

Cost-Effectiveness Analysis of the Parents under Pressure Programme for Methadone-Maintained Parents

Children living in families with parental substance abuse are at high risk of child maltreatment and associated adverse outcomes. A trial of methadone-maintained parents randomised to the Parents under Pressure (PuP) parenting programme reported significant improvements in family functioning relative to standard care or a brief intervention, as indicated by a reduction in scores on the Child Abuse Potential Inventory. We sought to determine the cost-effectiveness of the PuP programme to inform policy and programme implementation. The cost per expected case of child maltreatment prevented was calculated and compared with the estimated lifetime costs of maltreatment and sensitivity analyses were conducted. Compared to usual care, the PuP programme costs an additional AU\$8777 (£4880) per family to deliver. Assuming the most conservative estimate of one in five cases of maltreatment prevented, a cost-effectiveness estimate of AU\$43 975 (£24 451) per case of potential maltreatment prevented for the PuP group was obtained. This is significantly less than the estimated mean lifetime cost of a case of child maltreatment of AU\$200 000 (2013 present value) (£110 000). For 100 families in this population treated with PuP, there would be a net present value saving of an estimated AU\$3.1 million (£1.7 million). Copyright © 2015 John Wiley & Sons, Ltd.

KEY PRACTITIONER MESSAGES:

- The PuP programme is a cost-effective and likely cost-saving means of preventing maltreatment in opioid-dependent parents in receipt of methadone maintenance.
- These data suggest that investment in intensive home-based parenting programmes addressing multiple domains in very high-risk families, including substance-misusing parents, may result in both improvements in clinical outcomes and considerable net cost savings.
- Even though intensive programmes may seem more expensive, because the costs of maltreatment are so substantial, the cost of doing nothing or minimally intervening is likely to be more costly for society.

KEY WORDS: child maltreatment; parenting; substance abuse; cost-effectiveness

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‘The cost per expected case of child maltreatment prevented was calculated and compared with the estimated lifetime costs of maltreatment’

‘The cost of doing nothing or minimally intervening is likely to be more costly for society’

'The cost of child abuse and neglect was estimated at almost three times the estimated cost of obesity'

'Parental substance abuse tends to occur within the context of multiple sources of disadvantage that can span generations'

Child abuse and neglect have been widely identified as a major public health and social problem with consequences that include poor social and psychological outcomes in adulthood (Gilbert *et al.*, 2009). The total costs to society of child abuse and neglect are considerable and have been found to be high relative to other major diseases and risk factors. For example, in the USA, the total lifetime economic burden resulting from new cases of child maltreatment in 2008 was estimated at US\$124 billion, similar to the estimated cost of smoking (at \$130 billion) (Fang *et al.*, 2012; US Department of the Treasury, 1998; Wang and Holton, 2007). In Australia, the cost of child abuse and neglect was estimated at AU\$10.7 billion in 2007, almost three times the estimated cost of obesity in 2005 of AU\$3.8 billion (Access Economics, 2006; Taylor *et al.*, 2008). These costs cover productivity losses through interruptions to education, low school completions, low employability, premature death and child welfare costs including the costs of out-of-home care, criminal justice costs, special education costs and the burden of disease, including healthcare costs associated with mental illness (Fang *et al.*, 2012; Taylor *et al.*, 2008). Thus, there is an interest in determining both the clinical and cost-effectiveness of interventions to prevent child maltreatment and reduce its harmful consequences in high-risk populations (MacMillan *et al.*, 2009; Mikton and Butchart, 2009).

Parental substance misuse is consistently identified as one of the key risk factors for child maltreatment (Advisory Council on the Misuse of Drugs, 2003; Child Welfare Information Gateway, 2009; Delfabbro *et al.*, 2009; Zhou and Chilvers, 2010) and is one of the strongest predictors of subsequent new cases of child abuse and neglect (Chaffin *et al.*, 1996). However, parental substance abuse tends to occur within the context of multiple sources of disadvantage that can span generations. These typically involve depleted or limited social capital and intrapersonal difficulties that include parental affect dysregulation, impulsivity and mood disorders. Children raised in families with these and other risk factors are at high risk of poor outcomes such as emotional and behavioural problems, poor school attainment and early use of alcohol and drugs (Dawe *et al.*, 2007). Taken together, these data provide compelling therapeutic and economic reasons for seeking to reduce the risk of child abuse in substance-misusing families. Given the complex nature of disadvantage facing these families, simple approaches that target single domains of family functioning such as parenting skills or knowledge are unlikely to be sufficient. Thus, a treatment approach that addresses multiple domains of family functioning is necessary. There is an emerging consensus in the field that parental affect regulation and the quality of the caregiving relationship must be a critical component of interventions in families with parental substance abuse (Dunn *et al.*, 2002; Suchman *et al.*, 2011).

