Cost-Effectiveness Analysis of the Incredible Years Parenting Program as an Indicated Prevention of Child Conduct Problems

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Conflicts of interest

Maartje Raaijmakers is a certified mentor in the Incredible Years parent program and as such involved in dissemination of this parent program in the Netherlands. The other authors declare that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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Abstract

Conduct problems in childhood affect the daily lives of children and their families and have serious economic implications for society. The Incredible Years parent program (IY) is a manualized behavioral parent training that aims to improve parenting skills in order to reduce conduct problems of children. We conducted a cost-effectiveness analysis of IY, compared to care-as-usual (CAU), in pre-schoolers at risk for a chronic pattern of conduct problems. In a case-control design with a two-year follow-up, we assessed intervention costs, use of public services (e.g., healthcare and special education), property damage, travel costs, and parental productivity losses. Conduct problems reduced in children in the IY condition, relative to CAU. From the public authorities perspective, the net costs to reduce the child's conduct problems by one point of observed conduct problems (meaning a reduction of one disruptive behavior each 20 minutes) were €187. Taking the parents' perspective and the societal perspective it was €88 and €155, respectively.

Keywords: Incredible Years; parenting program; child conduct problems; cost-effectiveness

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Early onset conduct problems affect the quality-of-life of both children and their families, and have serious economic implications to society, both in the short (Raaijmakers, Posthumus, Van Hout, Van Engeland & Matthys, 2011) and long-term (Scott, Knapp, Henderson & Maughan, 2001). The Incredible Years parenting program (IY) (Webster-Stratton, 2001) has proven to be effective in reducing conduct problems in young children, both as indicated prevention (d = .20) and treatment (d = .50) (Menting, de Castro, & Matthys, 2013). The investment in parenting programs is believed to lead to large savings in mental healthcare and other sectors of society. Preventing a developmental trajectory of chronic aggressive behavior and associated criminality would result in lifelong savings up to 1.7 to 2.3 million dollar per person (Cohen, 1998). However, to define the intervention that gives best value for money, economic studies that compare different interventions among each other are required (Romeo, Byford, & Knapp, 2005).

In most economic evaluations of mental health programs, only intervention costs are included. This is a serious limitation, because the greatest cost burden is mostly borne by the family, as became apparent from an economic study that evaluated the costs incurred by children with antisocial behavior (Romeo, Knapp, & Scott, 2006). Economic evaluations in this field can be carried out from three perspectives: the public authorities perspective, the parents' perspective and a comprehensive societal perspective. The public authorities perspective includes all costs incurred by the provider in delivering health services to a patient, for example salaries of the health care professionals, costs of medication, equipment and fixed assets. In this perspective, all costs by health insurance companies, educational services and community work are included. In the parents' perspective, all costs that a patient or his or her family has to bear for seeking healthcare treatment including the costs of

transport to healthcare facilities and the cost of taking time off from work are incorporated. Also costs related to damage caused by the child are included. In the societal perspective, all costs to society, irrespective of who pays for these costs, are included. In the present study, an economic evaluation is carried out using all three perspectives.

To date, few cost-effectiveness analyses (CEA) of interventions aiming at reducing conduct problems in children have been conducted, most of them from a public authorities perspective. However, also other costs such as time costs, travel costs and productivity losses should be considered (Foster, Johnson-Shelton & Taylor, 2007; Thokala et al., 2016; Romeo, Knapp & Scott, 2006). To our knowledge, no CEA of IY as an indicated prevention has been conducted. On the other hand, two CEA of IY as a treatment were published (Edwards, Céilleachair, Bywater, Hughes, & Hutchings, 2007; O'Neil, McGilloway, Donnelly, Bywater, & Kelly, 2012).

In the treatment study by Edwards et al (2007), health care workers administered the Eyberg Child Behavior Inventory (ECBI) to parents in Wales. Parents who reported their child to be above the clinical cut-off on either the intensity or problem scale of the ECBI were invited to participate. With respect to the cost-effectiveness of IY, at post-intervention the authors obtained an incremental cost-effectiveness ratio (ICER) of €109 per one-point improvement on the ECBI intensity scale. In addition, it would cost €2006 to bring the average child in the treatment group within the non-clinical limits on the intensity score. In the treatment study by O'Neill et al. (2012), IY was delivered at community-based services in Ireland. At baseline, all eligible children had to score over the clinical cut-of on either the intensity or problem scale of the ECBI. The ICER was €87 per one-point reduction on the ECBI intensity score at post-intervention. Six months after completion of the intervention, service use and associated costs continued to decline (McGilloway, et al., 2014).

In a previously published indicated preventive study, we showed that IY reduces observed child conduct problems using the Dyadic Parent-child Interaction Coding System-revised (DPICS-R, Robinson & Eyberg, 1981), and this effect was sustained two years after termination of the intervention (Posthumus, Raaijmakers, Maassen, van Engeland, & Matthys, 2012). In this study, we present a CEA of the preventive IY program versus Care As Usual (CAU), and observed child conduct problems as outcome measure at two-years after termination of the intervention.

Methods

Participants

Families were recruited using addresses from the Office for Screening and Vaccination in the province of Utrecht, The Netherlands. Parents of 16002 4-year-old children received a Child Behavior Checklist 1½-5 (CBCL; Achenbach & Rescorla, 2000; Dutch version by Verhulst & Van der Ende) by mail. More than half of the parents filled out and returned this questionnaire (see Figure 1). Children ($n = 503$) were selected to participate if they scored at or above the 80th percentile of the Aggressive Behavior scale of the CBCL. Based on their place of residence, 277 families were selected for IY and 226 families for CAU. First, rural and urban areas were identified, based on address density data, resulting in eight urban and eight rural areas. Then, those areas were divided between the intervention and control group. IY families were recruited from four urban and four rural areas, and CAU families were recruited from four other urban and four rural areas. Parents were invited to participate by letter and were called within two weeks to ask for their response. Parents who were interested in participation got a visit from two research team members to explain the project and its procedures. During this home visit, families who were invited to participate in the intervention received additional information on IY. Children with an estimated full scale IQ

below 80 were excluded from the study. This resulted in 72 families (26% of the selected families) in IY and 110 families (47% of the selected families) in CAU.

