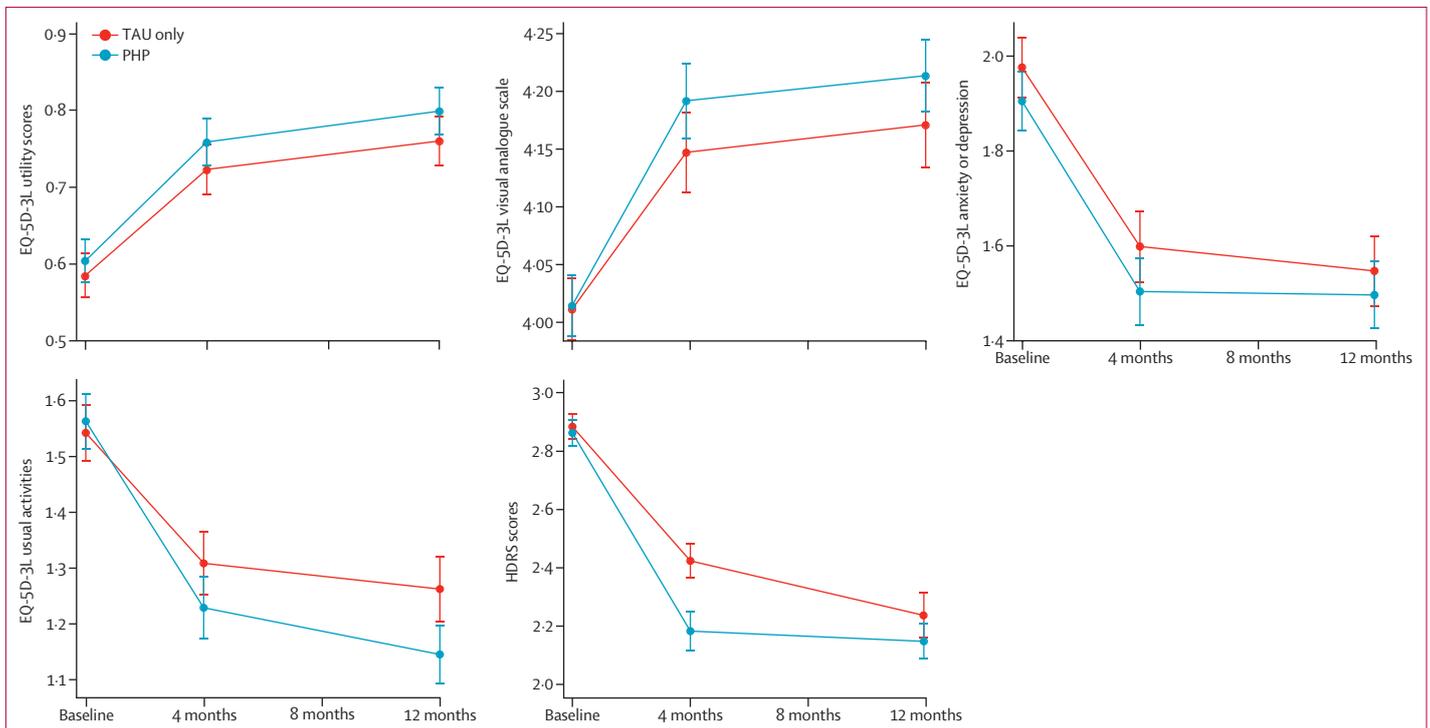


*Figure 1:* **Adjusted health-related quality of life and depression scores (based on multiple imputations)**
All plots are based on predicted values, adjusted for age, qualifications, study centre, and random intercepts at the PHP group level. EQ-5D-3L=three-level EuroQol 5-Dimension generic measure of health-related quality of life. HDRS=Hamilton Depression Rating Scale. PHP=Positive Health Programme. TAU=treatment as usual.

primary schooling, 117 (17%) GCSEs, 150 (21%) A-levels, 221 (32%) a first degree, 119 (17%) a higher degree, and 68 (10%) had other qualifications.[13] The mean number of PHP sessions attended per person was 6·01 (95% CI 5·54–6·47). Of the 368 PHP arm participants, 92 (25%) attended no sessions, 50 (14%) attended one to four sessions, 72 (20%) attended five to eight sessions, 154 (42%) attended more than eight sessions, and 35 (10%) attended all 12 sessions.

