Published in final edited form as:

Matern Child Health J. 2014 April ; 18(3): 575–583. doi:10.1007/s10995-013-1274-1.

Vision and Hearing Deficits and Associations with Parent-Reported Behavioral and Developmental Problems in International Adoptees

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Abstract

Objectives—To determine the occurrence of vision and hearing deficits in international adoptees and their associations with emotional, behavioral and cognitive problems.

Methods—The Minnesota International Adoption Project (MnIAP) was a 556-item survey that was mailed to 2969 parents who finalized an international adoption in Minnesota (MN) between January 1990 and December 1998 and whose children were between 4–18 years-old at the time of the survey. Families returned surveys for 1906 children (64%); 1005 had complete data for

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Disclosures

The authors have no financial relationships or conflicts of interest relevant to this article to disclose.

Contributors Statement Page

The following authors have made substantive intellectual contributions to this study in the following manner:

1. Substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data,
2. Drafting the article or revising it critically for important intellectual content; and
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analyses. The survey included questions about the child's pre-adoption experiences and post-placement medical diagnoses, and the Child Behavior Checklist (CBCL). Multivariate logistic regression assessed associations between hearing and vision problems and problems identified by the CBCL. Information on hearing and vision screening and specific vision and hearing problems was also collected via a telephone survey (HVS) from 96/184 children (52%) seen between June 1999 and December 2000 at the University of Minnesota (U of MN) International Adoption Clinic.

Results—In both cohorts, 61% of children had been screened for vision problems and 59% for hearing problems. Among those children screened, vision (MnIAP=25%, HVS=31%) and hearing (MnIAP=12%, HVS=13%) problems were common. For MnIAP children, such problems were significant independent predictors for T-scores >67 for the CBCL social problems and attention subscales and parent-reported, practitioner-diagnosed developmental delay, learning and speech/language problems, and cognitive impairment.

Conclusions—Hearing and vision problems are common in international adoptees and screening and correction are available in the immediate post-arrival period. The importance of identifying vision and hearing problems cannot be overstated as they are risk factors for development and behavior problems.

Keywords

Hearing; vision; adoption; child; behavior; developmental delay; disabilities; psychosocial deprivation; orphanages

Introduction

In the years 1948–1985, 117,405 children from abroad joined adoptive families in the United States¹ and this group of children became a unique source of immigration. Scant attention was paid to identifying specific health problems in these children until the late 1980s when investigators identified a high prevalence of infectious diseases that jeopardized the health of both the child and adoptive family.^{2–10} Due to political changes around the world, from 1990–2000 the number of adoptions to the US more than doubled from 7093 to 18,857.^{11, 12} Additionally, the landscape shifted as the majority of children came from countries that relied on institutional rather than foster care prior to adoption. Knowledge of problems affecting international adoptees evolved during this period to include poor growth^{6, 13–16} and a high risk of prenatal alcohol exposure.^{18–22} Other problems noted included recognition of a high prevalence of developmental delays,^{6, 13, 16, 23, 24} sensory processing problems^{25, 26} and emotional and behavioral issues.^{27–32}

Hearing and vision abnormalities are among the most readily identifiable and treatable problems that affect the long-term cognitive and socioemotional development.^{33–35} Risk factors known to be associated with these problems, e.g., poverty, low birth weight (LBW), and inadequate medical care, are more prevalent among adoptees, particularly those cared for within residential institutions.³⁶ From 1994 to the present, recommendations published by the American Academy of Pediatrics (AAP) consistently supported post-arrival hearing and vision screening for international adoptees.^{37, 38} However, while sporadic cases of

hearing and vision losses have been reported,^{5, 10, 13, 15, 16, 23, 39, 40} data from a screened cohort are lacking. This study investigates the occurrence and nature of hearing and vision problems in two separate groups of international adoptees and explores the hypothesis that these problems are important independent risk factors that could alter the lifecourse of a child by putting him/her at risk for developmental, emotional and behavioral sequelae that may persist to adulthood.

Methods

Study Design and Sample

Data were obtained from two separate cross-sectional studies of international adoptees conducted in similar environments and within comparable time frames. The studies were conducted according to current ethical standards and the Human Research Protection Program at the University of Minnesota (U of MN) approved both studies with IRB approval and oversight.

The MN International Adoption Project (MnIAP) was developed by a multidisciplinary team working with an Advisory Board of adoptive parents.^{28, 41} The sampling frame consisted of families who finalized international adoptions between 1990 and 1998 through the MN Department of Human Services (3,268 sets of parents and 4,134 children). The MnIAP continues to be the largest and broadest epidemiologic study on the outcomes of international adoptees during childhood. While the distribution of adoptees by country of origin has shifted since the study inception, care environments prior to adoption (foster vs. institutional care) and the predominance of early neglect and institutional care for adoptees entering the US remains similar.^{11, 12, 42}

This report focuses on children who were 4–18 years-old at the time of the MnIAP survey (n=3,270). We obtained 2969 current addresses (90.8%) from this group. Surveys were mailed to families in February 2001, with a request that the primary parent complete it. We received complete surveys for 1,906 children (64% of those with current addresses and 58% of the total).

The Hearing and Vision Study (HVS)—Because the MnIAP survey asked only whether problems with hearing and vision had been diagnosed or treated, we identified a separate cohort to determine the nature of these problems. The sample frame included all 184 children seen at the International Adoption Clinic at the U of MN from June of 1999 to December of 2000. At the time of the clinic visit, all families had been instructed to have their child screened for vision and hearing problems within three months. Of the 96 families (52%) where contact could be established, 100% agreed to participate in a telephone survey in February and March 2003.