Design

We used a case-control design, in which participants were selected to be in either the IY-group or CAU-group based on their place of residence. Randomization was not feasible because of geographical and motivational reasons. Since motivation to participate is a recurrent problem in intervention studies, especially when families of children with conduct problems are involved (Luk et al., 2001), we wanted to lower the threshold for families to participate. We therefore chose to deliver IY at four different sites which were easily accessible, such as community centers. These sites were within a 15 km radius from the consenting families' homes. Further, IY requires at least six parents to participate in a parent group to optimize group discussion and to foster support (Webster-Stratton, 2001); in the present study 8-14 parents formed a group. Consequently, the location of the sites had to be close to the homes of the parents and a sufficient number of parents had to live in the same area in order to form a group. In addition, families were blind to condition; they were not informed about other conditions participating in the study. This was acceptable as it was unclear whether the preventive intervention would be effective. Hence, to prevent the two groups from running into each other, CAU families had to live at a considerable distance from IY families, preferably in another town or city. Therefore, a case control design was used in which families of the two conditions were matched on the child's gender, level of aggression and IQ, the parents' educational level and stress level, and address density of the place of residence of the family (Posthumus, Raaijmakers, Maassen, van Engeland, & Matthys, 2012). According to the Standards of Evidence given by the Society for Prevention Research (2005), use of a case-control design is permitted "as long as assignment was not by self-selection, but instead by some other factor (for instance geography)".

Procedure

Inclusion took place after obtaining written informed consent. Families in both conditions were allowed to seek help any time. Home visits were conducted in both groups at pre-intervention (PRE) and two-years after termination of the intervention (FU2) in order to carry out an observation of parent-child interactions using video-registration. In addition, a set of questionnaires measuring resources use and costs during a 3-month follow-up period was mailed to the parents at post intervention (POST; directly after the intervention), at one-year follow-up (FU1; one year after termination of the intervention) and at FU2. Parents received a financial reimbursement for their participation (€25 for every assessment). The study was approved by the Institutional Review Board of the University Medical Center Utrecht.

The intervention

IY is a manualized behavioral parent training aiming at increasing positive parenting skills such as child-directed play and praise and decreasing the use of critical statements and harsh discipline in order to reduce the risk of developing a chronic pattern of conduct problems (Webster-Stratton, 2001, 2002). IY consists of two programs: BASIC (12 sessions) and ADVANCE (6 sessions). The eighteen sessions were delivered weekly to groups of 8-12 parents in two-hour sessions by professionals with a background in clinical child psychology or child psychiatry. The training took place at four sites across the province of Utrecht.

Effect measurement

Effectiveness of IY on children's conduct problems was measured by means of reductions in observed *Child Conduct Problems*. The DPICS-R (Eyberg & Robinson, 1981; revised 2000), an observational measure, assesses the quality of parent-child interactions at home. At PRE and FU2, parent and child were observed for 20 minutes while playing with a standard set of toys at home. The observation was videotaped and coded by trained researchers and research assistants. Coders were blind to condition. With respect to child

behavior, a composite score of categories Smart Talk, Cry/Whine/Yell, and Physical Negative was used. This composite score was labelled *Child Conduct Problems* and was counted during the 20 minutes of parent-child interaction and ranged from 0 (absence of problems) to 35 (highest level of *Child Conduct Problems*). Trained researchers and research assistants achieved an interrater-reliability of 70% before coding parent and child behaviors into these categories. The quality of scoring was monitored continuously by having 20% of the observations checked by a second rater. Double checking the observations revealed a mean interrater-reliability of 80% (SD = 5.20, range: 70–96%).

Costs and cost-effectiveness analysis

Intervention costs

Intervention costs consist of non-recurrent and recurrent costs. Non-recurrent costs are start-up costs consisting of a licence fee, (translation of the) program materials for the IY-program, education of the group leaders and supervision of the group leaders during at least the first year. Recurrent intervention costs are directly related to the implementation of the intervention and included costs of running the IY-group sessions as well as expenses of the parents (i.e. travel costs, paid babysitting during absence and other expenses). These costs were measured by group leaders' weekly diaries in which they reported their time spent on delivering IY, preparation, phone calls to the families and travel time. Additionally, parents reported their travel time and if they used paid or unpaid babysitting. Further, costs for renting training locations, materials and refreshments offered during the parent groups were included as recurrent costs.

Non-recurrent costs per participating child were estimated assuming that on average two courses per trainer per semester would be given. We assumed that licence, materials and trainer knowledge would be valid for 10 years. Dutch unit prices (Hakkaart-Van Roijen et al., 2011) were used, wherever possible. Prices and underlying parameters are reported in

Appendix 1. Babysitting, either paid or by family members, was assumed to cost €13.80 per hour, reflecting standard costs for informal care (Hakkaart-Van Roijen et al, 2011). Costs for renting trainer locations, materials and refreshments offered during the program were based on actual data collected during the study, and updated to current costs, using the Consumer Price Index (Statistics Netherlands, 2016).

Other costs

The child's service use (as reported by the primary-caregiver) and services use of both the primary- and secondary-caregiver were acquired using questionnaires. Types of service use considered were for children: *medical care* (e.g., general practitioner (GP), specialist, physiotherapist, and medication), *mental health care* (e.g., clinical child psychologist, and outpatient treatment), *youth care* (e.g., social work and child protection services), and *educational care* (e.g., special education, service for the learning disabled). For parents, these were *medical care*, *mental healthcare* and *community care*. Four questions focused on potential damage and related costs caused by children due to their aggressive behavior. Employment status and absenteeism at work in order to take care of their child were assessed for the primary- and secondary-caregiver based on the Health and Labour Questionnaire (HLQ; Hakkaart–Van Roijen, Essink-Bot, Koopmanschap, Bonsel & Rutten, 1999).