The estimated cost of the PHP programme was £4063 per group and £463 per person. The main cost was facilitator pay (£1100 per group, £125 per participant), based on NHS bands 4, 5, and 6 for 2·5 h per session (preparation and delivery). The next largest costs were for crèche services (£1002 per group), venue hire (£537 per group), participant travel (£513 per group), catering (£392 per group), PHP supervisor pay and travel (£152 per group), and facilitator travel (£142 per group). Additional costs included facilitator training (£6622 total) and printing PHP manuals and training materials.

The mean health-care costs and EQ-5D-3L health states are reported in the appendix (pp 3–7). Unadjusted mean health and social care utilisation costs were £608 per participant in the PHP arm and £596 in the treatment-as-usual arm at baseline, and £274 versus £264 at the 12-month follow-up (appendix pp 3–4). Secondary care was the primary source of health-care costs in both arms, primarily for physical reasons (appendix p 5). At baseline, mean elective inpatient days were 0·11 in both the PHP and treatment-as-usual arms, mean number of outpatient appointments was 0·10 and 0·11, and mean number of emergency visits was 0·06 and 0·07, respectively. During the trial period (1–12 months), mean elective inpatient days were 0·04 for both arms, whereas the mean number of outpatient appointments increased to 0·27 in the PHP arm (0·17 in the treatment-as-usual arm), and the mean number of emergency visits per participant was 0·09 versus 0·06, respectively. At baseline, mean general practitioner visits per participant were 1·10 in the PHP arm and 1·07 in the treatment-as-usual arm, compared with 0·92 and 0·89 during the trial period. Community-based mental health service use was minimal in both arms (0·01 per participant). Other health and social support use was relatively higher, with a mean of 0·09 in the PHP arm versus 0·05 in the treatment-as-usual arm at baseline, and 0·13 in the PHP arm versus 0·10 in the treatment-as-usual arm during the trial period, suggesting the use of traditional healing services (appendix p 5). Overall, during the trial period (1–12 months), the unadjusted mean health-care costs were £784 (95% CI 581–1013) in the PHP arm and £636 (495–791) in the treatment-as-usual arm.

During the trial period (1–12 months), the mean unadjusted QALYs were 0·747 (95% CI 0·729–0·764) in the PHP arm and 0·713 (0·692–0·733) in the treatment-as-usual arm. The adjusted quality-of-life and depression scores, accounting for all covariates included in the main analysis, are presented in figure 1. Health-related quality of life, measured by the 3-level EuroQol 5-dimension (EQ-5D-3L), was higher in the PHP arm than in the treatment as usual arm, but utility scores were not statistically significant at any time point (figure 1). However, the PHP arm showed a significantly better health-related quality of life in the usual activities dimension at the 12-month follow-up (figure 1). A notable difference in remission from depression was observed at the 4-month follow-up (figure 1), although this difference was not statistically significant by 12 months. Further details on the EQ-5D-3L health states are presented in the appendix (pp 6–7).

The adjusted differences in costs (health-care use and PHP delivery) and effects between the PHP intervention and treatment-as-usual arms from health and social care perspectives are presented in table 1. In the intention-to-treat analysis, the PHP resulted in a significant cost increase (£712, 95% CI 311–1113) and a QALY gain of 0·036 (95% CI 0·006–0·067) over 12 months (table 1). The mean difference in remission rates at 4 months was 0·126 (0·049–0·203), with a corresponding mean cost difference of £692 (283–1101).