Survey measures

Parents of children in the MnIAP study completed a 16-page, 556-item mail survey created by the MnIAP team. This survey included closed-ended questions about the child's pre-adoption experiences, post-placement health, and learning and developmental delays. These questions used terminology familiar to parents in order to gather information about the

domains in which children and their families experienced post-adoption challenges. Data about behavioral problems were gathered more explicitly from the Child Behavior Checklist (CBCL/4–18),⁴³ embedded in the MnIAP survey. We defined T-scores > 67 ($>95^{\text{th}}$ percentile) as the categorical cutoff for each scale to differentiate non-deviant from deviant groups. This cutoff included borderline clinical cases.⁴⁴ In order to provide the most accurate portrayal of the child, we requested that the primary parent complete the survey. However, compliance with this request could not be independently verified due to the confidential nature of the survey.

Parents of children in the HVS completed a 29-item structured telephone interview about hearing and vision screening to extract specific diagnoses since their clinic visit. Interviews for the HVS were conducted by a Doctor of Audiology candidate with experience in the testing, diagnosis and treatment of hearing disorders.

The MnIAP and HVS surveys were completed by parents and we used reported diagnoses given by a health practitioner. These hearing and vision diagnoses were not independently verified.

Analysis

All analyses to examine correlates of hearing or vision loss, as well as the association between them and CBCL scores, were restricted to children in MnIAP who had been screened for both hearing and vision problems, had CBCL data, and who had complete data on key variables ($n = 1,005$). We conducted multivariate logistic regression to produce odds ratios and 95% confidence intervals to describe associations between parent-reported hearing and vision problems and dichotomous variables reflecting symptoms and syndromes from the CBCL data as well as parent-reported developmental, cognitive, learning and speech/language problems. The analyses were adjusted for factors known to be strongly associated with maldevelopment in adopted children, including institutionalization > 6 months⁴⁵, male gender⁴⁶, age at placement < 24 months^{24, 46–48} and known prenatal alcohol or drug exposure.^{49–51} The child's age at the time of the survey was also included, as the occurrence or recognition of problems post-adoption is known to increase with chronologic age.^{28, 52, 53} We made a Bonferroni correction to identify statistically significant ($p = .05$) associations and analyzed data with SPSS (Version 11.0 for Macintosh).

Results

TABLE 1 provides the characteristics of the children in the MnIAP and HVS cohorts.

MnIAP

Ninety-five percent of the parents reported their child had received a post-arrival medical examination and 92% reported receiving care from a pediatrician or pediatric nurse practitioner. Screening rates in the MnIAP cohort were 60.8% for vision and 57.6% for hearing. (TABLE 2) Children screened for vision problems, compared with those not screened, were older, 9.0 ± 3.2 (SD) vs. 8.2 ± 2.8 years, respectively [$t(1904) = -5.82$, $p < .001$]. Children screened for hearing problems, compared with those not screened, were more likely to be institutionalized > 6 months, 44.2% vs. 31.4%, respectively [$\chi^2(1) = 31.8$, $p < .001$]

and were more likely to have diagnosed or treated chronic ear infections 19.9% vs. 14.1%, respectively [$X^2(1)=11.00$, $p=.001$].

Parents reported that, among those screened, 24.7% had vision and 11.9% had hearing problems. Children seen by optometry/ophthalmology had more vision diagnoses vs. other vision screening sites [34.3% vs. 0.6%, respectively, $X^2(1)=350.4$, $p<.001$]. More hearing problems were diagnosed by audiologists vs. other hearing screening sites [33.3% vs. 1.5%, respectively, $X^2(1)=424.0$, $p<.001$]. Eighteen percent of children were diagnosed or treated for chronic ear infections after arrival to their adoptive home.

Age at the time of the survey was positively associated with vision problems in adjusted analyses (TABLE 3). Hearing problems were positively associated with >6 months of institutionalization, diagnosis or treatment of chronic ear infections post-placement, and known prenatal alcohol or drug exposure. Vision problems were associated with a 2-fold or greater risk of CBCL *T* scores >67 on the social and attention subscales as well as the parent report of practitioner diagnosed or treated developmental delay. Hearing problems were associated with a 2- to 5-fold higher risk of CBCL *T* scores >67 on the social and attention subscales as well as parent report of practitioner diagnosed or treated developmental delay, learning problems, cognitive impairment and speech disorder/language delay (TABLES 4 and 5).

HVS

Vision was screened in 74% of the HVS cohort by primary care (47.9%), school (11.3%), optometry/ophthalmology (38%) or at multiple sites (2.8%). Among those screened, 31% had abnormalities (TABLE 2). Of those 22 children with abnormalities, 36% had multiple diagnoses. Diagnoses in the 71 screened children included myopia (4%), hyperopia (8%), astigmatism (6%), strabismus (16.9%) and other (6%), including optic atrophy and abnormal tearing. Eye professionals found more diagnoses (59.3%) than other screening sites (13.6%) [$X^2(1)=16.27$, $p<.001$]. Ophthalmologic problems were diagnosed in five children prior to adoption and all had abnormalities confirmed after adoption (strabismus $n=4$) and nasolacrimal duct obstruction ($n=1$). Among those with vision abnormalities documented after adoption, only 23% had been identified in their birth countries.

Hearing had been screened in 81.2% of the children in the HVS cohort by primary care providers (30.8% of screened children), audiologists (48.7%) school screening (14.1%) or at multiple sites (6.4%). Among the 78 screened, 10 (12.8%) had hearing loss of which 70% had temporary/correctable hearing loss and 30% had losses felt to be permanent. Audiologists found abnormal hearing abnormalities more often (21.1%) than those at other screening sites (5.0%) [$X^2(1)=4.49$, $p<.05$]. A diagnosis of hearing loss was made in six children prior to adoption but only two of these children had abnormal hearing confirmed after adoption. Only 20% with hearing loss had been correctly identified in their birth countries. During the first year post-placement, 43.7% of had ear infections with 14.6% having four or more infections. Bilateral pressure equalization tubes were placed in 13 (13.5%) children. Hearing aids were needed for three children (two bilateral, one unilateral).

