

Meta-analysis of Intelligence Scores of 'Street Children' in Developing Countries

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In many developing countries, unsupervised children spend much of their time in the urban environment and in the context of extreme poverty. These 'street children' are generally not attending school, psychological traumas are common and rates of substance abuse are high. The multiple deprivations suffered and the exposure to factors mitigating normal neurocognitive development would suggest that attainment of optimal intellectual function would be hindered. This would have implications for interventions aimed at bringing these children back into mainstream society, which generally favour reintegration into educational programs. Despite this, there is scant published material on intelligence testing of samples of street children. A systematic review and meta-analysis of the existing academic literature was conducted in English and Spanish. Only five studies of street children that included data on intelligence tests or proxy measures of intellectual functioning could be identified. These reports, from Colombia, Bolivia, Indonesia, Ethiopia and South Africa, described 201 different children. Mean scores from the street children were compared with control sample means or population norm estimates, in the latter case adjustments were made for cross-cultural comparisons and for the Flynn effect. The adjusted means were used to calculate effect sizes (Cohen's d). In all five samples, performance was below that which would be expected from the normal population, though there was much variation. The sample from Indonesia showed the smallest effect size ($d=.25$) and the sample from Ethiopia showed the largest effect size ($d=2.87$). The mean weighted effect size was 0.99. Although limited by the dearth of research on the topic, the current results suggest that the multiple deprivations suffered by street children in developing countries tend to impair normal neurocognitive development, but that the extent of this varies by culture.

The concept of 'street child' refers to those young people who spend much of their time unsupervised in the urban environment in a context of extreme poverty. A formal definition has been developed by UNICEF: *"any girl or boy who has not reached adulthood, for whom the street (in the broadest sense of the word, including unoccupied dwellings, wasteland, etc.) has become her or his habitual abode and/or sources of livelihood, and who is inadequately protected, supervised or directed by responsible adults"* (Black 1993).

In addition to UNICEF, various other charities and NGOs worldwide exist to help the street children of developing countries. These frequently publish estimates of the size of the problem, generally quoting figures of 100 million or 150 million children globally. However, the true extent of children living in the urban centres of developing countries is largely unknown. No reliable systematic surveys are available and the estimates of tens or hundreds of millions are essentially guesses (Thomas de Benitez 2011).

The reasons that children are spending much of the time in the urban environment are complex. Some may be homeless, but others, perhaps the majority, will have families to whom they return at night. Some will be begging or engaged in criminal activity and many will be child labourers, e.g. earning money by entertaining motorists or selling small items in cafes and bars. Poverty and an imperative to obtain money is a critical feature of their presence in the cities of developing countries. Street children are often demonised by the more privileged classes, by the media and security forces. In Brazil, street children are commonplace in the large cities and receive very little protection from the police. Furthermore, they may be victim to violence or assassination from local vigilante groups and even rouge police units (Inciardi & Surratt, 1998). Exposure to violence and trauma is thought to be a very common feature of the lives of street children worldwide (Thomas de Benitez 2007).

There is further health related research with street children that has often focused on substance abuse, particularly 'glue sniffing'. Indeed this form of substance abuse appears to be a common feature globally of homeless and street connected youths (e.g. Vega & Gutierrez 1998). Other research topics have been food access and undernourishment (e.g. Patriasih et al. 2010) and blood levels of lead and other toxins caused by urban pollution (e.g. Samaniego & Benítez-Leite 2002). Furthermore, there is a reasonable body of academic studies of street children stemming from sociological and anthropological work (e.g. Aptekar 1991). Academics working with and investigating the NGO sector have focused on rehabilitation efforts to move children from reliance on street living and to reengage them with educational services (e.g. Lusk 1989). Despite all these efforts, cognitive function and development of street children has been a generally neglected topic. This is something of an omission because many of the features described above (e.g. trauma, substance abuse, pollution or malnutrition) have the potential to impair cognitive functions and prevent normal neurocognitive development. In turn, this could hinder attempts at reintegrating children back into educational systems.

In contrast, there is considerably more known about the effects of homelessness on cognitive function in developed industrialised countries. Reports from the USA (e.g. Solliday-McRoy et al. 2004) and England (e.g. Pluck et al. 2012) have demonstrated that, based on population norms, IQ scores are lower than would be expected in samples of homeless adults. Indeed, such homeless samples appear to score about one standard deviation below the population norms provided by the test manufacturers. The evidence suggests that this reduction in cognitive ability is acquired and is associated with many of those features known to be overrepresented in homeless populations in developed countries. For example, high rates of childhood traumatic

experiences, psychiatric illness and alcohol and drug abuse are associated with cognitive impairment in homeless adults (Pluck et al. 2011).