Costs for resources use were calculated by multiplying their frequencies by Dutch unit prices (Hakkaart-van Roijen et al., 2011), where available. Medication prices were obtained from the Medication and Aid Information Project database (CVZ, 2019) and based on the daily defined dosage. Since no information was available on means of transport, we assumed that when going to the GP or other services in close proximity to their home, 50% would use a car. For longer travel distance, we assumed that 95% would use a car, and 5% would use public transport. Parking fees were estimated at €2.70 per-visit. Following Dutch health economic guidelines, costs of productivity losses for caregivers were calculated by means of

the friction cost method, using the mean productivity of the 35-44 years-old Dutch working-population, but corrected by 0.8 to correct for part-time work (Hakkaart-van Roijen et al., 2011). All costs were expressed in 2015 euros, using the Consumer Price Index (Statistics Netherlands, 2016), see appendix 3. In order to obtain annual costs the collected three-monthly resources/costs were multiplied by four.

Cost-effectiveness analysis

Cost-effectiveness of the intervention is expressed in the incremental cost-effectiveness ratio (ICER) that relates cost differences between the intervention and usual care (i.e. net costs) to effect differences between the intervention and usual care. Costs were discounted at 4%, (Hakkaart-van Roijen et al., 2011).

ICER was estimated using different perspectives. First, the perspective of public authorities, including intervention costs and costs of public service use of children and parents. Second, the parents' perspective, including all costs paid by parents such as damage-related costs, travel costs to training and for use of services during the two-year follow-up period, but also costs for paid babysitting during the intervention. Third, the societal perspective, including all costs, irrespective of the payer.

Sensitivity analyses

One-way sensitivity analyses were performed to study the robustness of the study results, meaning only one parameter is changed at the time ceteris paribus. Given that we know that the BASIC program reduces children's conduct problems (Webster-Stratton, Reid & Hammond, 2001; Hutchings et al., 2007), we considered in the sensitivity analysis the costs of the IY BASIC program specifically, assuming the same effect on child conduct problems. Additionally, IY can also be delivered by community social workers (Webster-Stratton, 2001), instead of by psychologists. Assuming same effect, we calculated intervention costs

assuming that social workers would deliver BASIC and both BASIC and ADVANCE, respectively.

No recruitment costs were considered in the base-case analysis. In the sensitivity analysis, we assumed that for each included child 1.57 children would need to be contacted, requiring two hours per contacted child. We based the number of 1.57 on the percentage of eligible families that participated in our study. Although in the current study no parking fees during the training programme were assumed, it might no longer be the case once implementing the intervention nationwide. Therefore, sensitivity analysis was applied assuming parking fees of €3.30 per session (Hakkaart-van Roijen et al., 2011). Costs for informal care (i.e., babysitting by family members during the training) were considered in the base-case analysis. Since in general no actual payments take place for informal care, these costs were excluded in a sensitivity analysis. In another sensitivity analysis, the loss of leisure time of parents who participate in the program was taken into account. Both the costs for informal care and the loss of leisure time were valued by the minimal hourly wages for paid work in the Netherlands (Hakkaart-van Roijen et al., 2011). We also present a sensitivity analysis in which only children with a score above the 93rd percentile of the CBCL Aggressive Behavior scale (borderline range) were taken into account, in order to investigate the cost effectiveness of IY for children most at risk for a developmental pathway that comes with high societal costs.

Statistical analysis

All costs generated directly after the intervention (POST), one-year (FU1) and two-years (FU2) after termination of the intervention, were added up for each child. Differences between IY and CAU on total costs were evaluated by means of ANOVA and the intervention effect was evaluated by means of a repeated measures ANOVA. A criterion of $p < .05$ was used in the analyses. Analyses were performed with SPSS 20.0. Four percent of the DPICS

data and cost data were missing, due to technical problems in assessing *Child Conduct Problems* (by means of a video registration) and parents who did not fill out the questionnaire on service use. Most variables had low (0-5%) rates of missing data. For 20 families (13% of all families in the intervention condition; 15% of all families in the control condition), data on productivity loss on all three time points were missing. These families did not differ on any demographics or indicators of child and family mental health from families for whom data on productivity loss were available ($p > .16$), except that children from families for whom data were missing on all three time points showed higher levels of observed negative child behavior at second follow-up ($t(133) = 2.10, p < .05$).

We used Multiple Imputation procedures in SPSS 20.0 to estimate missing parameters (IBM Corp, 2011; Little & Rubin, 2002). Multiple Imputation produces maximally unbiased parameter estimates (Allison, 2002; Little & Rubin, 2002). We created five imputed datasets (cf. Kenward & Carpenter, 2007). Imputed negative values (i.e., values below zero) were set to zero, because negative costs would be principally incorrect. Imputed positive values that exceeded maximum values present in the original dataset were set to the maximum value. Following standard practice, we used the variations across these five imputed data sets by re-running our analyses on all five data sets and pooling these results as a single estimate (Rubin, 1987). We compared the results based on this procedure with the results based on our original procedure in which missing data were not imputed.

Confidence intervals around the mean differences in costs and effects were estimated using bootstrapping with 1000 replications. To graphically present uncertainty around the cost-effectiveness ratio, bootstrapped cost-effect pairs (1000 replications) were plotted on a cost-effectiveness plane.

Results

Participants

Table 1 presents the characteristics of the IY and CAU group.

Effectiveness of the IY-program

The IY and CAU condition significantly differed at PRE on *Child Conduct Problems* (IY: *M* = 8.55, SD = 12.80; CAU: *M* = 3.62, SD = 5.19; *t* (135) = 2.95, *p* = .004). At FU2, children from the IY-condition had a mean score on *Child Conduct Problems* of 1.10 (SD = 2.03) and children from the CAU-condition had a mean score on *Child Conduct Problems* of 0.96 (SD = 1.89). Over time, children from the IY-condition significantly differed from children from the CAU-condition with respect to their observed negative behavior score (*F* = 7.18, *p* < .05, *d* = .30); IY-children showed a larger decrease on *Child Conduct Problems* than CAU-children.