Discussion

Despite AAP guidelines recommending that all international adoptees be screened for vision and hearing problems soon after placement, we found that only 61% of the children in both cohorts had been screened for vision problems and 59% had been screened for hearing problems. Children in the MnIAP and HVS cohorts were 7.1 and 2.7 years post-placement, respectively, at the time of the surveys. We have no reason to think that children adopted in MN have less aggressive pediatric care than those in any other state. Low screening rates could nonetheless be related to parental recall, given the lengthy interval between adoption and survey conduct. However most of the adoptive parents were highly educated, well-insured and extremely motivated.⁴¹ Another reason for low screening rates could be that initial screening guidelines were first published in 1994, midway through the study period (1990–98).³⁷ However, data were collected five to seven years after screening guidelines were first published and most of the children in the MnIAP cohort received care, presumably ongoing, from a pediatric provider.

In the absence of other US data about screening for internationally adopted children in the US, we must conclude rates are alarmingly low. Children coming from abroad were not a part of the universal hearing and vision screening that is a part of the USA newborn hospital stay and then standard during school and medical visits as well. Our finding that vision (MnIAP 24.7%, HVS 31%) and hearing problems (MnIAP 11.9%, HVS 12.8%) were common in screened international adoptees—and that such problems were associated with parent-reported behavioral and developmental problems--informs our concern.

Some limitations include the fact that our cohorts were not universally screened and the screened sample was more likely to have some risk factors for vision and hearing loss. The MnIAP survey was 16 pages and the time to fill this out may have decreased the response rate. Both surveys had some non-response or inability to contact eligible families, thus the true associations could be stronger than those we represent. We are unable to gauge the presence, direction or strength of bias related to sample selection.

Given non-random screening and lack of clear diagnostic criteria we cannot provide a true prevalence of hearing or vision problems. For vision, the incidences of problems such as myopia, hyperopia and astigmatism do not appear to be greater than reported in US preschool children.^{54, 55} However, the high rate of strabismus (16.9%) in international adoptees compared to preschool children in the UK (2.1%)⁵⁶ and US (2.4%)⁵⁷ is of great concern since esotropia is one of the most robust predictors of decreased visual acuity in pre-school children.⁵⁸ Our identification of a high rate of strabismus is supported by Gronlund, et al., who reported a prospective study of 72 of 99 children in Western Sweden who were adopted from Eastern Europe during 1993–1997, comparing them to an age- and sex-matched reference group.¹⁸ Among those screened (mean age 7.5 years) strabismus was particularly common vs. the reference group (32% vs. 2%).

Gauging whether international adoptees have a higher rate of conductive or sensorineural hearing loss is complicated by our reliance on parent report rather than audiometric results. The National Health and Nutrition Examination Survey III (NHANES-III) examined

children (n=6,166) of similar age to our cohorts (i.e., 6–19 years), but who were universally screened for hearing problems. It reported 1.3% had mild unilateral or bilateral loss (26 to 40-dB hearing level), increasing to 14.9% for slight hearing loss (16–25-dB hearing level).⁵⁹ However, the self- or parent-reported prevalence rates of “hearing trouble” in children in twenty nationally representative US studies conducted between 1963 and 2004 averaged 1.9% (1.3–4.9%)⁶⁰. Therefore, our findings that about 12% of children experienced hearing loss likely reflect either a bias in our design (i.e., examination of differentially screened children) and/or the risks of internationally adopted children.

Several factors would predict a higher rate of vision or hearing problems in international adoptees. Prevalence studies have repeatedly documented that lower socioeconomic status and non-Caucasian race, characteristics of most international adoptees, increase the risk for childhood hearing^{59–62} and vision problems.^{54, 56, 63} Increased risk of vision problems with increased age of the child at the time of the survey probably reflects a combination of a greater likelihood of recognizing vision problems as children enter school as well as the progression of refractive error with age.⁶⁴ Low birth weight, common among international adoptees^{20, 36} but not analyzed in this study due to limited data, is a risk factor for vision problems, particularly strabismus.^{56, 57, 65} Middle ear disease is a leading cause of hearing loss in children,⁶⁶ as reflected in the MnIAP cohort where recurrent ear infections post-adoption was identified as an independent risk factor. Duration of institutionalization is an independent risk factor for hearing problems, most likely mediated via high rates of respiratory illness in congregate care settings^{36, 67} coupled with overall medical, nutritional and social neglect. Prenatal alcohol exposure, common among adoptees from some areas,^{18–22} increases the risk of hearing abnormalities in experimental animals and humans.^{68–70}

The rationale for vision and hearing screening during early childhood is not simply because these problems are common but that identification and treatment may prevent or attenuate a variety of related adverse outcomes, including speech and language problems, reduced school performance, behavior problems, decreased psychosocial well-being and poor adaptive skills.^{33, 34, 71–74} We partially confirmed our hypotheses that hearing and vision problems would be related to behavioral and developmental problems, independent of other acknowledged risk markers prevalent in this group of children. Hearing problems were strongly associated with about a 2.5 to 5.0-fold risk for practitioner diagnosed or treated developmental, learning, cognitive and speech problems. Vision problems were associated with an almost 2-fold risk of developmental problems. Vision and hearing problems were each associated with about a 2.5 to 3-fold risk for social and attention problems.