A small number of interventions have been developed that address multiple domains of family functioning that include a focus on supporting parents to improve their wellbeing as core to improving the relationship with and outcomes for their child. While a review of this literature is beyond the scope of the current paper (see Barlow *et al.*, 2013, for an overview of this literature), three programmes are briefly described that incorporate the breadth of elements for successfully working with parents with substance abuse problems.

The first of these is the Parents under Pressure (PuP) programme, an intensive, home-based intervention underpinned by two key constructs: (i) that child wellbeing is dependent on the parent's capacity to provide a sensitive, responsive and nurturing caregiving environment; and (ii) that in order for this to occur, a parent needs to be able to understand and manage their own affect both in relation to parenting and to managing substance abuse problems (Dawe and Harnett, 2013). The PuP programme was evaluated initially through a series of case studies targeting parents with multiple risk factors. The target groups included parents who were in receipt of methadone maintenance (Dawe *et al.*, 2003), who were involved in the child protection system (Harnett and Dawe, 2008) and mothers leaving prison (Frye and Dawe, 2008). The effectiveness of PuP has been evaluated through a randomised controlled trial (RCT) (Dawe and Harnett, 2007) in parents on methadone maintenance, in which PuP was compared with a clinic-based, brief parenting intervention and standard care. The parents in this study reported high rates of social welfare dependence (> 70% in receipt of government benefits) and most had been in methadone maintenance services prior to the current episode of treatment (> 70% had previous treatment). The mean age of the parent was 30 years (SD=6), and the mean age of the target child was four years. The PuP programme was provided in families' homes and sessions were conducted by therapists trained in the PuP programme and supervised by Dawe. At the end of treatment and at six-month follow-up, significant improvement was reported on measures of child abuse potential, parenting stress, child behaviour problems and methadone dose relative to families in the Brief Intervention or Standard Care groups.

Similarly encouraging results were obtained with substance-abusing mothers who were provided with an intensive, therapeutically driven model of care, the Engaging Moms Program delivered as part of a family drug court process with mothers who were drug or alcohol dependent (Dakof *et al.*, 2010). The Engaging Moms model included a focus on the quality of caregiving, parenting skills and maternal emotional regulation and was compared to an intensive case management service. Substantial reductions were reported at 18-month follow-up across a number of domains including maternal substance use and potential for child abuse, for both groups (Dakof *et al.*, 2010). However, mothers receiving the Engaging Moms Program were more likely to have a positive permanency outcome for their children, that is retain custody of their children and not have their parental rights terminated, compared to case management only (77% and 55%, respectively). Some evidence of enduring benefit for such programmes is indicated by Haggerty and colleagues (2008). They report a reduction in substance use disorders in boys (but not girls) at 15 years whose families had taken part in an intensive case management and family-focused intervention for parents on methadone maintenance (see also Black *et al.*, 1994; Haggerty *et al.*, 2008; Schuler *et al.*, 2002; Suchman *et al.*, 2011).

The provision of intensive programmes for families involved with drug treatment and court systems has generated significant clinical improvement. However, before recommending wider roll-out, the policy question is whether such programmes represent value for money. The current evidence on this is limited. A recent economic evaluation of 33 home visiting programmes reported on five programmes that targeted very high/extreme-risk mothers (current abuse/illicit drug use) of infants (less than 2 years of age). Three of

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'At the end of treatment and at six-month follow-up, significant improvement was reported'

'Before recommending wider roll-out, the policy question is whether such programmes represent value for money'

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‘The PuP programme was developed as an intensive, home-based intervention that draws on attachment theory’

these programmes were identified as either cost saving or highly cost-effective against societal norms, while two performed poorly (Dalziel and Segal, 2012). The most cost-effective of the 33 programmes typically used professional home visitors in a multidisciplinary team, targeted higher-risk populations and included more than just home visiting. A systematic review of economic evaluations of drug treatment programmes for pregnant women noted that all six programmes identified were either cost-effective or cost saving. However, they also noted serious problems with study design, with none based on an RCT (Ruger and Lazar, 2012).