Costs

Intervention costs

Intervention costs are expressed as per-child costs, and were in total €1,743 per child. The majority of costs (€1,236 per child, about 71%) were borne by public authorities and were mainly personnel fees. Parents' costs were equal to €507 per child, whereof €172 per child for paid babysitting and €261 per child for (unpaid) babysitting by family members. About 23% of the parents required a paid babysitter, 35% had (unpaid) family members who took care of the children, and in 42% of the cases one of the parents stayed at home during the training.

Other costs

The two-year cost profiles of both IY and CAU-conditions, discounted at 4%, are presented in Table 2 for all type of costs considered. Table 2 shows that there were no differences between the IY and CAU group from the public authorities perspective. For the IY

group, medical care, mental health care, educational care and youth care for children and

medical care, mental health care and community care for parents did not significantly differ

from the CAU group (medical care, mental health care, educational care and youth care for

children and medical care, mental health care and community care for parents). From the

parents perspective, there were also no significant differences between the IY and CAU

group. For the IY group, costs related to damage, travel costs, babysitting costs and costs

related to participation in the IY group were considered; for the CAU group, costs related to

damage and travel costs were considered. IY and CAU did not differ on productivity losses,

neither did the two groups differ on total costs.

Cost-effectiveness analysis

Base-case CEA results are presented in Table 3. An ICER of €187 (95% CI: dominant

– €1274) per one-point change on observed negative child behavior was calculated from the

public authorities perspective. Taking the parents' perspective and the societal perspective it

was €88 (95% CI: €81 - €365) and €155 (95% CI: dominant - €1958), respectively. Taking a

societal perspective, 64% of the bootstrap replications were in the north-east quadrant (IY is

better but more expensive than usual care), and 36% in the south-east quadrant (IY dominates

CAU, i.e., IY is cost-saving and results in better effects), see Figure 2.

Sensitivity analyses

The sensitivity analyses are presented in a tornado plot (Figure 3) as net costs per-

point change of observed child conduct problems. Sensitivity analyses revealed that from a

societal perspective, intervention costs would be reduced by 11% if IY is delivered by a social

worker rather than a psychologist. Delivering only BASIC by a psychologist would reduce the

intervention costs by 32%, and if delivered by a social worker by 39%. Not considering

informal care would decrease the costs by 14%. Adding recruitment costs, parking fees, and

loss of leisure time would raise the costs by 20%, 4% and 20%, respectively. Including loss of

leisure time, including recruitment costs, including parking fees and current training and licence costs ADVANCE versus the base case analysis, resulted in a less cost-effective intervention. Whereas a social worker, twelve sessions versus eighteen sessions (both social worker and psychologist), not considering costs for informal help (i.e. unpaid babysitting) and licence costs BASIC versus the base case analysis, resulted in a more favourable ICER for the societal perspective. The same findings were observed for the public authorities' perspective. Taking a societal perspective and considering only children with most severe conduct problems ($n = 64$; 50% IY condition), that is above the 93rd percentile on CBCL aggression scale at selection) IY is dominant over CAU, implying that IY is both cost-saving and generates better effects. Scores at PRE were (IY: $M = 11.29$, SD = 15.76; CAU: $M = 4.67$, SD = 6.25) and at FU2: (IY: $M = 1.23$, SD = 1.80; CAU: $M = 0.97$, SD = 1.67), ($F = 4.68$, $p = .03$). This sensitivity analysis showed that 99% of the bootstrap replications were in the south-east quadrant and 1% in the north-east quadrant (Table 3, Figure 2). Overall, the sensitivity analyses revealed that the results are robust.

Discussion

We conducted a CEA of IY as an indicated preventive intervention. Results are in line with the cost-effectiveness treatment studies of the IY treatment studies by Edwards et al. (2007) and O'Neil et al. (2012) who used only public authorities perspectives at post-intervention. Similarly, in the economic evaluation of Incredible Years and several other parenting programs in which parents either contacted services or were recruited, only direct intervention costs at post-treatment were included (Sampaio, Enebrink, Mihanopulos, & Feldman, 2016). In contrast, in the present study the economic evaluation was conducted using both the parents', the societal and the public authorities perspective. From the public authorities perspective, the net costs per child to reduce the child's conduct problems by one point were €187 (95% CI: dominant – 1274). Taking the parents' perspective and the societal

perspective it was €88 and €155, respectively. Reducing the child's conduct problems by one point means a reduction of one disruptive behavior (e.g., punching, yelling, kicking) each 20 minutes. IY appeared to be dominant over CAU (better effects and cost-saving) in 99% of the cases if targeted at the children with the most severe conduct problems only and taking a societal perspective.

Work absence of caregivers accounted for 49% and 48% of total costs for IY and CAU, respectively. This is higher than the 30% reported by Knapp, Scott and Davies (1999). Damage-related costs accounted further for 5% of total costs in the CAU group. Healthcare costs, including mental health, accounted only for 45% and 31% of total costs for IY and CAU, respectively. The fact that a large part of costs in the follow-up period was generated outside the healthcare sector demonstrates the importance of using a comprehensive societal viewpoint in economic evaluations of interventions for children with conduct problems.

From the families' perspective it is important to consider time costs in the intervention costs as such costs may affect participation negatively. Families may be more likely to drop out of programs that require a lot of their leisure time. If the BASIC curriculum is indeed effective in reducing child conduct problems, as shown by Hutchings et al. (2007), then in a preventive context we suggest to only use the BASIC curriculum as intervention costs would decrease and IY would be more cost-effective, independent of the perspective taken.

Sensitivity analyses revealed that the findings were robust for all three perspectives. IY was dominant over CAU in a subgroup of children with the most severe conduct problems at baseline, independent of the perspective taken. This last result is in line with findings of previous treatment studies in which only children with clinical levels of conduct problems were included (Edwards et al., 2007; O'Neil et al, 2012) and of the Fast Track program study, a multicomponent indicated prevention study. This program has been shown to be cost-effective only in children with most severe conduct problems (i.e., above the 90th percentile

on screening measures) (Foster, Jones & the Conduct Problems Prevention Research Group, 2006). Both the Fast Track program and the present study used inclusion criteria that are usual for indicated prevention and clearly lower than clinical cut-off points: in the Fast Track study ninety five percent of the selected sample scored in the top 20% on both parent and teacher screening measures (Foster et al., 2006) whereas in the present study children were selected to participate if they scored at or above the 80th percentile of the CBCL aggression scale.