The importance of the ecobiodevelopmental framework in which a child develops has recently been highlighted.^{77–79} Within this context, the devastating, long-term effect of early childhood adversity and consequent toxic stress is helpful in understanding adverse outcomes in international adoptees. In adoption, the assumption is that a positive developmental environment is established upon entering a nurturing family but stress likely persists if sensory deficits impair a child’s perception of the world. Sensory impairments should be added to a growing list of factors that contribute to the pathogenesis of

developmental, cognitive and socioemotional problems in children experiencing severe deprivation in early life.^{33, 34}

While the children screened by an eye specialist or audiologist in MnIAP and HVS may have represented a select group with suspected problems, the prospective vision assessment of Eastern European adoptees found a similar high rate of eye problems when examined by a vision professionals.¹⁸ These findings suggest that the true prevalence of hearing and vision problems may be even greater than rates reported using data from all screening providers. Evaluation by specialists in these areas is the best option for children who join their families through international adoption given the number of risk factors in this group of children. In addition, the age of arrival for most international adoptees (74%) is <36 months of age.⁴² At this age, vision screening in pediatric offices is particularly challenging⁸⁰ because children are often adjusting to the English language for directions and hearing screening requires equipment and a recommended screening protocol⁸¹ more likely available in a specialist's office.

Summary

To our knowledge, ours is the first study to report the rates of hearing and vision screening in a geographically defined sample of international adoptees in the US and demonstrate that international adoptees are at significant risk for hearing and vision problems undiagnosed in their country of origin. Our findings show that children with these sensory deficits have a higher probability of a variety of problems including attention and social problems as well as diagnoses of speech and language delays, developmental delays and cognitive impairment. Primary care practitioners should arrange screening through vision and hearing specialists within the first few months after arrival to insure timely diagnosis and proper treatment. The importance of identifying vision and hearing problems cannot be overstated as they are risk factors for long term development and behavior problems where ready screening and correction are available in the immediate post-arrival period.

Acknowledgments

This research was supported by a National Institute of Mental Health grants (MH59848, MH080905, P50MH078105, Gunnar PI). The authors thank the parents and children who helped with this research. We would also like to thank members of the Minnesota International Adoption Project Team including H. Grotevant, R. Lee, N. Madsen, and K. Dole as well as the parent advisory board, and personnel at the adoption unit at the Minnesota Department of Human Services for their contributions to this work.

Abbreviations

AAP	American Academy of Pediatrics
CBCL	Child Behavior Checklist
HVS	Hearing and Vision Study
LBW	low birth weight
NHANES	National Health and Nutrition Examination Survey
MnIAP	Minnesota International Adoption Project

SD standard deviation

References

1. Alstein, H.; Simon, RJ. Introduction. In: Alstein, H.; Simon, RJ., editors. *Intercountry Adoption: A Multinational Perspective*. New York: Praeger; 1991. p. 1-20.
2. Hostetter MK, Iverson S, Dole K, Johnson D. Unsuspected infectious diseases and other medical diagnoses in the evaluation of internationally adopted children. *Pediatrics*. Apr; 1989 83(4):559–564. [PubMed: 2927997]
3. Hostetter MK, Iverson S, Thomas W, McKenzie D, Dole K, Johnson DE. Medical evaluation of internationally adopted children. *N Engl J Med*. Aug 15; 1991 325(7):479–485. [PubMed: 1649404]
4. Jenista JA. Infectious disease and the internationally adopted child. *Curr Opin Infect Dis*. 1993; 6:576–584.
5. Jenista JA, Chapman D. Medical problems of foreign-born adopted children. *Am J Dis Child*. 1987; 141(3):298–302. [PubMed: 3812412]
6. Johnson DE, Miller LC, Iverson S, et al. The health of children adopted from Romania. *JAMA*. Dec 23–30; 1992 268(24):3446–3451. [PubMed: 1281241]
7. Lange WR, Kreider SD, Warnock-Eckhart E. Hepatitis B surveillance in Korean adoptees. *Md Med J*. Feb; 1987 36(2):163–166. [PubMed: 3561202]
8. Lange WR, Warnock-Eckhart E. Selected infectious disease risks in international adoptees. *Pediatr Infect Dis J*. May; 1987 6(5):447–450. [PubMed: 3601491]
9. Lange WR, Warnock-Eckhart E, Bean ME. Mycobacterium tuberculosis infection in foreign born adoptees. *Pediatr Infect Dis J*. Sep; 1989 8(9):625–629. [PubMed: 2797959]
10. Nicholson AJ, Francis BM, Mulholland EK, Moulden AL, Oberklaid F. Health screening of international adoptees. Evaluation of a hospital based clinic. *Med J Aust*. Mar 16; 1992 156(6):377–379. [PubMed: 1545743]
11. Gailey, CW. Race, class and gender in intercountry adoption in the USA. In: Selman, P., editor. *Intercountry Adoption: Developments, trends and perspectives*. London: British Agency for Adoption & Fostering; 2000. p. 295-313.
12. Mandalakas, AM.; Groza, V. International Adoption (Overview). In: Shepperd Stolley, K.; Bullough, VL., editors. *The Praeger Handbook of Adoption*. 1. Vol. 1. Westport, CT: Praeger; 2006. p. 331-337.
13. Albers LH, Johnson DE, Hostetter MK, Iverson S, Miller LC. Health of children adopted from the former Soviet Union and Eastern Europe. Comparison with preadoptive medical records. *JAMA*. Sep 17; 1997 278(11):922–924. [PubMed: 9302245]
14. Mason P, Narad C. International adoption: a health and developmental prospective. *Semin Speech Lang*. Feb; 2005 26(1):1–9. [PubMed: 15731965]
15. Miller LC, Hendrie NW. Health of children adopted from China. *Pediatrics*. Jun.2000 105(6):E76. [PubMed: 10835089]
16. Miller LC, Kiernan MT, Mathers MI, Klein-Gitelman M. Developmental and nutritional status of internationally adopted children. *Arch Pediatr Adolesc Med*. Jan; 1995 149(1):40–44. [PubMed: 7827658]
17. Aronson J, Smith AM, Kothari V, et al. Elevated Blood Lead Levels Among Internationally Adopted Children -- United States, 1998. *MMRW*. 2000; 49(05):97–100.
18. Gronlund MA, Aring E, Hellstrom A, Landgren M, Stromland K. Visual and ocular findings in children adopted from Eastern Europe. *Br J Ophthalmol*. Nov; 2004 88(11):1362–1367. [PubMed: 15489473]
19. Landgren M, Svensson L, Stromland K, Andersson Gronlund M. Prenatal alcohol exposure and neurodevelopmental disorders in children adopted from Eastern Europe. *Pediatrics*. May; 2010 125(5):e1178–1185. [PubMed: 20385628]