To our knowledge, there are no published economic evaluations of intensive family support programmes for substance-using families with young children (older than infants). We therefore conducted an economic evaluation of the PuP programme, to provide advice to policy makers on ‘value for money’. Performance was expressed in units of most relevance for policy makers – cost per case of maltreatment (or potential maltreatment) prevented (gross and net of expected downstream cost savings). The aim was to provide the relevant evidence to guide policy decisions regarding investment in the PuP programme for methadone-maintained parents.

Method

The PuP Programme

The PuP programme was developed as an intensive, home-based intervention that draws on attachment theory with its emphasis on the central importance of a safe and nurturing relationship between children and their primary carer(s). The parent’s capacity to provide consistent and appropriate parenting skills and be emotionally available to their children (Biringen and Easterbrooks, 2012) is dependent upon the parent’s ability to understand and manage their own emotional state. The construct of mindfulness is utilised as a way of helping parents to understand and manage affect and to be fully present in the current moment with their child. This, in turn, is influenced by the ecological context of the family (Biringen *et al.*, 2014). Each of these capabilities is first assessed and a treatment plan is developed collaboratively with the family in which clear goals for change are agreed to. The programme consists of up to 20 weeks of in-home sessions (mean 10.5) of one to two hours where families work with the PuP therapist. The therapeutic process is assisted by the use of a parent workbook that invites the parent to engage in a process of self-reflection and personal goal setting around a series of modules. Each module has a specific focus, for example, improving the quality of the parent–child relationship, entitled ‘Connecting with Your Child’, parenting skills, entitled ‘Mindful Child Management’, and parental affect regulation, entitled ‘Managing Under Pressure’. The programme also includes specific case management activities such as school visits, assistance with housing and legal advice as required.

Description of the Comparison Group

The costs and outcomes of the PuP programme are compared to the combined ‘Usual Care’ and ‘Brief Intervention’ groups from the RCT conducted by two of the authors (Dawe and Harnett, 2007). The Usual Care group received routine care as provided by the methadone clinic staff. This was an

appointment with the prescribing doctor every three months and included access to a case worker. These same components were also available to the PuP group. The Brief Intervention group received in addition two standard parenting sessions delivered in the clinic by the same pool of therapists who delivered the PuP programme. These two groups combined most accurately reflect current practice across opioid substitution services, where some case management including minimal parenting training may (or may not) be provided in addition to prescribing and urine toxicology assessment. Combining these two groups also provided greater statistical power for the cost-effectiveness analysis.

Procedure

Incremental cost-effectiveness analysis was the evaluation method chosen. In this, the differential programme cost of delivering PuP compared with the Usual Care/Brief Intervention control of achieving a differential outcome on child maltreatment potential is estimated. The outcome available from the RCT for use in the cost-effectiveness analysis was change in predicted maltreatment between baseline and six-month follow-up for the PuP and Usual Care/Brief Intervention control. This outcome is suitable for the application of decision analytic techniques. The analysis takes a societal perspective. The effectiveness part of the analysis takes the form of a simple decision tree with three possible outcome states: (i) high potential for child maltreatment; (ii) moderate risks; or (iii) low risk of child maltreatment. The latter is based on published cut-points for the Child Abuse Potential Inventory (CAP) measured in the RCT at baseline and six months, see the Discussion.

Effectiveness Measurement and Valuation

The CAP score was used as the primary outcome measure for the economic evaluation. The CAP is a 160-item instrument (Milner, 1986; Milner *et al.*, 1986) containing ten scales, including the 77-item Abuse scale. The predictive and discriminant validity of the CAP Abuse scale is widely reported (Caliso and Milner, 1992; Milner, 1986, 1989, 1994; Milner *et al.*, 1984, 1986; Ondersma *et al.*, 2005). CAP scores above the defined cut-offs of 215 and 166 have been translated into estimates of expected 'abuse' using observations from the published validation literature. For this economic evaluation, the original CAP data from the PuP RCT have been adjusted through the application of the published predictive validity estimates. Specifically, scores above 215 are taken to imply an 87 per cent risk of abuse, scores between 166 and 215 an 80 per cent risk of abuse and scores below the lower 166 cut-off as not abuse – the best estimates from the literature of actual abuse at CAP score cut-offs. The estimates of expected abuse for those with scores over 215 and between 166 and 215 are combined to derive the total expected cases of abuse. The translation between CAP score and abuse is varied in sensitivity analyses.

The baseline and six-month CAP scores from the original trial are used for the economic evaluation; with participants allocated into one of three categories based on their score (> 215 87% likelihood of abuse, 166 to 215 80% abuse likelihood or < 166 non-abuse).