The present study shows a number of strengths. First, as in other economic evaluations, objective primary outcome measures have to be used. The use of blinded behavioral observation therefore is a strength of the present study. Second, the assessment of costs and the CEA were conducted using different perspectives, that is public authorities, parents and society. Third, unlike other IY CEA studies, data on direct (e.g., intervention costs, healthcare costs) and indirect costs (e.g., travel costs, productivity losses) were collected. Fourth, extensive sensitivity analyses were conducted. Fifth, a relatively long follow-up period of two years after termination of the intervention was used in this study, opposite to other studies with four (Sampaio et al., 2016) or six months (McGilloway et al., 2014) follow up periods.

The results should be interpreted in the light of some limitations. First, despite IY and CAU families were matched on six key characteristics the IY and CAU group significantly differed on child conduct problems at PRE; thus there might have been a larger probability of improvement in IY children. Second, productivity losses of parents who were absent from work due to own illness were not assessed. However, as this absence might be related to the child problems, productivity losses may be underestimated. Third, although the assumptions of the normal distribution of data were violated, traditional parametric statistical tests in the analyses of cost data were used, mainly because nonparametric statistical methods and transformation of the data are supposed to be inappropriate to measure differences in mean

costs between groups (Doshi, Glick & Polsky, 2006; Thompson & Barber, 2000). Fourth, it was assumed that parents would pay damage-related costs, but some of these costs might be taken over by their insurance companies, thus fewer costs for parents and a shift of these costs to other stakeholders in the society could have taken place.

In sum, from the public authorities perspective, the net costs per child to reduce the child's conduct problems by one point were €187, representing a reduction of one disruptive behaviour each 20 minutes. If policy makers are willing to invest in improving parenting skills in families with children at risk of a chronic pattern of conduct problems, both the child's conduct problems will be reduced and potential cost-savings in society might be expected in the two-years following the intervention.

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Table 1

Sample \Characteristics

	IY condition (n = 72)	CAU condition (n = 72)
Measure	*M* (*SD*)	*M* (*SD*)
Child		
Gender (% boys)	72	72
Age (months)	50.2 (3.1)	51.3 (2.8)
IQ	107.6 (9.5)	107.4 (11.9)
CBCL 1½-5 (raw score at selection)		
Aggressive Behavior	22.5 (4.5)	22.9 (4.6)
Parent		
Age (years)		
Primary caregiver	35.7 (4.6)	34.7 (3.8)
Secondary caregiver	38.2 (5.0)	36.8 (5.0)
Education (%)		
Primary	-	4.0
Secondary	4.0	4.0
Intermediate vocational	26.0	30.0
Higher vocational	36.0	26.0
University	34.0	36.0
Paid job (%)		
Primary caregiver	68	62

Secondary caregiver	98	98
Employment (hours per week)		
Primary caregiver	22.00 (8.9)	20.27 (9.4)
Secondary caregiver	39.55 (8.2)	41.09 (8.2)

Note. Education denotes the highest educational level of the parents

Table 2

Two-Year Cost Profiles for IY and CAU, Excluding Intervention Costs; Costs Discounted at 4%.

	Children		Parents		Total			
	IY	CAU	IY	CAU	IY	CAU		
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)		
		F	p					
Medical care	1443	1412	1317	1589	2760	3001	.36	ns
Mental health care	682	930	889	403	1571	1333	.32	ns
Educational care	570	819			570	819	.21	ns
Youth care	266	421			266	421	.42	ns
Community care			208	212	208	212	.00	ns
Costs paid by public authorities	**2961**	**3582**	**2414**	**2204**	**5375**	**5786**	**.06**	**ns**
Damage	57	136			57	136	3.04	.08
Travel costs	165	187	120	120	285	307	.13	ns
Costs paid by parents	**222**	**323**	**120**	**120**	**342**	**443**	**1.06**	**ns**

Productivity losses			5710	6266	5710	6266	0.97	ns
Sum	3183	3905	8244	8590	11427	12495	.00	ns

Note: *p* values refer to total IY and CAU

Table 3

Cost-Effectiveness Analyses

|	Intervention costs/child	Difference in costs (excluding intervention costs)[#] /child	Incremental/child*	Difference in effect / child	ICER** *(95% CI)*	Distributions over quadrants in CEA-plane (in %)	
						South-east	North-east
Base-case analysis							
Public authorities perspective	1236	-374	862 *(-1400 - 3090)*	4.6 *(1.9-7.6)*	187 *(dominant - 1274)*	21%	79%
Parents perspective	507	-100	407 *(235 - 570)*	4.6 *(1.9-7.6)*	88 *(81 - 365)*	0%	100%
Societal perspective	1743	-1030	713 *(-4300 - 5550)*	4.6 *(1.9-7.6)*	155 *(dominant – 1958)*	36%	64%
Children with severe conduct problems only (sensitivity analysis)							

| Societal | 1743 | -8544 | -6801 | 8.2 | Dominant | 99% | 1% |
| perspective | | | *(-17534 - 1494)* | *(2.4-15.1)* | *(dominant - 1274)* | | |