20. Miller BS, Kroupina MG, Iverson SL, et al. Auxological evaluation and determinants of growth failure at the time of adoption in Eastern European adoptees. *J Pediatr Endocrinol Metab.* Jan; 2009 22(1):31–39. [PubMed: 19344072]
21. Miller LC, Chan W, Litvinova A, et al. Fetal alcohol spectrum disorders in children residing in Russian orphanages: a phenotypic survey. *Alcohol Clin Exp Res.* Mar; 2006 30(3):531–538. [PubMed: 16499495]
22. Robert M, Carceller A, Domken V, et al. Physical and neurodevelopmental evaluation of children adopted from Eastern Europe. *Can J Clin Pharmacol.* Fall;2009 16(3):e432–440. [PubMed: 19926894]
23. Groze V, Ileana D. A follow-up study of adopted children from Romania. *Child Adolesc Social Work J.* 1996; 13(6):541–565.
24. Rutter M. Developmental catch-up, and deficit, following adoption after severe global early privation. English and Romanian Adoptees (ERA) Study Team. *J Child Psychol Psychiatry.* May; 1998 39(4):465–476. [PubMed: 9599775]
25. Cermak SA, Daunhauer LA. Sensory processing in the postinstitutionalized child. *Am J Occup Ther.* Jul-Aug;1997 51(7):500–507. [PubMed: 9242855]
26. Wilbarger J, Gunnar M, Schneider M, Pollak S. Sensory processing in internationally adopted, post-institutionalized children. *J Child Psychol Psychiatry.* Oct; 2010 51(10):1105–1114. [PubMed: 20738449]
27. Ames, EW. The development of Romanian orphanage children adopted to Canada. Burnaby, BC Canada: Simon Fraser University; 1997.
28. Gunnar MR, van Dulmen MH. Behavior problems in postinstitutionalized internationally adopted children. *Dev Psychopathol.* Winter;2007 19(1):129–148. [PubMed: 17241487]
29. O'Connor TG, Rutter M. Attachment disorder behavior following early severe deprivation: extension and longitudinal follow-up. English and Romanian Adoptees Study Team. *J Am Acad Child Adolesc Psychiatry.* Jun; 2000 39(6):703–712. [PubMed: 10846304]
30. O'Connor TG, Rutter M, Beckett C, Keaveney L, Kreppner JM. The effects of global severe privation on cognitive competence: extension and longitudinal follow-up. English and Romanian Adoptees Study Team. *Child Dev.* Mar-Apr;2000 71(2):376–390. [PubMed: 10834471]
31. Rutter ML. Psychosocial adversity and child psychopathology. *Br J Psychiatry.* Jun; 1999 174(6):480–493. [PubMed: 10616625]
32. Rutter ML, Kreppner JM, O'Connor TG. Specificity and heterogeneity in children's responses to profound institutional privation. *Br J Psychiatry.* Aug; 2001 179(2):97–103. [PubMed: 11483469]
33. Nelson HD, Bougatsos C, Nygren P. Universal newborn hearing screening: systematic review to update the 2001 US Preventive Services Task Force Recommendation. *Pediatrics.* Jul; 2008 122(1):e266–276. [PubMed: 18595973]
34. Swanson J. Eye examination in infants, children, and young adults by pediatricians. *Pediatrics.* Apr; 2003 111(4 Pt 1):902–907. [PubMed: 12671132]
35. Thorpe AM. Unilateral and mild bilateral hearing loss in children: past and current perspectives. *Trends Amplif.* Mar; 2008 12(1):7–15. [PubMed: 18270174]
36. Johnson, DE. Medical and developmental sequelae of early childhood institutionalization in Eastern European adoptees. In: Nelson, CA., editor. *The effects of early adversity on neurobehavioral development: The MN Symposia on Child Psychology.* Mahwah, NJ: Lawrence Erlbaum Associates; 2000. p. 113–162.
37. 1994 Red Book: Report of the committee on infectious diseases. 23. Elk Grove Village, IL: American Academy of Pediatrics; 1994.
38. Jones VF, High PC, Donoghue E, et al. Comprehensive health evaluation of the newly adopted child. *Pediatrics.* Jan; 2012 129(1):e214–223. [PubMed: 22201151]
39. Miller L, Chan W, Comfort K, Tirella L. Health of children adopted from Guatemala: comparison of orphanage and foster care. *Pediatrics.* Jun; 2005 115(6):e710–717. [PubMed: 15930199]
40. Miller LC, Tseng B, Tirella LG, Chan W, Feig E. Health of children adopted from Ethiopia. *Matern Child Health J.* Sep; 2008 12(5):599–605. [PubMed: 17712613]