'Combining these two groups also provided greater statistical power for the cost-effectiveness analysis'

'The CAP Inventory score was used as the primary outcome measure for the economic evaluation'

‘There was an 18.7 per cent drop out between baseline and follow-up’

‘The CAP includes a Faking Good scale’

‘Costs were classified into screening/enrolment and programme delivery’

As reported in the PuP RCT (Dawe and Harnett, 2007), there was an 18.7 per cent drop out between baseline and follow-up (3/22 patients in the PuP group, 3/23 in the Brief Intervention group and 6/19 in the Standard Care group). This rate of drop out is modest for a drug-using population, particularly given the difficulty of retaining control patients’ in research trials. We have carefully assessed the impact of the missing data through the use of several methods of imputation. For the primary analysis, we have adopted the common approach of replacing missing data with the last measured value carried forward for that individual. This essentially assumes that the mother (parent) does not change in terms of likelihood of abuse. This was deemed to be an appropriate assumption, reflecting on the natural history of abuse in this population. Alternative scenarios such as mean imputation and multiple imputation are presented in sensitivity analyses.

The CAP includes a Faking Good scale (Milner, 1986). An elevated score can be interpreted to reflect a combination of some of the following: socially desirable responding, denial of negative attitudes, excessive subscription to conventional societal norms and/or rigid and controlling personality. In the economic analyses, participants with a positive ‘faking good’ score have been assigned a score of 215+ (i.e. highest likelihood of abuse category). This ensures that only participants with a ‘genuine response’ can potentially be found to have improved. Positive faking good scores were observed on at least one of the three time points that the CAP was measured (baseline, post intervention or 6-month follow-up) for 13 individuals: one of 22 individuals in the PuP group and 12/42 individuals in the combined comparison group (Brief Intervention and Standard Care). In the sensitivity analysis, cases with positive faking good scores are omitted.

Programme Costs

Programme components for costing were based on the programme delivered in the original RCT, as recorded in budget documents and the RCT protocol, clarified as required with interviews with project staff. Australian 2013 unit costs were applied to calculate costs of delivering the same programme in 2013. All financial estimates presented throughout this paper are in Australian dollars (AU\$) (with currency conversion to £UK also presented using the December 2013 exchange rate of 0.55602). Costs were classified into screening/enrolment and programme delivery. Unit costs for salaries were sourced from the Australian Allied Health Professionals salary scales for social workers. Programme cost categories included were salaries for those who deliver the programme (incorporating salary oncosts and overheads), programme administration, training and supervision (based on the fee set by the PuP programme), and travel to family homes (based on the Australian Tax Office motor vehicle rates). Discounting was not applied to the within-trial programme effect or programme costs given the short trial and follow-up period of six months.

The comparison group incurred the costs of the two-session group parenting programme for 46 per cent of participants, with the costing based as the description in the PuP trial (Dawe and Harnett, 2007). All other aspects of routine care by methadone staff, doctor consultation and case management

were received by both PuP and comparison participants and thus do not represent a differential cost and were therefore ignored (see Table 1).

Lifetime-Estimated Costs of Child Maltreatment

Estimated costs of child maltreatment were informed by the costing study undertaken by Access Economics and others (Deloitte Access Economics, 2011; Taylor *et al.*, 2008), as reinterpreted for the Queensland inquiry into child protection (Segal *et al.*, 2013), as the best available estimate of the costs of child maltreatment in Australia. The report calculates a lifetime cost of maltreatment for a cohort of first-abused children in 2007: composed of healthcare costs (hospitalisation for injuries and treatment of depression and anxiety), additional educational assistance, productivity losses, crime, government expenditure on out-of-home care and protection, deadweight losses (efficiency lost through taxation), premature death and loss of quality of life (mostly associated with anxiety and depression). This cost reflects a societal cost of child maltreatment including cost to government, individuals and services. The base case estimate of lifetime present value cost was AU\$16.3 million (£9 million) with a range of AU\$7.5 to AU\$46.9 million (£4.2 to £26.1 million) adjusted to 2013 values. One of the key inputs to translating this to a lifetime cost per child estimate was the incident cases of child maltreatment in 2007. The incidence of child maltreatment is uncertain and varies depending on the definition of maltreatment and the data sources used. As the largest component in the cost estimate is that of the child protection and criminal justice system and as such is primarily concerned with the cost of abuse for those involved with the child protection system. We have used the number of children in finalised investigations in 2007 as the best estimate of child maltreatment cases. With 84 344 children so identified (Productivity Commission, 2011, Table 15A.8), this puts the estimated lifetime cost of child maltreatment at just under AU\$200 000 (£110 000) per child. This lifetime cost estimate is taken as the mean cost that could be avoided by preventing a potential case of maltreatment. Upper and lower estimated costs of maltreatment are modelled in the sensitivity analysis of AU\$50 366 and AU\$318 760 per child (£28 005 and £177 237).