Similarly, in developed countries, reductions in expected IQ scores are observed in samples of homeless children and children in homeless families. For example, a study of black homeless families in the USA reported that as a group, the children scored at the 34th percentile on an IQ test (Masten et al. 1997), equating to an IQ of about 86. On the test used the population mean was set at 100 with a standard deviation of 15. So it can be seen that the children scored in the same pattern as homeless adults, about one standard deviation below the population mean.

We have recently performed a systematic review of cognitive functions of street children in developing countries and reported that a wide range of cognitive and neuropsychological impairments have been described, albeit from a small corpus of research involving only seven studies reporting on 215 individuals (Pluck 2013). Furthermore, the studies used a wide range of methods, limiting cross-cultural comparisons. Nevertheless, there was a pattern of cognitive developmental problems and in some samples neuropsychological impairments and evidence of acquired brain damage. Only four studies included data on general intellectual function (e.g. IQ). Comparison of these scores seemed to suggested significant global variation. Nevertheless, the conclusion was that there is a relatively consistent pattern of poor performance on tests of intellectual function by samples of street children.

Since that systematic review was performed, a fifth publication has become available. This describes a neuropsychological study of street children in La Paz and El Alto, Bolivia (Dahlman et al. 2012). This includes data on a measure of IQ and also includes data on a comparison group of poor but not homeless children. In order to help interpret this new data, we have extracted the important information so that it can be compared with the data reported in the previously described systematic review. In addition, it is possible to calculate effect sizes for the five different studies, so that despite the different data collection methods used in each, direct comparisons of the results can be made. Furthermore, the subsequent effect sizes from the five different studies can be used to produce a weighted average to describe the overall estimated effect size. In essence, to provide a single statistic that conveys the results from all the available data.

However, to do this there are some methodological issues that must be considered. It is known that globally there has been a steady increase in IQ test performance. Indeed the 'Flynn effect', as it is known, describes how IQ scores have increased by about 3

points each decade (Neisser 1997). In effect, IQ tests will tend to overestimate as they become older. Therefore, comparisons of effect sizes of IQ scores, such as attempted in this meta-analysis, must account for the Flynn effect.

In addition, there is also significant global variation in IQ test score performance. Population means are different in different countries. However, as we wished to focus on developing countries, this presents a problem. In many such countries standardised and normed IQ assessments have not been available and researchers have frequently resorted to using tests from the large developed countries (generally the USA). However, what is normal in the USA is not necessarily normal in other countries. Although controversial, estimations for average IQ scores for most countries have been published (Lynn & Vanhanen 2002). These can be used to correct for geographical variation, when for example a USA normed test has been used outside the USA. Although these IQ estimates are controversial and imprecise, to correct with them will probably increase the accuracy of estimates of gaps between observed IQ score performance and what would be expected in the normal (local) population.

To summarize, we report on a systematic review and meta-analysis of scores of intellectual function of street children in developing countries.

Methods

The systematic literature review that recovered the studies from Colombia, South Africa, Ethiopia and Indonesia has been reported previously (Pluck 2013). The search was performed in July 2012. The search was performed in both English and Spanish using the large global search engines for academic material (e.g. Web of Knowledge, Google Scholar). The definition used for 'street children' was: "*Street children are recognised to be young people who experience a combination of multiple deprivations and 'street-connectedness'*" (Thomas de Benitez 2011 p viii). Studies were included if the children fulfilled this definition and were aged between 5 and 16. The search revealed 7 studies reporting on 215 individual street children. However, data on intellectual function (e.g. IQ) was only reported in four different samples. These were on samples of street children in Indonesia (Hartini et al. 2001), South Africa (Jansen et al. 1990, 1992), Ethiopia (Minaye 2003) and Colombia (Aptekar 1988).

In December 2012, the search was repeated and this located a fifth article that had recently been published. It reported on a sample of 36 homeless street children (all boys) from Bolivia and provides comparison data on 31 domiciled but

socioeconomically similar boys (Dahlman 2012). A summary of all the available studies with data amenable for meta-analysis is provided in Table 1.