41. Hellerstedt WL, Madsen NJ, Gunnar MR, Grotevant HD, Lee RM, Johnson DE. The International Adoption Project: population-based surveillance of MN parents who adopted children internationally. *Matern Child Health J.* Mar; 2008 12(2):162–171. [PubMed: 17562147]
42. Bureau of Consular Affairs USDoS. [Accessed January 27, 2012] Intercountry Adoption Statistics. Jan 17. 2012 http://adoption.state.gov/about_us/statistics.php
43. Achenbach, TM. Manual for the Child Behavior Checklist/4–18 and 1991 profile. Burlington, VT: Univeristy of Vermont, Department of Psychiatry; 1991.
44. Achenbach TM, Ruffle TM. The Child Behavior Checklist and related forms for assessing behavioral/emotional problems and competencies. *Pediatr Rev.* Aug; 2000 21(8):265–271. [PubMed: 10922023]
45. Rutter M, Sonuga-Barke EJX. Conclusions: overview of findings from the era study, inferences, and research implications. *Monogr Soc Res Child Dev.* Apr; 2010 75(1):212–229. [PubMed: 20500640]
46. Smith, SL. Keeping the promise: The critical need for post-adoption services to enable children and families to succeed. New York, NY: Evan B. Donaldson Adoption Institute; 2010.
47. Merz EC, McCall RB. Behavior problems in children adopted from psychosocially depriving institutions. *J Abnorm Child Psychol.* May; 2010 38(4):459–470. [PubMed: 20084451]
48. Nelson CA, Zeanah CH, Fox NA, Marshall PJ, Smyke AT, Guthrie D. Cognitive recovery in socially deprived young children: the Bucharest Early Intervention Project. *Science.* Dec 21; 2007 318(5858):1937–1940. [PubMed: 18096809]
49. Aronson J. Medical evaluation and infectious considerations on arrival. *Pediatr Ann.* Apr; 2000 29(4):218–223. [PubMed: 10782477]
50. Barth, RP.; Brooks, D. Outcomes for drug-exposed children eight years postadoption. In: Barth, RP.; Freundlich, M.; Brodzinsky, D., editors. *Adoption & prenatal alcohol and drug exposure.* Washington, D.C: Child Welfare League of America; 2000. p. 23-58.
51. Freundlich, M. The impact of prenatal substance exposure: Research findings and their implications for adoption. In: Barth, RP.; Freundlich, M.; Brodzinsky, D., editors. *Adoption & prenatal alcohol and drug exposure.* Washington, D.C: Child Welfare League of America; 2000. p. 1-22.
52. Merz EC, McCall RB. Parent ratings of executive functioning in children adopted from psychosocially depriving institutions. *J Child Psychol Psychiatry.* May; 2011 52(5):537–546. [PubMed: 20955189]
53. Sonuga-Barke EJ, Schlotz W, Kreppner JV. Differentiating developmental trajectories for conduct, emotion, and peer problems following early deprivation. *Monogr Soc Res Child Dev.* Apr; 2010 75(1):102–124. [PubMed: 20500635]
54. Borchert MS, Varma R, Cotter SA, et al. Risk factors for hyperopia and myopia in preschool children the multi-ethnic pediatric eye disease and Baltimore pediatric eye disease studies. *Ophthalmology.* Oct; 2011 118(10):1966–1973. [PubMed: 21856013]
55. McKean-Cowdin R, Varma R, Cotter SA, et al. Risk factors for astigmatism in preschool children: the multi-ethnic pediatric eye disease and Baltimore pediatric eye disease studies. *Ophthalmology.* Oct; 2011 118(10):1974–1981. [PubMed: 21856010]
56. Pathai S, Cumberland PM, Rahi JS. Prevalence of and early-life influences on childhood strabismus: findings from the Millennium Cohort Study. *Arch Pediatr Adolesc Med.* Mar; 2010 164(3):250–257. [PubMed: 20194258]
57. Cotter SA, Varma R, Tarczy-Hornoch K, et al. Risk factors associated with childhood strabismus: the multi-ethnic pediatric eye disease and Baltimore pediatric eye disease studies. *Ophthalmology.* Nov; 2011 118(11):2251–2261. [PubMed: 21856012]
58. Tarczy-Hornoch K, Varma R, Cotter SA, et al. Risk factors for decreased visual acuity in preschool children: the multi-ethnic pediatric eye disease and Baltimore pediatric eye disease studies. *Ophthalmology.* Nov; 2011 118(11):2262–2273. [PubMed: 21856014]
59. Niskar AS, Kieszak SM, Holmes A, Esteban E, Rubin C, Brody DJ. Prevalence of hearing loss among children 6 to 19 years of age: the Third National Health and Nutrition Examination Survey. *JAMA.* Apr 8; 1998 279(14):1071–1075. [PubMed: 9546565]