The analysis yielded a mean ICER of £19601, indicating that gaining one additional QALY with PHP versus treatment as usual alone is associated with a cost of £19601 (95% CI 7622–83772, based on 10000 bootstrapped replications). Remission in postnatal depression (Hamilton Depression Rating Scale score of ≤7) at the 4-month follow-up resulted in an ICER of £5509 (2916–17860) based on the 10000 bootstrapped samples.

The bootstrapped incremental costs and effects were used to generate cost-effectiveness planes and cost-effectiveness acceptability curves. The first panels in figures 2 and 3 show the cost-effectiveness planes for the base-case of the cost-utility and cost-effectiveness analyses, plotting costs against effects. The uncertainty

| | Incremental cost (95% CI) | Incremental effect (95% CI) | ICER (95% CI) |
|---|---|---|---|
| QALYs, adjusted incremental differences* | £712 (311 to 1113) | 0·036 (0·006 to 0·067) | £19601 (7622 to 83772) |
| Remission, adjusted incremental differences* | £692 (283 to 1101) | 0·126 (0·049 to 0·203) | £5509 (2916 to 17860) |
| In-person and online vs treatment as usual* | | | |
| Zero sessions | £771 (327 to 1214) | 0·003 (–0·040 to 0·046) | £205568† |
| In-person sessions | £784 (404 to 1163) | 0·035 (0·002 to 0·069) | £22295 (7678 to 156689) |
| Online sessions | £25 (–512 to 563) | 0·125 (0·048 to 0·203) | £202 (–3906 to 10918) |

All incremental cost and effect analyses are based on multiple imputation data, adjusted for baseline cost, effects, qualifications, age, and study centre, and include random intercepts at the PHP group level. The 95% CIs for ICERs are constructed from 10000 bootstrapped replications (200 replications per multiple imputation dataset). ICER=incremental cost-effectiveness ratio. PHP=Positive Health Programme. QALY=quality-adjusted life year. *Multiple imputation. †For the ICER of the zero sessions, 95% CIs are not reported because, as shown in figure 4, 43% of replications fall in the top left quadrant (higher cost and lower effectiveness), where negative ICER values are misleading.

*Table 1:* Differences in costs (2018–19) and effects between PHP plus treatment as usual versus treatment as usual only over 12 months

in the ICERs was predominantly driven by uncertainty in incremental costs (figures 2 and 3). In figure 2, 99% of replications fell in the top right quadrant, indicating that PHP was more effective in improving QALYs and was more costly in 99% of samples. In figure 3, nearly all replications fell in the top right quadrant, showing that PHP was more effective in achieving remission from depression, but at a higher cost in all samples compared with treatment as usual alone.

The second panels in figures 2 and 3 show cost-effectiveness acceptability curves, illustrating the probability of PHP being more cost-effective than treatment as usual alone at different willingness-to-pay thresholds for one additional QALY or remission from depression. At the lower bound of the NICE threshold of £20 000, the probability of PHP being cost-effective in generating an additional QALY was 53%, increasing to 77% at the upper bound of NICE's threshold of £30 000 per QALY (figure 2). In figure 3, the probability of PHP being cost-effective in achieving remission from depression exceeded 50% at a willingness-to-pay threshold of £5500 and reached 90% at £10 000.

For the stratified analysis, the PHP arm was divided into those who attended no sessions (92), attended all sessions in person (242), or attended most or all sessions online (referred to as the online group; 34). In the online group, 17 participants attended only online sessions, and the other 17 attended a mean of 8·24 sessions, with 6·94 of them being online sessions. The mean cost per person

for online delivery of the sessions was £289, compared with £463 overall. The 34 participants attending online sessions showed greater, sustained quality-of-life improvements than those attending in person (appendix p 1). This difference is unlikely to be due to session attendance, because the in-person group attended 8·06 mean number of sessions compared with 7·62 in the online group.