Allowance for Uncertainty

One-way sensitivity analyses were performed as described in Table 4. The variables selected as upper and lower limits were determined based on the reported ranges in programme delivery (e.g. caseload per visitor, kilometres travelled for visits), alternative methods for dealing with faking good data (omission of case or use of results as reported) and alternative methods for dealing with missing data (mean imputation and multiple imputation), or range in the estimated downstream cost of maltreatment.

Probabilistic sensitivity analysis was conducted to estimate the impact of known parameter uncertainty on the economic evaluation results. The minimum and maximum risks of maltreatment reported for the 166 (minimum 60%, maximum 83%) and 215 (minimum 73%, maximum 100%) CAP score cut-offs were used with a uniform distribution as reported in Caliso and Milner (1992). In addition, the scenarios described as minimum and maximum relating to costs in Table 4 were used to form a

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Table 1. PuP programme and comparison group delivery costs

Type of cost	Unit cost	Units	Source of costs	Cost to programme
<i>Screening and enrolling (for 64 participants)</i>				
Promotional posters	AUS50 per poster	12 posters	The number of posters was estimated by staff	AUS600 (£334)
Phone calls to assess eligibility	AUS50 cents per call	128 families called	Trial protocol outlined a phone call to assess eligibility. Staff indicated approximately 2 calls per 1 eligible family were made	AUS64 (£36)
Time to assess eligibility	Social worker (AHP 1–3) AUS\$60 801 pa +25% casual loading (equates to AUS\$8.46/hour)	32 hours (assumes two families assessed, 15 mins each, per family enrolled)	Time requirements estimated by staff	AUS1871 (£1040)
Time for enrolment consult (in clinic)	Social worker (AHP 1–3) AUS\$60 801 pa +25% casual loading (equates to AUS\$8.46/hour)	1 hour per family plus 1 hour administration time, 128 hours	Time requirements estimated by staff and stipulated in policy manual	AUS7483 (£4161)
Total screening and enrolment costs				AUS10 018 (£5570)
Total screening and enrolment costs per person enrolled				AUS157 (£87)
<i>PuP programme delivery (for 22 participants)</i>				
Therapists	Social worker (AHP 1–3) AUS\$60 801 pa +50% oncosts	2 therapists for 12 months*	From project budget figures	AUS182 403 (£101 420)
PuP training and supervision for therapists	AUS3000 per therapist	2 therapists	Reflects actual cost charged for training and supervision	AUS6000 (£3336)
Workbooks	AUS10 each	1 per family (x 22)	Reflects actual cost incurred	AUS220 (£122)
Cost of travel to home visits	AUS74 cents per kilometre travelled	6 kilometres per client, 10.5 visits on average per client	Average visits are from programme logs, kilometres are estimated by staff and cost per kilometre is from the Australian Tax Office	AUS1026 (£570)
Total PuP programme delivery costs				AUS189 649 (£105 449)
Total PuP programme delivery costs per person				AUS8620 (£4793)
Total screening, enrolment and programme PuP costs				AUS8777 (£4880)
<i>Comparison group costs (for 23/42 participants who received parenting sessions)</i>				
Therapists	Social worker (AHP 1–3) AUS\$60 801 pa +50% oncosts	1 therapist, 1 hours per session, 2 sessions	As stipulated in the policy manual	AUS2689 (£1495)
Workbooks	AUS10 each	1 per family	Reflects actual cost incurred	AUS230 (£128)
Total comparison group delivery costs				AUS2919 (£1623)
Total comparison group delivery costs per person				AUS70 (£39)

*Two therapists full time for 12 months are required to service 22 participants as part of the PuP programme protocols. In practice, therapists may also be split across other programmes and duties. For example, four therapists may spend half their time on PuP and half their time on other programmes and service 22 PuP participants. Organisations are permitted to structure their own workforce flexibly in order to meet protocol requirements. PuP = Parents under Pressure; AHP = Allied Health Professionals.

triangular distribution for PuP programme costs. These led to maximum programme costs of AU\$28 712 (£15 964) and minimum programme costs of AU\$4669 (£2596) per family. The same approach to estimating a distribution was used for the control group with a minimum cost of AU\$0 and a maximum as the full cost of a brief intervention AU\$127 (£71) per family.