Note. # Costs for the use of public services (e.g., healthcare and special education), property damage, travel costs, and parental productivity losses for both IY and CAU were estimated, excluding intervention costs (for details see Table 2), and by comparing both, the difference obtained; *Negative net costs are net savings; **The intervention is dominant over CAU as generating net savings and a positive effect; the 95% CI around the mean differences in costs and effects was determined using bootstrapping with 1000 replications.
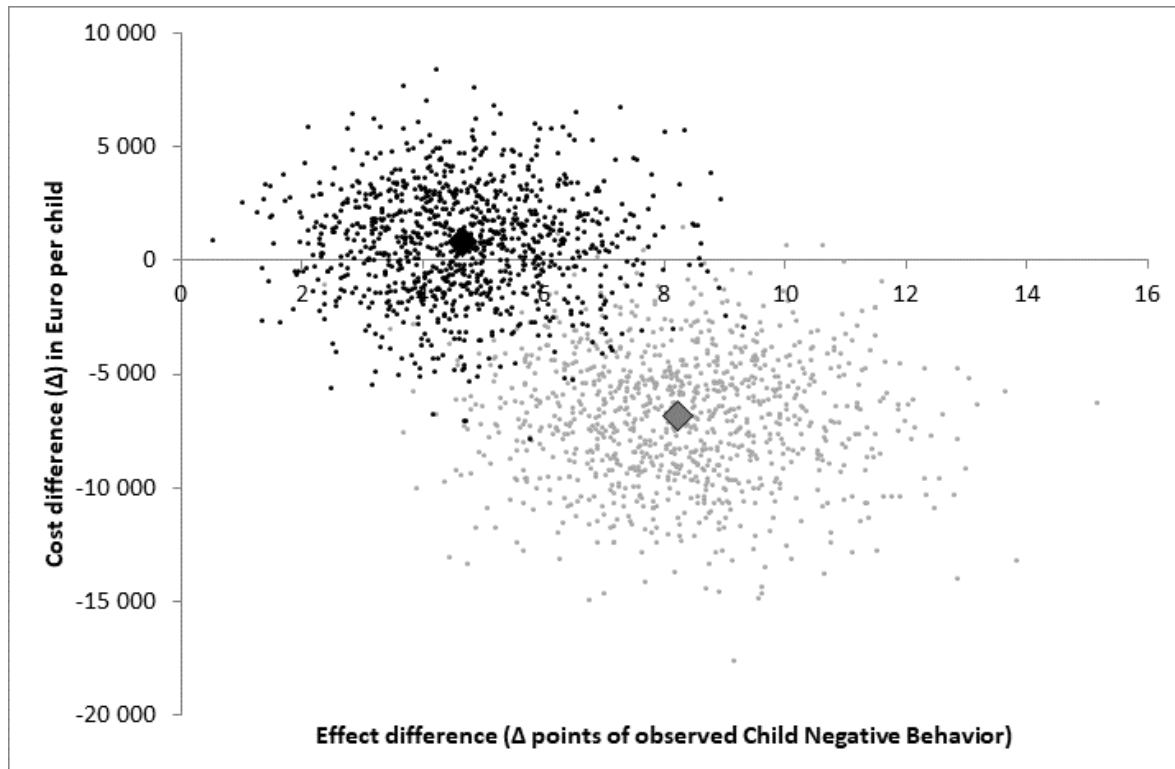
Figure 1

Flow Chart of Selection and Assessments
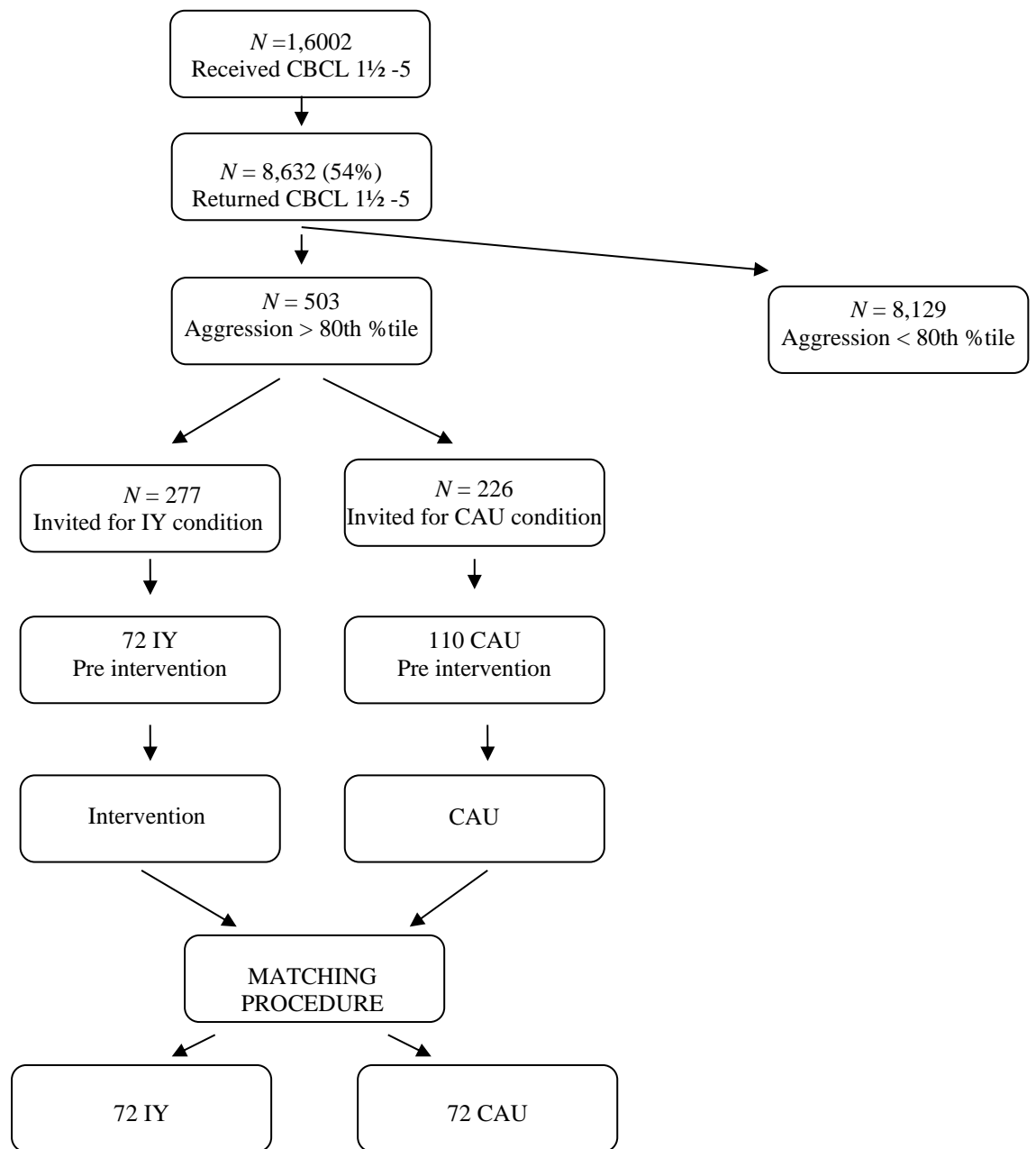
Figure 2