To assess the cost implications of all or partial online delivery, we compared participants in each category with the treatment-as-usual arm using 10 000 non-parametric bootstrapped samples to estimate uncertainty around ICERs. In-person sessions resulted in an ICER of £22 295 (95% CI 7678 to 156 689). For the online group, there was a non-significant cost increase of £25 (95% CI −512 to 563) and a significant QALY gain of 0·125 (95% CI 0·048 to 0·203), with an ICER of £202 (−3906 to 10 918) per QALY. The probability of PHP being cost-effective exceeded 50% at negligible costs and reached 100% at less than the £20 000 threshold for those receiving online sessions during the COVID-19 pandemic (figure 4).

Several sensitivity analyses were conducted to test the robustness of PHP's cost-effectiveness (table 2), with ICERs estimated from 5000 non-parametric bootstrapped samples. Complete case analysis (59% of participants) resulted in a higher ICER of £23 592 (95% CI 10 253–338 046). However, the data were not missing completely at random. Complier average causal effects analysis gave a lower ICER of £17 749 (2219–73 802).
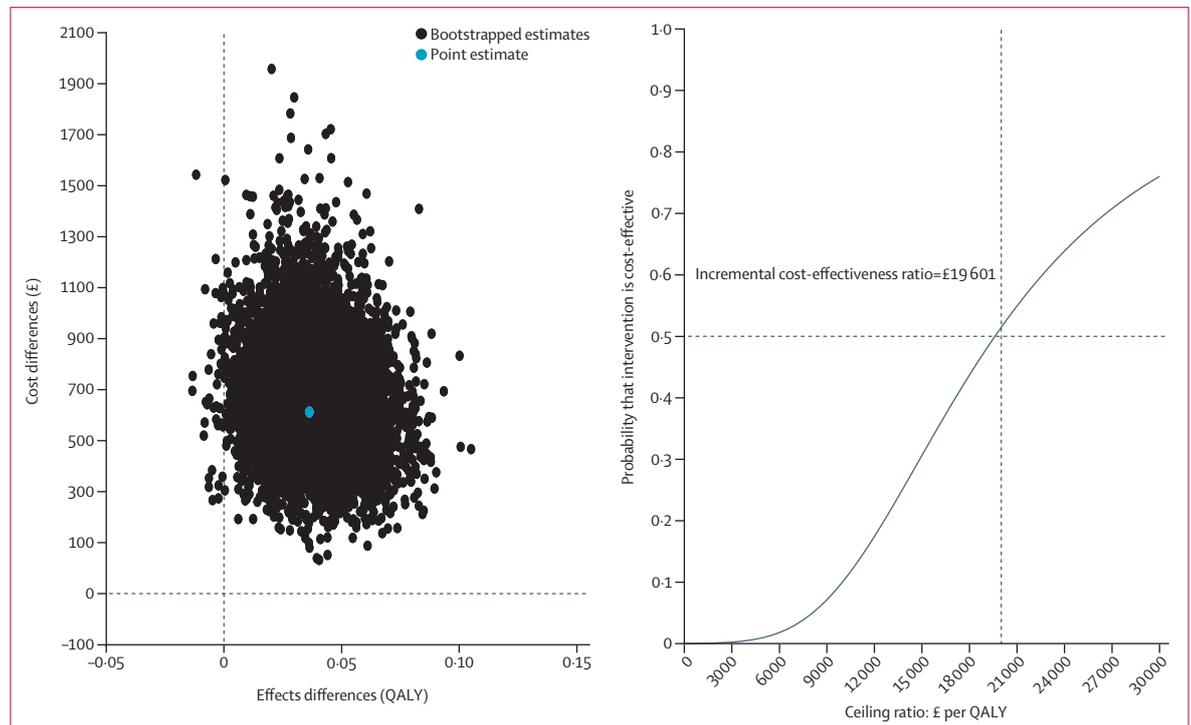