Results

CAP Results

The proportions of each group classified by CAP score for the PuP and comparison groups at baseline and at six-month follow-up are shown in Table 2. The process for weighting CAP scores by likelihood of abuse (based on the validation studies) is also shown in Table 2.

At baseline, the rate of expected (potential) abuse was estimated at 70.9 per cent in the PuP group and 73.3 per cent in the comparison group. At six-month follow-up, the average rates of expected abuse were 54.1 per cent in the PuP group (a reduction of 16.8 percentage points) and 76.4 per cent in the comparison group (a slight increase of 3.1 percentage points).

The net difference in predicted cases of abuse is therefore 19.9 per 100 families treated (16.8 - (-3.1)).

Cost-Effectiveness Results

The cost-effectiveness results are presented in Table 3. The incremental cost of providing PuP relative to standard care was estimated at AU\$8777 (£4880) per family. The cost per case of potential maltreatment avoided was AU\$43 975 (£24 451). (Full figures from the original data without rounding are used in the calculations.) This compares to the estimated mean lifetime cost of abuse of an estimated AU\$200 000 (£110 000) per incident case.

These results mean that for a group of 100 methadone-maintained parents who are receiving PuP, the programme would cost AU\$877 700 (£488 019) to deliver and would result in an expected 20 fewer cases of maltreatment,

‘The net difference in predicted cases of abuse is therefore 19.9 per 100 families treated’

Table 2. Number of participants in each group who fall within CAP cut-offs at baseline and six months, along with numbers adjusted by predictive validity

	Group	6 month follow up			Total N	Adjusted baseline N*	
		CAP>215	CAP 166-215	CAP<166			
Baseline	CAP>215 PuP (n=22)	9	4	4	17	14.8	A
	Comparison (n=42)	27	0	1	28	24.4	B
	CAP 166-215 PuP (n=22)	1	0	0	1	0.8	C
	Comparison (n=42)	6	2	0	8	6.4	D
	CAP <166 PuP (n=22)	0	0	4	4		
	Comparison (n=42)	2	0	4	6		
	Total N PuP (n=22)	10	4	8	22	15.6	A+C
	Comparison (n=42)	35	2	5	42	30.8	B+D
	Adjusted 6 month N* PuP (n=22)	8.7	E	3.2	F	11.9	E+F
	Comparison (n=42)	30.5	G	1.6	H	32.1	G+H

‘20 fewer cases of maltreatment, which is estimated to result in a saving of AU\$4 million (£2.2 million) in cost consequences of maltreatment’

‘The PuP programme remained cost-effective under all scenarios’

‘Probabilistic sensitivity analysis with 10 000 simulations leads to... an average decrease in potential cases of maltreatment of 20 per cent’

Table 3. Cost-effectiveness results

Group	Programme cost/individual receiving PuP (a)	Programme cost/100 participants receiving PuP	Change in number of cases from baseline to 6-month follow-up (%: b)	Change in number of cases from baseline to 6-month follow-up/100 participants receiving PuP	Cost per case of maltreatment avoided (a/b)
PuP (n = 22)	AU\$8777 (£4880)	AU\$877 700 (£488 019)	−3.69 (16.8%)*	16.8	
Comparison (n = 42)	AU\$70 (£39)	AU\$4600 (£3892)	+1.29 (3.1%)†	3.1	
Difference (incremental analysis)	AU\$8707 (£4841)	AU\$870 700 (£484 127)	4.98 (19.8%)‡	19.8	AU\$43 975 (£24 451)

* $(E + F) - (A + C)$ from Table 2.

† $(G + H) - (B + D)$ from Table 2.

‡Analysis is based on full digits with no rounding. PuP = Parenting under Pressure.

which is estimated to result in a saving of AU\$4 million (£2.2 million) in cost consequences of maltreatment, a net cost saving of AU\$3.1 million (£1.71 million).

Sensitivity Analyses

Results for sensitivity analyses are presented in Table 4. The range from sensitivity analyses was a cost per potential case of maltreatment prevented of between AU\$17 959 (£9986) and AU\$79 842 (£44 394) (ignoring expected downstream cost savings). The PuP programme remained cost-effective under all scenarios. The results were most sensitive to the wage and caseload of the PuP programme practitioner. Results were significantly more favourable if only the 215 CAP cut-off score was used and assumed to represent 100 per cent abuse (incremental cost effectiveness ratio (ICER) AU\$17 959; £9986). Changes in methods of dealing with missing data, or of treating faking good scores resulted in changes in the Incremental cost effectiveness ratio of less than AU\$11 000 (£6100) per case of maltreatment avoided.