Distributions on the Cost-Effectiveness Plane

. children with most severe conduct problems
. all children
Distribution on the cost-effectivenes plane for children with most severe conduct problems:
North east quadrant   1%
North west quadrant   0%
South west quadrant   0%
South east quadrant   99%
Distributions on the cost-effectiveness plane for all children:
North east quadrant   64%
North west quadrant   0%
South west quadrant   0%
South east quadrant   36%

Figure 3

Tornado Chart Sensitivity Analyses Societal Perspective
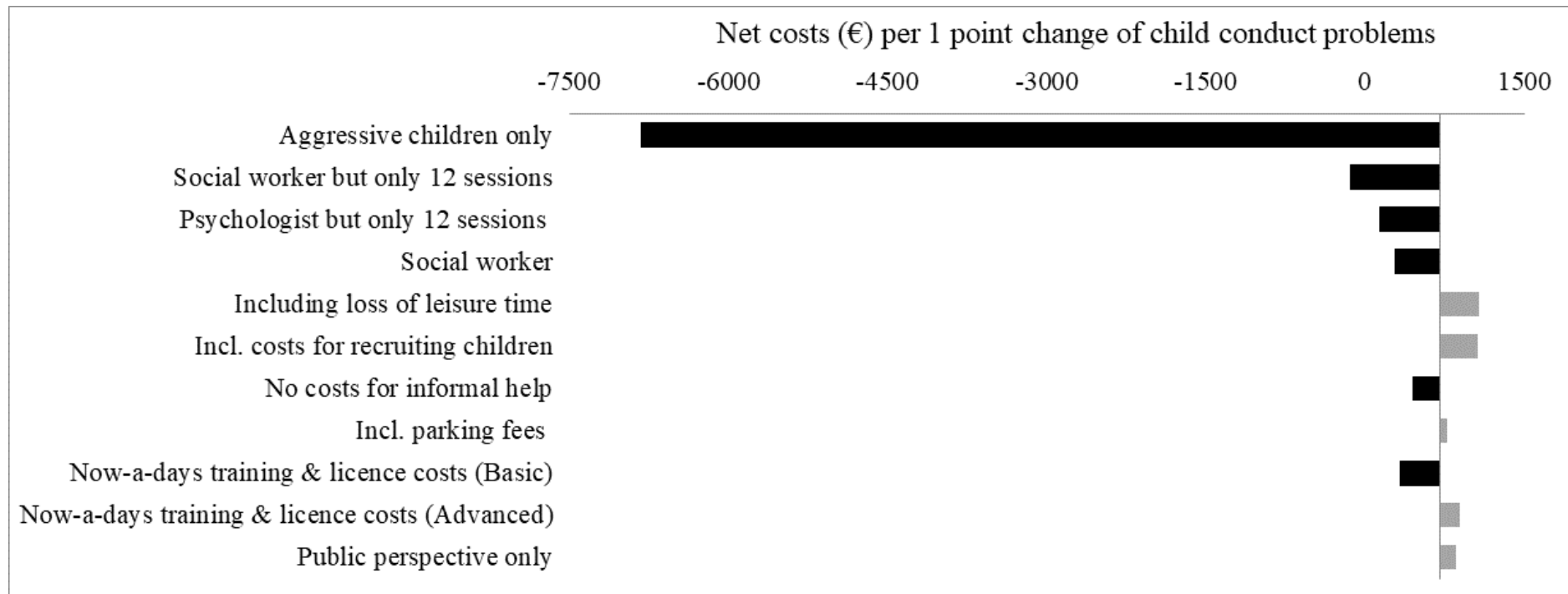
Appendix 1

Intervention costs and underlying parameters (base-case analysis)