***Figure 2:*** **Cost-effectiveness plane and cost-effectiveness acceptability curve (outcome: QALYs)**
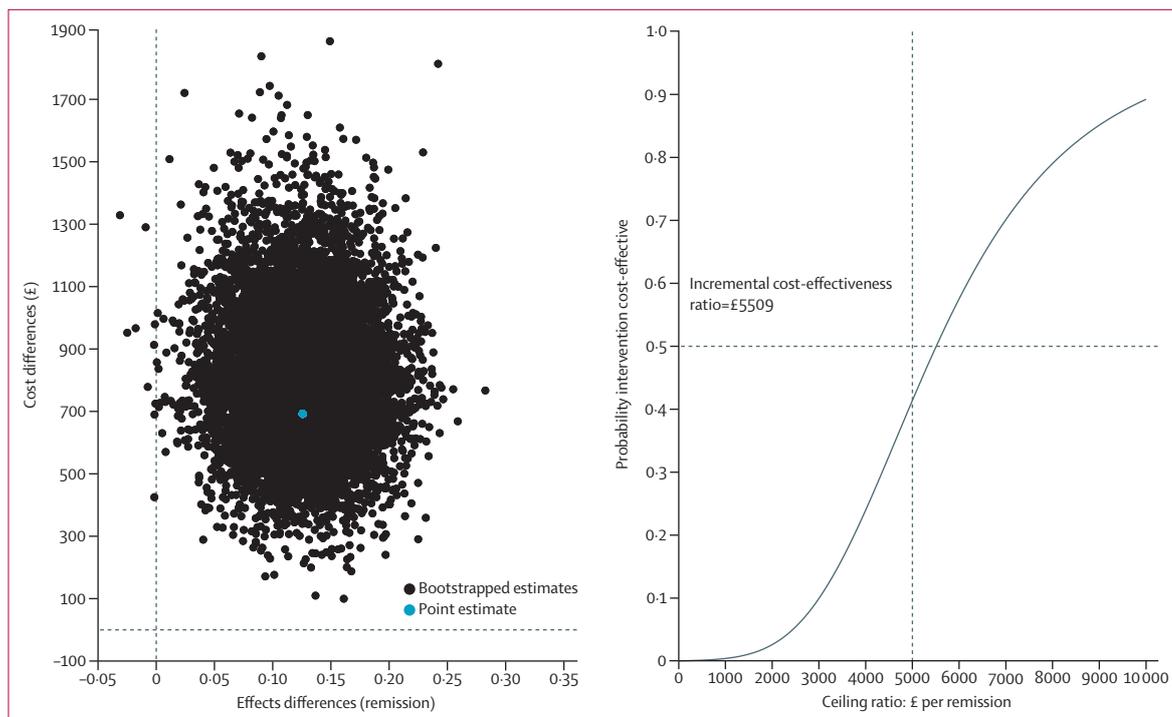QALY=quality-adjusted life-year.