Probabilistic sensitivity analysis with 10 000 simulations leads to an incremental cost per family of AU\$13 928 (£7744) and an average decrease in potential cases of maltreatment of 20 per cent, leading to cost-effectiveness of AU\$69 640 (£38 721) per potential case of maltreatment avoided. Under all simulations at a threshold willingness to pay of AU\$100 000 (£55 602) per potential case avoided, the PuP programme is 100 per cent likely to be more cost-effective than the control.

Using the upper and lower estimates of the lifetime cost of maltreatment according to the range reported by Deloitte Access Economics (2011) provides a range for estimated cost saving from AU\$2.4 million (£1.3 million) to AU\$10 million (£5.6 million). This assumes that an estimated reduction in expected cases of maltreatment is realised and that these cases do not revert back to abuse.

Discussion

These data indicate that the PuP programme is effective and estimated to result in 20 fewer cases of abuse per 100 parents receiving the programme. It is also

Table 4. Sensitivity analysis results

Variable	Base case	Upper limit	Lower limit	Range (lower, upper) – cost per case of maltreatment avoided
<i>Base case</i>				<i>\$43 975 (£24 451)</i>
<i>Sensitivity analyses relating to costs</i>				
Professional wage	AU\$60 801 Social worker	AU\$91 835 Psychologist	AU\$48 043 Paraprofessional	AU\$65 416 to AU\$35 025 (£36 373 to £19 475)
Oncosts for all wages	50%	75%	35%	AU\$50 911 to AU\$39 660 (£28 308 to £22 052)
Average kilometres travelled to visit each client	6	12	4	AU\$44 114 to AU\$43 801 (£24 528 to £24 354)
Caseload per visitor	11	6	15	AU\$79 842 to AU\$32 371 (£44 394 to £17 999)
Number of families assessed for each family enrolled	2	3	1	AU\$44 049 to AU\$43 827 (£24 492 to £24 369)
Addition of case management (hours per PuP client)	0	10 hours	-	AU\$46 825 (£26 036)
<i>Sensitivity analyses relating to effectiveness (CAP)</i>				
CAP scores (use of 215 cut-off only, 100% predictability)	> 215 87% > 166 < 215 80%	-	-	AU\$17 959 (£9986)
CAP scores (use of alternative validation statistics, 215: 80%, 166: 87%)	> 215 87% > 166 < 215 80%	-	-	AU\$60 069 (£33 400)
Imputing group mean for missing CAP data	Last reported value imputed	-	-	AU\$34 978 (£19 448)
Multiple imputation methods*	Last reported value imputed	-	-	AU\$30 286 (£16 840)
No account taken of positive faking good (FG) CAP scores	FG assumed to be abuse	-	-	AU\$44 065 (£24 501)
Those cases with positive FG scores omitted from analysis	FG assumed to be abuse	-	-	AU\$35 004 (£19 463)
<i>Sensitivity analyses relating to alternative comparators</i>				
PuP versus Standard Care (cost AU\$0 and cases prevented –1.22)	Combined control group	-	-	AU\$37 842 (£21 041)
PuP versus Brief Intervention (cost AU\$126.93 and cases prevented –0.07)	Combined control group	-	-	AU\$50 652 (£28 164)

*Missing data have been replaced using multiple imputation (multivariate sequential imputation using chained equations) to predict missing follow-up data from baseline data and the mean of five separate simulations. PuP = Parents under Pressure; CAP = Child Abuse Potential Inventory.

highly cost-effective at a cost of AU\$43 975 (£24 451) per case of child maltreatment avoided. It is also estimated to achieve considerable downstream savings in the cost consequences of child maltreatment, estimated at AU\$4 million (£2.2 million), a net cost saving of AU\$3.11 million (£1.71 million).

This represents excellent value to society, especially when considering the lifetime costs associated with maltreatment, such that in the longer term it will

‘Estimated to achieve considerable downstream savings in the cost consequences of child maltreatment’

'This analysis could also be used internationally to aid local policy translation'

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almost certainly generate large cost savings. This analysis is based on the policy-relevant metric of 'cases of potential maltreatment avoided'. It is straightforward to compare the cost of the PuP programme to the estimated lifetime costs associated with a case of child maltreatment. This analysis could also be used internationally to aid local policy translation.