60. Mehra S, Eavey RD, Keamy DG Jr. The epidemiology of hearing impairment in the United States: newborns, children, and adolescents. *Otolaryngol Head Neck Surg.* Apr; 2009 140(4):461–472. [PubMed: 19328331]
61. Paradise JL, Dollaghan CA, Campbell TF, et al. Otitis media and tympanostomy tube insertion during the first three years of life: developmental outcomes at the age of four years. *Pediatrics.* Aug; 2003 112(2):265–277. [PubMed: 12897272]
62. Stevens G, Flaxman S, Brunskill E, Mascarenhas M, Mathers CD, Finucane M. Global and regional hearing impairment prevalence: an analysis of 42 studies in 29 countries. *Eur J Public Health.* Dec 24.2011 epub December 24.
63. Cumberland PM, Pathai S, Rahi JS. Prevalence of eye disease in early childhood and associated factors: findings from the millennium cohort study. *Ophthalmology.* Nov; 2010 117(11):2184–2190. [PubMed: 20561688]
64. Braun CI, Freidlin V, Sperduto RD, Milton RC, Strahlman ER. The progression of myopia in school age children: data from the Columbia Medical Plan. *Ophthalmic Epidemiol.* Mar; 1996 3(1):13–21. [PubMed: 8705869]
65. Torp-Pedersen T, Boyd HA, Poulsen G, et al. Perinatal risk factors for strabismus. *Int J Epidemiol.* Oct; 2010 39(5):1229–1239. [PubMed: 20525734]
66. Lok W, Anteunis LJ, Meesters C, Chenault MN, Haggard MP. Risk factors for failing the hearing screen due to otitis media in Dutch infants. *Eur Arch Otorhinolaryngol.* Dec 30.2011 Epub December 30.
67. Ladomenou F, Kafatos A, Tselentis Y, Galanakis E. Predisposing factors for acute otitis media in infancy. *J Infect.* Jul; 2010 61(1):49–53. [PubMed: 20394772]
68. Berman RF, Beare DJ, Church MW, Abel EL. Audiogenic seizure susceptibility and auditory brainstem responses in rats prenatally exposed to alcohol. *Alcohol Clin Exp Res.* Jun; 1992 16(3):490–498. [PubMed: 1626649]
69. Church MW. Chronic in utero alcohol exposure affects auditory function in rats and in humans. *Alcohol.* Jul-Aug;1987 4(4):231–239. [PubMed: 3620090]
70. Church MW, Abel EL, Kaltenbach JA, Overbeck GW. Effects of prenatal alcohol exposure and aging on auditory function in the rat: preliminary results. *Alcohol Clin Exp Res.* Feb; 1996 20(1):172–179. [PubMed: 8651449]
71. Borsting E, Rouse M, Chu R. Measuring ADHD behaviors in children with symptomatic accommodative dysfunction or convergence insufficiency: a preliminary study. *Optometry.* Oct; 2005 76(10):588–592. [PubMed: 16230274]
72. Gronlund MA, Aring E, Landgren M, Hellstrom A. Visual function and ocular features in children and adolescents with attention deficit hyperactivity disorder, with and without treatment with stimulants. *Eye (Lond).* Apr; 2007 21(4):494–502. [PubMed: 16518370]
73. Hogan A, Shipley M, Strazdins L, Purcell A, Baker E. Communication and behavioural disorders among children with hearing loss increases risk of mental health disorders. *Aust N Z J Public Health.* Aug; 2011 35(4):377–383. [PubMed: 21806734]
74. Ibrionke JO, Friedman DS, Repka MX, et al. Child development and refractive errors in preschool children. *Optom Vis Sci.* Feb; 2011 88(2):181–187. [PubMed: 21150680]
75. Zeanah CH, Egger HL, Smyke AT, et al. Institutional rearing and psychiatric disorders in Romanian preschool children. *Am J Psychiatry.* Jul; 2009 166(7):777–785. [PubMed: 19487394]
76. Zeanah CH, Smyke AT, Koga SF, Carlson E. Attachment in institutionalized and community children in Romania. *Child Dev.* Sep-Oct;2005 76(5):1015–1028. [PubMed: 16149999]
77. Garner AS, Shonkoff JP, Siegel BS, et al. Early childhood adversity, toxic stress, and the role of the pediatrician: translating developmental science into lifelong health. *Pediatrics.* Jan; 2012 129(1):e224–231. [PubMed: 22201148]
78. Shonkoff JP, Garner AS, Siegel BS, et al. The Lifelong Effects of Early Childhood Adversity and Toxic Stress. *Pediatrics.* Jan; 2012 129(1):e232–e246. [PubMed: 22201156]
79. Stirling J Jr, Amaya-Jackson L. Understanding the behavioral and emotional consequences of child abuse. *Pediatrics.* Sep; 2008 122(3):667–673. [PubMed: 18762538]

80. Kemper AR, Helfrich A, Talbot J, Patel N, Crews JE. Improving the rate of preschool vision screening: an interrupted time-series analysis. *Pediatrics*. Nov; 2011 128(5):e1279–1284. [PubMed: 21987706]
81. Busa B, Harrison J, Chappell J, et al. Year 2007 position statement: Principles and guidelines for early hearing detection and intervention programs. *Pediatrics*. Oct; 2007 120(4):898–921. [PubMed: 17908777]

TABLE 1

Characteristics of children in the MnIAP (n = 1,906) and HVS (n= 96) cohorts.

	MnIAP	HVS
Female	59.8%	48.9%
Mean age of arrival, SD (years)	1.6 ± 2.2	2.6 ± 2.9
Mean age at time of survey, SD (years)	8.7 ± 3.1	5.3 ± 2.9
Mean length of time between arrival and survey, SD (years)	7.1 ± 2.6	2.7 ± 0.4
Experienced institutional care, %	57.2%	81.0%

MnIAP indicates MN International Adoption Project, HVS, Hearing and Vision Study, SD, standard deviation

TABLE 2

Hearing, vision and related problems in the MnIAP (n = 1,906) and HVS (n = 96) cohorts.