*Figure 3:* Cost-effectiveness plane and cost-effectiveness acceptability curve (outcome: remission)
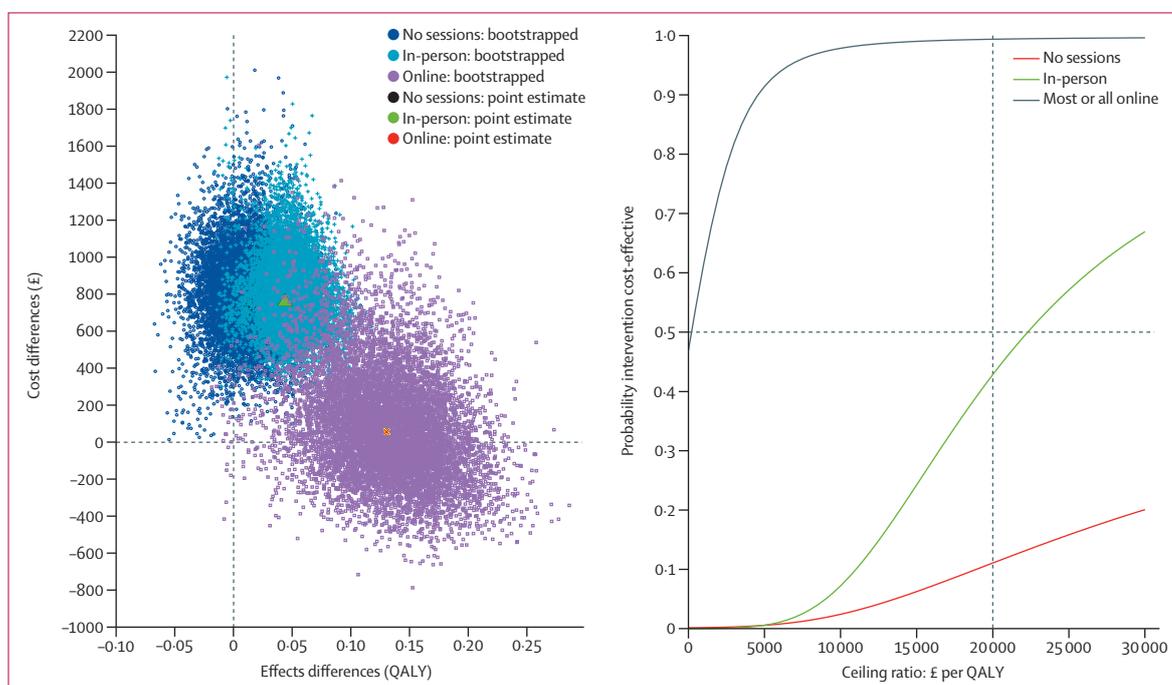


*Figure 4:* Cost-effectiveness planes and cost-effectiveness acceptability curves for in-person and online sessions versus the control arm (outcome: QALYs)
QALY=quality-adjusted life-year.

To test assumptions about missing data, two adjustments were made to multiple imputations.[27] In the worst-case scenario (costs 10% higher and utility scores 10% lower than the model-predicted missing values), the ICER was £21429 (95% CI 7937–103936; table 2). In the best-case scenario (the reverse), the ICER was £17654 (7192–68883). Reducing all health and social care unit costs by 10% compared with the published unit costs produced an ICER

| | Incremental cost 2018–19 (95% CI) | Incremental QALYs (95% CI) | ICER (95% CI) |
|---|---|---|---|
| Complete cases (429 [59%] of 732 participants) | £700 (422 to 978) | 0·030 (−0·016 to 0·078) | £23 592 (10 253 to 338 046) |
| Worst-case missing data scenario | £728 (305 to 1151) | 0·034 (0·005 to 0·063) | £21 429 (7937 to 103 936) |
| Best-case missing data scenario | £713 (320 to 1106) | 0·040 (0·008 to 0·073) | £17 654 (7192 to 68 883) |
| 10% lower health-care unit cost | £700 (329 to 1071) | 0·036 (0·006 to 0·067) | £19 282 (7591 to 84 499) |
| 10% higher health-care unit cost | £724 (295 to 1153) | 0·036 (0·006 to 0·067) | £19 929 (7223 to 88 293) |
| CACE | £761 (281 to 1241) | 0·043 (0·007 to 0·078) | £17 749 (2219 to 73 802) |
| Linear model | £631 (316 to 946) | 0·026 (−0·004 to 0·055) | £24 374 (7503 to 271 479) |
| With PHP attendance costs | £788 (401 to 1174) | 0·036 (0·005 to 0·067) | £21 691 (8929 to 90 582) |
| Multiple imputation of baseline missing data | £673 (292 to 1054) | 0·033 (0·003 to 0·062) | £20 573 (7474 to 98 478) |

Except for the first row, all results are from multiple imputation data. In the worst-case scenario, missing health-care use costs were 10% higher and health states were 10% lower than the multiple imputation models. The best-case scenario was the opposite of worst-case scenario. All analyses controlled for baseline cost, utility score, qualifications, age, study centre, and include random intercepts at the PHP group level. The 95% CIs for ICERs are constructed from 5000 bootstrapped replications (with 100 replications per multiple imputation dataset). For the complete cases, the 95% CI for the ICER is constructed from 5000 bootstrapped replications of incremental cost and effects. CACE=complier average causal effects. ICER=incremental cost-effectiveness ratio. PHP=Positive Health Programme. QALY=quality-adjusted life year.