Child maltreatment is known to be associated with significant social and economic consequences, so it is therefore not surprising that a programme that is successful with a very high-risk population would be cost saving. The value of investing in very high-risk populations, such as the opioid-dependent parents in this PuP trial, is consistent with a recent cost-effectiveness analysis of infant home visiting programmes by Dalziel and Segal (2012). This study found that the most cost-effective programmes were generally in the highest-risk populations. Notably, in a recent study of the cost-effectiveness of 33 home visiting programmes, cost per case of maltreatment prevented ranged from AU\$22 000 (£12 232) to several million dollars per case of maltreatment avoided (Dalziel and Segal, 2012). Of the 33 home visiting programmes, there were only four where both the quality of the evaluation was adequate and the cost per case of maltreatment avoided represented potentially good value (less than AU\$200 000 or £111 204). The PuP programme performed better than all but two of these programmes, representing value for investment in preventing child maltreatment.

While these findings are encouraging, it is important to highlight study limitations. The analysis relies on the CAP to estimate the number of cases of expected abuse in each study group. There have been 18 studies in which risk groups have been differentiated on the basis of CAP scores and risk factors. These 18 studies consistently found that children with higher CAP scores also had known risk factors for child maltreatment (such as poor parent-child interactions, disturbed parental perceptions of child behaviour, parental substance use, marital violence and parental distress) (Walker and Davies, 2010). Data on predictive validity of the CAP are less robust. Three studies identified by Walker and Davies (2010) provide cautious support for the use of the CAP as a tool that measures change following an intervention. Harnett and Dawe (2008) found reductions in CAP scores in their single case study series of ten families engaged in the child protection system, with a significant decrease in scores from pre-treatment of 229 (SD=116) to 137 (SD=103) at three months. Further, Dakof *et al.* (2010) found reductions in scores using the Brief CAP in mothers engaged in family drug courts.

The key issue for this paper is the extent to which the CAP scores are an accurate representation of child maltreatment. In an extensive review on the prevalence of child maltreatment, Gilbert *et al.* (2009) found that one per cent of children were referred to child protection services, whilst population-based surveys would suggest that rates of maltreatment are considerably higher, ranging from four to 16 per cent of children experiencing physical abuse, ten per cent experiencing psychological abuse and between one and 15 per cent experiencing neglect.

There is independent support for the proposition that parents' response to a questioner can reliably indicate abuse. When population surveys ask questions about behaviour that is indicative of abuse, there is remarkable concordance between children's reports of their parents' behaviour and parents' report of their own behaviour (Finkelhor *et al.*, 2005a). For example, in a large population survey conducted in the UK, parents were asked to report on children 11 years and under,

whilst children aged 11 to 18 years were asked to report on their own experience of maltreatment. The point of comparison, made to ascertain potential under-reporting of parents, was parent report on children aged ten years and child report of children aged 11 years. Children and their parents gave remarkably consistent responses to reports of abuse in the past year and lifetime-reported rates (Radford *et al.*, 2011). This replicates earlier findings that when both carers and their children were retrospectively asked to report childhood abuse, there was significant agreement between child and parents' recall and reporting of events (Finkelhor *et al.*, 2005b).

Thus, while CAP Abuse scores are not equivalent to substantiated cases of child maltreatment (Chaffin and Valle, 2003), they are likely to be good proxy measures of behaviours and attitudes associated with potential or current child maltreatment. While the use of substantiation data of child abuse from official records considerably underestimates abuse, future research would benefit from further investigation of both the relationship between CAP Abuse scores and the rates of substantiated child maltreatment and CAP scores and parents' report of actual maltreating behaviour. It is clear from the data above that neither, in isolation, is going to be the most accurate representation of actual child maltreatment at a community level.

In conclusion, substance-abusing parents typically have a range of complex problems that are associated with adverse outcomes for children, and are observed to have high rates of involvement with child protection systems (Advisory Council on the Misuse of Drugs, 2003; Child Welfare Information Gateway, 2009; Delfabbro *et al.*, 2009; Taylor and Kroll, 2004; Zhou and Chilvers, 2010). Programmes that are clinically effective and cost-effective are critical to address the needs of these most vulnerable children and families. This analysis RCT indicates that the PuP programme is cost-effective. The individualised, case management approach requires caseloads of approximately seven to eight families per practitioner. Thus, it is entirely reasonable that government and policy makers would seek data on cost-effectiveness to determine potential gains before investing in such programmes. This paper contributes to that knowledge base and provides clear support for the expanded delivery of intensive family support programmes.

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‘Children and their parents gave remarkably consistent responses to reports of abuse’

‘The programme helps improve family functioning... it is also cost-effective’

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