Table 1: Studies included in the meta-analysis of intellectual function test scores of street children

City and Country	Sample	Mean age	Comparison group	Test of intellectual function	Reference
Cali, Colombia	56 street children	11.6 (range = 7-16)	Normative data	Kohs Block Design	Aptekar, 1988
El Alto and La Paz, Bolivia	36 boys with experience of living in the street	14.1 (SD = 1.8)	31 domiciled boys of similar SES	Leiter Performance Scale	Dahlman et al (2012)
Ngagel and Banyu Urip, Indonesia	42 street children	11.5 (range = 10-12)	Normative data	Cattell Culture Fair Test-ii	Hartini et al, 2001
Johannesburg, South Africa	44 street children (half were glue sniffers)	14.1 (SD = 1.46)	22 domiciled children	Category Test of the Halstead-Reitan Battery	Jansen et al, 1990, 1992
Addis Ababa, Ethiopia	23 child beggars	5.6	30 children from a local kindergarten	Custom made tests	Minaye, 2003

The IQ and other measures of intellectual function were corrected for the Flynn effect and for regional differences in the use of norms as necessary. In effect this involved adding 0.3 IQ points to the normative mean for each year that had passed between the publication of the research and the publication of the IQ test. Where normative IQ scores had been used from the USA and formed comparisons of data from other countries, the population norm for the local country was adjusted by reference to the expected difference in IQ scores between that country and the USA based on the tables provided by Lynn and Vanhanen (2002).

Results

For the data from Bolivia, South Africa and Ethiopia, comparison data was provided on control groups. Therefore the calculation of interest was the score difference between the street children sample and the control sample. For the other reports,

control data was not provided, and its place normative population estimates have been used, in each case adjusted for the Flynn effect and geographical variation. In each case, effect sizes were calculated with Cohen's d (Cohen 1992). A summary of the study-by-study effect sizes are shown in Figure 1. Although such effect sizes are not usually represented with polarity, we have maintained the plus/minus information in order to represent the direction of the difference between the street children sample and the respective comparison data. A negative value indicates that the street children performed worse than the comparison group. In addition we have used the qualitative categories also provided by Cohen (1992) to describe effect sizes, these are 'negligible' from 0 to .2, 'small' from .2 to .5, 'medium' from .5 to .8 and 'large' if larger than .8.

In Figure 1 we can see that in all cases the effect sizes were negative, indicating that the street children samples achieved lower scores than their respective comparison samples. However, there is considerable variation by study location, the Indonesian report had only a small effect size ($d=-.25$) while the Ethiopian report had a large effect size ($d=-2.87$). When the data describing all 201 cases reported in the five studies is combined, the estimated weighted effect size is $d=-.099$.