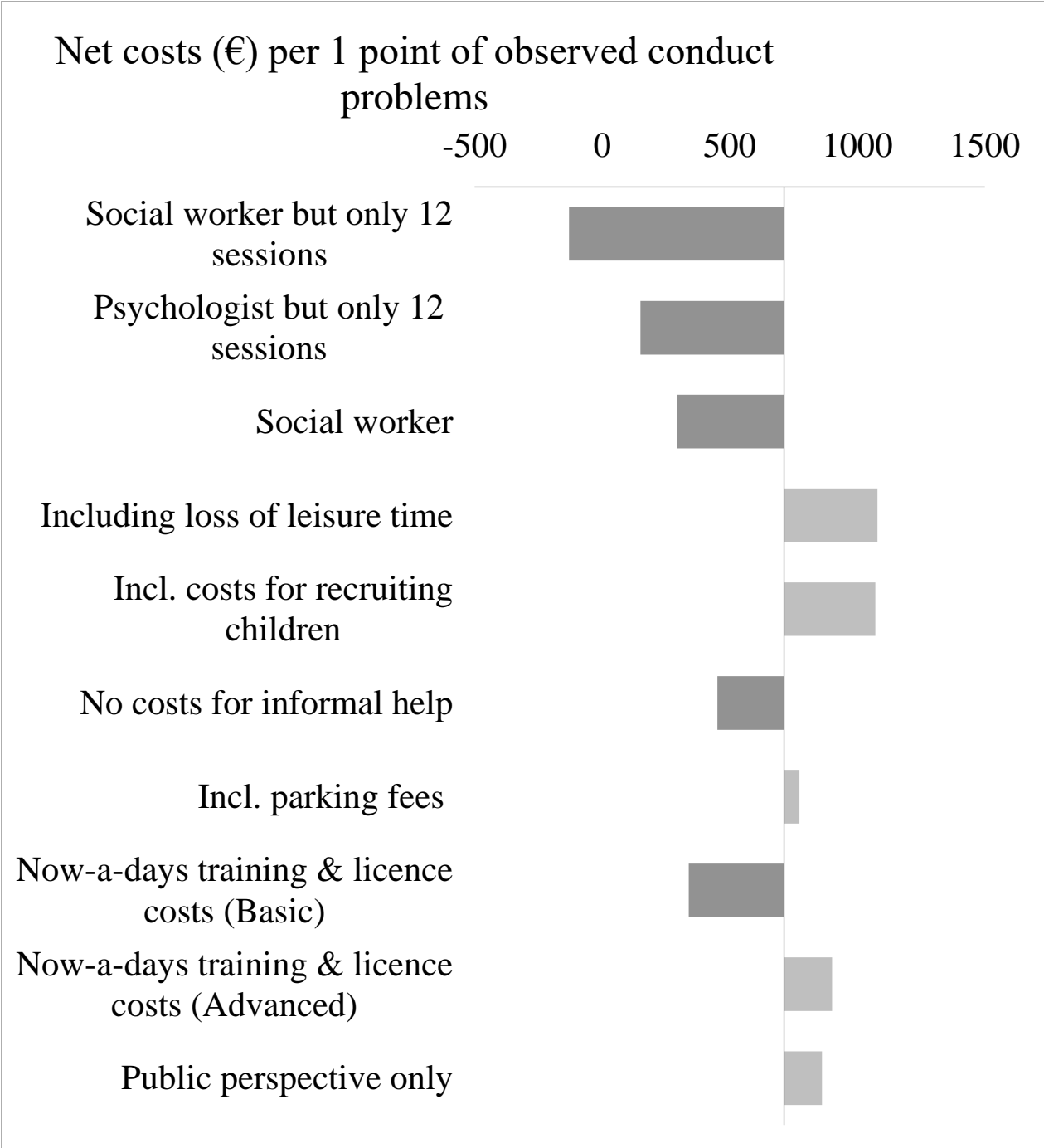|		**Source**
Start-up cost when implementing the program		
Materials (€/program)	1119.5	www.incredibleyears.com
Initial group leader training (€/person)	1119.5	www.incredibleyears.com
Recurrent costs per training and underlying parameters		
Number of sessions	18	
Number of hours per session, including preparation, administration and travel		
For trainer (hours/session)	5	[2]
For parent (hours/session)	3.5	[2]
For babysitter (paid and unpaid)　(hours/session)	3	[2]
Average distance to travel – one way (km)	7	[2]
Group materials pack (€/group)	224	[2]
Space rental and refreshments (€/session)	33.0	[2]
Book (€/book)	29.5	[2]
Psychologist (€/hour)	113.9	[3]
Social worker (sensitivity analysis) (€/hour)	71.9	[3]
Paid babysitting (€/hour)	13.8	[3]
Informal help (unpaid babysitting) (€/hour)	13.8	[3]
Loss of leisure time parents (sensitivity analysis)	13.8	[3]
Travel costs (public transport or car) (€/km)	0.2	[3]

[1] Group leader being a psychologist.

[2] Estimation based on collected data in weekly group leader diaries.

[3] Based on Dutch guideline prices (Hakkaart-Van Roijen et al. 2011)

Appendix 2
Tornado chart sensitivity analyses societal perspective

Net costs (€) per 1 point of observed conduct problems

| | -500 | 0 | 500 | 1000 | 1500 |

Social worker but only 12 sessions

Psychologist but only 12 sessions

Social worker

Including loss of leisure time

Incl. costs for recruiting children

No costs for informal help

Incl. parking fees

Now-a-days training & licence costs (Basic)

Now-a-days training & licence costs (Advanced)

Public perspective only

Appendix 3

Services and Unit Costs

Service	Unit Cost	Source	Travel Cost
Medical Care			
General Practitioner	31.0	[1]	1.8
Specialist services	79.7	[1]	5.6
Alternative medicine	93.0	Health Insurance company	1.8
Physiotherapist	38.7	[1]	1.8
Speech therapist	36.5	[1]	5.6
Health visitor in school	51.8	PC Local health service	
Language Centre	92.7	NZA 2008	15.5
Company doctor	99.0	PC director ARBO dienst [3]	
Medication Ritalin (1 mg)	0.014		
Concerta (1 mg)	0.15	Medication and Aid	
Pharmacy fee	7.00	Information Project	
Annual Costs	27.90		
Mental Health Care			
Psychologist	113.9	[1]	5.6
Child psychologist	80.00	[2]	5.6
Psychiatrist	82.00	[1]	5.6
'subscription fee' childpsychiatry	146.00	[5]	NZA 2008 b
Outpatient treatment center	77.00	[1]	14.70
Youth Care			
Regional Child Care	53.00	PC Regional Child Care	7.40
Social Work	64.00	PC KWIZ	5.00

Social Pedagogical Service	64.00	PC KWIZ	5.00
Child Care & Protection Board	85.00	PC CC & PB	9.50

Educational Care

Educational Services	52.00	PC director special education [4]	
Preventive ambulant services	52.00	PC director special education [4]	
Individual educational support (year)	12067	[6]	[4]
Special education (year)	4500	[6]	[4]
Cluster IV education (year)	7850	[6]	[4]

Community Care

Social work	64.00	[1]	5.00
Community social work	29.00	[1]	9.50

Note. All unit costs are prices per consult, unless indicated otherwise

[1] Based on Dutch guideline prices (Hakkaart-Van Rooijen et al. 2011)

[2] Pilot of 10 private practices. Available on request by the first author

[3] No travel costs considered. Assuming that visit occurs during working hours at the working place

[4] No additional costs for travelling considered

[5] Dutch specialists charge their patients a so-called 'subscription fee'. We assumed a yearly subscription for a psychiatrist for children and parents when consulting

[6] Costs per child per year, expressed as the difference with regular education. Source: Ministry of Education (2017).

 (NZA: Nederlandse Zorgautoriteit [Dutch Health Care Authority]; KWIZ: Kenniscentrum Werk, Inkomen en Zorg; ARBO = Health and Safety Service)