Condition	Percentage of children screened		Percentage of those screened with reported diagnosis or treatment	
	MnIAP	HVS	MnIAP	HVS
Vision problems	60.8%	74.0%	24.7%	31.0%
Hearing problems	57.6%	81.2%	11.9%	12.8%
			Percentage Reporting Problem	
Chronic ear infections ^a			17.6%	14.6%
Speech disorder/language delay			19.4%	26.0%

MnIAP indicates MN International Adoption Project, HVS, Hearing and Vision Study, SD, standard deviation

^aFour or more ear infections after arrival to the United States

TABLE 3

Multiple logistic regression analyses with adjusted odds ratios (95% confidence intervals) for risk factors predicting post-placement primary parent-reported vision or hearing problems in the MnIAP cohort. (n=1,005)

Risk Factors	Hearing Problems ^a	Vision Problems ^b
Age at time of survey	1.08 0.99–1.16	1.11^d 1.05–1.17
Male	1.02 0.65–1.62	1.06 0.78–1.45
Age at adoption 24 months	0.83 0.44–1.54	1.51 0.67–1.63
Institutionalized > 6 months	2.71^d 1.65–4.43	1.66 0.96–2.88
Known prenatal alcohol or drug exposure	2.45^c 1.22–4.95	1.66 0.96–2.88
Chronic ear infections ^e	7.90^d 5.01–12.44	Not included in analysis

MnIAP indicates MN International Adoption Project

Note: Significant (p .05) associations in boldface

^aTreated or diagnosed with hearing problems after arrival to the United States

^bTreated or diagnosed with vision problems after arrival to the United States

^cP < .05

^dP .001

^eDiagnosed/treated with chronic ear infections after arrival to the United States

TABLE 4

Multiple logistic regression analyses with adjusted odds ratios (95% confidence intervals) for risk factors predicting T-scores > 67 as reported by the primary parent on the Child Behavior Checklist (n=1,005) in the MnIAP cohort.

Subscales (Percent of cohort with T-scores > 67))	Age at survey	Male	Adoption age 24 mo.	Institutionalized 6 months	Prenatal alcohol/drug exposure	Hearing problems ^a	Vision problems ^b
Withdrawn (2.6%)	1.27 ^c 1.11–1.45	0.62 0.27–1.45	5.99 1.58–22.63	1.16 0.42–3.16	2.23 0.79–6.29	1.04 0.32–3.43	1.69 0.71–4.01
Somatic complaints (2.0%)	1.20 1.01–1.41	3.59 1.26–10.26	1.20 0.31–1.78	0.55 0.17–1.78	3.66 1.18–11.32	1.69 0.52–5.56	2.42 0.92–6.37
Anxious/depressed (4.2%)	1.15 1.04–1.29	1.44 0.77–2.68	1.51 0.62–3.63	0.67 0.32–1.41	2.01 0.83–4.90	1.94 0.86–4.36	1.53 0.78–2.99
Social problems (7.9%)	1.07 0.98–1.16	1.28 0.78–2.10	1.72 0.90–3.28	1.53 0.87–2.72	2.03 1.01–4.07	2.37 ^c 1.31–4.31	2.49 ^c 1.51–4.11
Thought problems (5.3%)	1.01 0.92–1.11	0.84 0.46–1.51	1.59 0.75–3.35	1.78 0.92–3.46	1.81 0.79–4.14	2.48 1.25–4.91	1.63 0.88–2.99
Attention problems (10.8%)	1.03 0.95–1.10	1.01 0.65–1.57	1.21 0.68–2.15	2.40 ^c 1.45–3.96	3.47 ^c 1.90–6.34	2.97 ^c 1.77–4.99	2.49 ^c 1.58–3.90
Delinquent behavior (5.0%)	1.09 1.00–1.20	1.13 0.62–2.04	2.45 1.10–5.46	1.90 0.92–3.92	2.11 0.94–4.77	0.92 0.37–2.32	1.03 0.52–2.02
Aggressive behavior (6.7%)	1.02 0.94–1.11	1.21 0.72–2.05	2.63 ^c 1.33–5.22	1.79 0.96–3.35	1.92 0.92–4.00	1.33 0.65–2.73	1.66 0.95–2.90

MnIAP indicates MN International Adoption Project

^aTreated or diagnosed with hearing problems after arrival to the United States

^bTreated or diagnosed with vision problems after arrival to the United States

^c $P < .006$.05/8 scales) Bonferroni correction

TABLE 5

Multiple logistic regression analyses with adjusted odds ratios (95% confidence intervals) for risk factors predicting primary parent-reported developmental/behavioral problems that were treated after placement (n=1,005) in the MnIAP cohort.

Treated Problem (Percent of cohort reporting problem)	Age at survey	Male	Adoption Age 24 mo.	Institutionalized months	Prenatal alcohol/drug exposure	Hearing problems ^a	Vision problems ^b
Developmental delay (13.9%)	1.01 0.94–1.07	1.20 0.81–1.79	1.69 1.02–2.80	2.84 ^c 1.80–4.47	1.69 0.91–3.11	3.41 ^c 2.10–5.53	1.75 ^c 1.14–2.66
Learning problems (11.6%)	1.21 ^c 1.12–1.30	1.21 0.79–1.85	1.19 0.67–2.09	1.99 ^c 1.22–3.25	1.90 1.00–3.63	2.39 ^c 1.38–4.11	1.78 1.13–2.79
Cognitive impairment (3.7%)	1.20 ^c 1.07–1.36	0.93 0.45–1.90	1.34 0.52–3.43	1.49 0.65–2.92	2.39 0.95–5.98	4.06 ^c 1.87–8.83	1.63 0.78–3.42
Speech disorder/language delay (23%)	1.00 0.94–1.06	1.46 1.05–2.33	1.50 0.97–2.33	1.99 ^c 1.38–2.86	1.63 0.94–2.84	4.99 ^c 3.19–7.81	1.18 0.81–1.71

MnIAP indicates MIN International Adoption Project

^aTreated or diagnosed with hearing problems after arrival to the United States

^bTreated or diagnosed with vision problems after arrival to the United States

^c $P < .013$ (.05/4 scales) Bonferroni correction