*Table 2:* Sensitivity analyses

of £19 282 (7591–84 499). Increasing health and social care unit costs by 10% produced an ICER of £19 929 (7223–88 293). Compared with table 1, the ICER increased to £24 374 (95% CI 7503–271 479) using linear regression models (table 2). Adding session attendance costs (£10 per session) raised the ICER to £21 691 (8929–90 582). Finally, when baseline missing cost and health state data were imputed using multiple imputation instead of single imputation, the ICER remained £20 573 (474–98 478). Thus, most sensitivity analyses were less than or within NICE's £20 000–30 000 range.

## Discussion

This analysis suggests that the PHP programme leads to higher QALYs (mean difference 0·036; 95% CI 0·006–0·067) and costs (mean difference £712; 311–1113) compared with treatment as usual alone, translating to a cost of £19 601 (7622–83 772) per QALY gained. The ICER of £19 601 per QALY is near the lower boundary of the £20 000–30 000 per QALY willingness-to-pay thresholds used by NICE, with a 53% likelihood of PHP being cost-effective at £20 000 and 77% at £30 000 compared with treatment as usual alone. Although not cost-saving, PHP could be a cost-effective intervention at the NICE willingness-to-pay threshold of £20 000–30 000 per QALY from the perspective of NHS and personal social services.

Each episode of perinatal depression in the UK is estimated to cost £75 000 over a lifetime for the mother and child, with two-thirds of this burden falling on the child.[5] Considering the cultural and linguistic needs of minority ethnic groups, PHP could serve as a cost-effective intervention for postpartum depression in women from minority ethnic groups. PHP effectively facilitated quick recovery from postnatal depression and improved parenting competence, which might lead to better child outcomes—benefits not included in this economic evaluation.[13,29,30] The difference in health-related quality of life between the PHP and treatment-as-usual arm participants not only persisted but also increased at the 12-month follow-up. Similarly, at 12 months, the PHP arm participants showed significantly higher Parenting Sense of Competence Scale scores as reported in the clinical efficacy paper[13] (adjusted difference 3·32; 95% CI 1·10–5·54), indicating a greater sense of competence in parenting compared with the control arm participants. This finding suggests that the benefits of PHP might extend beyond the mother and trial period, potentially further reducing the long-term cost per QALY gained.[15]

The PHP programme was interrupted by the onset of the COVID-19 pandemic, leading to a protocol change to deliver the remaining sessions online. The stratified cost-utility analysis indicated that the ICER for online sessions was just £202 per QALY, with a 100% likelihood of cost-effectiveness at a willingness-to-pay threshold of less than £15 000, suggesting that the online delivery of PHP might be a viable future option. However, these results are based on a small sample of 34 participants, limiting the robustness of the comparison. The potential clinical and cost-effectiveness of online PHP warrant further investigation in future studies. The better outcomes for those in the online PHP group might be due to participants learning to cope with isolation during the sessions or because pandemic restrictions reduced the positive effects of PHP for those who completed the programme earlier. Additionally, online delivery probably shifted some costs, such as childcare and catering, to participants, although these might be offset by reduced travel expenses and environmental benefits.

Interviews revealed that participants preferred in-person sessions over online sessions for better confidentiality, group interaction, and to avoid connectivity issues. Nonetheless, many valued the flexibility of remote delivery, particularly those whose household responsibilities had previously hindered in-person attendance, and they felt that PHP helped them navigate the challenges of lockdown.[13] Given the mixed preferences and the fact many people from minority ethnic groups live in joint families with care-giving duties, a blended (ie, partly in-person and partly online) PHP intervention could enhance participation and cost-effectiveness in the future.[31]

Camacho and Shields[32] reported on eight studies assessing the cost-effectiveness of interventions for the prevention, treatment, or screening of postnatal depression. These studies evaluated various treatments, including access to psychiatric day hospitals, counselling, support from trained health visitors, CBT, and collaborative

care with psychiatrists. The interventions ranged from dominant (rare) to those costing more than £30000 per QALY gained in 2015 sterling, with costs per recovery varying from net saving to as high as £56865. Among 39 perinatal mental health interventions, Verbeke and colleagues[15] identified 21 studies on interventions for anxiety and depression in high-income countries, mostly from the UK and the USA, with only seven based on CBT or interpersonal therapy, or both. Of these, five included cost-utility analyses. In two studies, the intervention dominated treatment as usual, whereas in the others, the cost per QALY ranged from €8850 to €59099. Although uniquely delivered by non-specialist workers to diverse ethnocultural groups, the QALY gains and cost per QALY for the PHP intervention aligned with those of similar interventions in the UK.

Unlike depression remission, the difference in health-related quality of life between the PHP and treatment-as-usual arms in the ROSHNI-2 trial was sustained at 12-month follow-up. This finding highlights the value of faster recovery from postnatal depression for participants and potentially for their infants and families.[13,33,34] Early intervention can prevent chronic depression, improve quality of life, enhance mother–infant bonding, and lead to better cognitive and emotional outcomes in infants.[29,30] Women who recover early are more likely to return to work, show improved productivity, have reduced absenteeism, and foster stronger family cohesion and stability.[3,35] The marked improvement observed in the usual activity dimension of EQ-5D-3L in figure 1 might be the manifestation of these advantages resulting from the PHP intervention. For example, the intervention led to a significant improvement in parenting sense of competence.[13] Quality parenting in early childhood is associated with positive mental and physical health outcomes and financial benefits over the lifespan.[36]

The PHP intervention focused on developing assertiveness skills and enhancing participants' confidence and communication, as well as reducing social isolation through new relationships and social networks. These new developments could help alleviate the fear of stigma, leading to increased health-care use and reporting.[7,8,37] Existing evidence indicates a clear negative association between mental health-related stigma or stigmatising attitudes and help-seeking among individuals.[38] Similarly, group-level anti-stigma interventions have shown at least short-term benefits in combating stigma and discrimination related to mental illnesses.[39] If so, the cost per QALY gain from the PHP could be overestimated.

This study has several limitations. EQ-5D-3L responses were converted into QALYs using a value set for the general UK population, because no ethnicity-specific value set is available. Resource use data were collected through a patient questionnaire, which might introduce recall bias. The study assumes that the monetary and non-monetary engagement efforts during recruitment to the trial[13] did not differentially affect participants in the two arms, attributing all cost and effect differences to the PHP intervention. Only 59% of participants had complete data, potentially introducing bias. However, introducing 10% deviations on either side of the model-predicted values for the missing data suggested that any bias due to missing data was minimal. Participants were not masked to treatment allocation, which might have led to strategic behaviour in reporting costs and health-related quality of life, introducing further bias. Cost-effectiveness analyses could not be conducted from family or societal perspectives. Finally, the ROSHNI-2 trial focused exclusively on British south Asian women, limiting the generalisability of findings to other minority ethnic groups.

This study provides evidence that the PHP programme, combined with usual care, might be a cost-effective alternative to the standard of care for treating depression and improving quality of life among British south Asian women with postnatal depression, provided policy makers are willing to pay £20000–30000 per QALY gained. Further research is required to evaluate the effectiveness and cost-effectiveness of online delivery of such therapies and their broader effect on children and family outcomes.

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