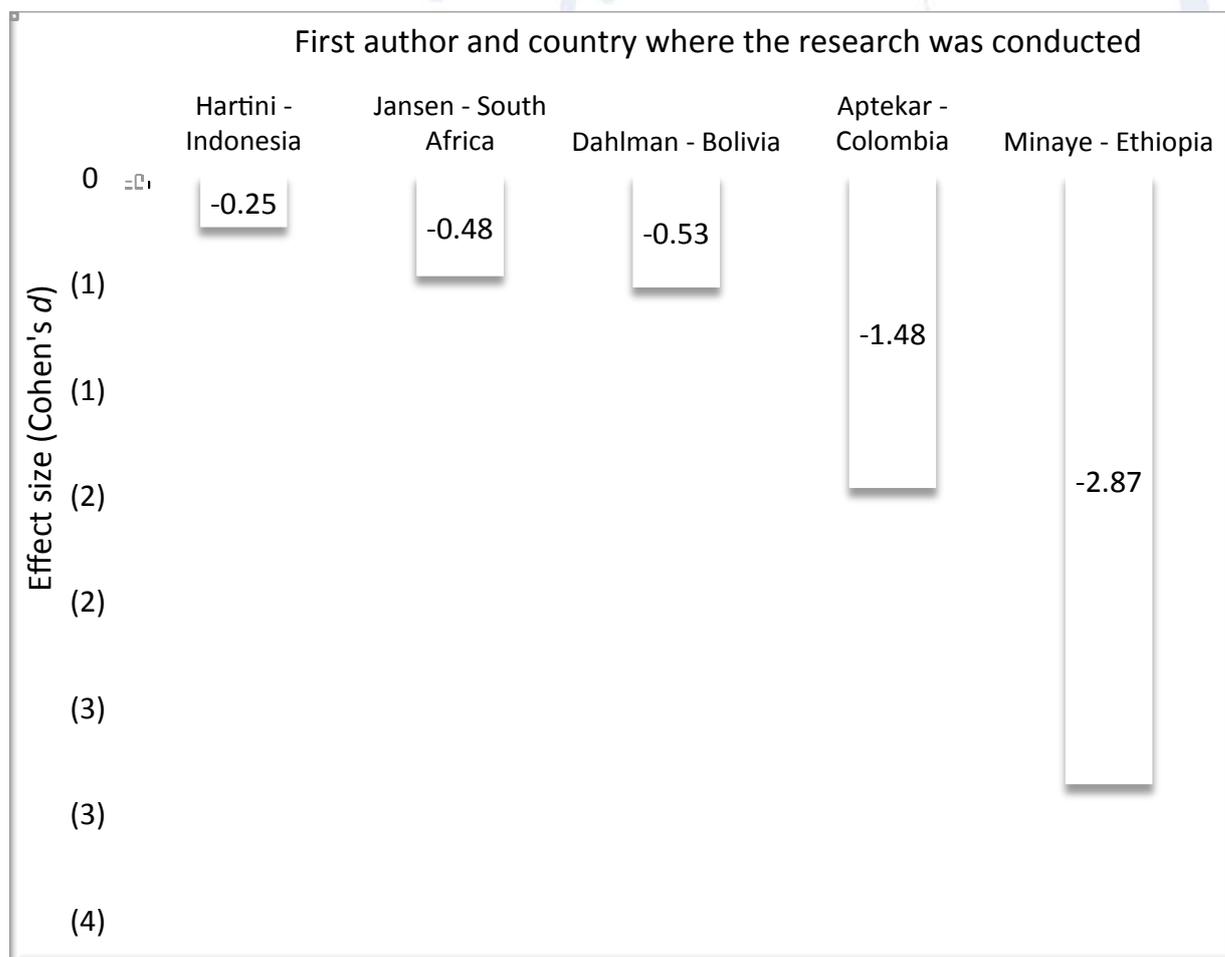


Figure 1: Effect sizes for tests of intellectual function scores by the street child samples from the five countries when compared with a control or normative sample

Discussion

We have reported on a systematic review of cognitive function of street children in developing countries and performed a meta-analysis on all of the available data relevant to general intellectual function. Only five studies reported in six publications and involving only 201 individual children were identified. Poorer performance by the street children samples compared to the comparison data was observed in all five of these studies; however, there was considerable variation. For example the effect size reported in the Indonesian study was only $d=-.25$, by convention this would be considered a small effect size, as would the effect size in the South African sample ($d=-.48$). The effect size in the Bolivian study would be considered of medium size ($d=-.053$) and the others, both the Colombian ($d=-1.48$) and Ethiopian ($d=-2.87$) would be considered large effect sizes.

When the data from all five studies was combined, the estimated average weighted effect size was $d=-0.99$. This indicates that, on average, the street children performed almost exactly one standard deviation below what might be expected of children in their culture (in the analysis we used, the effect size is equivalent to the number of standard deviations of difference). However, it must be noted that as this is a meta-analysis, it is dependent on the volume of previous reports. As described, only five studies were available, reporting on only 201 children. Although we noted in the introduction that the extent of the problem of children spending much of their time unsupervised in urban environments is unknown, it is clear that 201 children studied is a tiny figure in relation to magnitude of the issue globally.

In addition, this analysis is dependent on the quality of the existing reports. These were generally quite small studies, and some used barely adequate methods to measure intellectual functioning. For example the study in Ethiopia used custom made tests of knowledge and vocabulary (Minaye 2003). This is partly understandable, as normed and validated tests are often not available in developing countries. Nevertheless, the use of non-standard assessments or inappropriate assessments weakens the interpretation of this meta-analysis.

Despite this, some conclusions can be reached. There was an obvious pattern to the study-by-study effect results. In each case the effect sizes indicated that the street children studied performed worse than their comparison groups. There was significant

geographical variation, this should perhaps not be surprising, as the local contexts in which the children live in each culture will vary tremendously. The average effect size was very close to one.

A mean effect size that approximates one is of interest as the same phenomenon has been observed in homeless populations in developed countries. For example Pluck et al. (2012) have shown that homeless adults in the UK scored below population means by effect sizes of 1.0 for IQ and 0.99 for memory performance. Similar effects of homeless adults scoring one effect size below the population mean have been demonstrated in the USA (e.g. Solliday-McRoy et al. 2004). Furthermore, the same phenomenon has been observed in homeless children in the USA (Masten et al. 1997). It would appear therefore, that there is a general phenomenon of distributions of intellectual function test scores displaying a pattern in which those of particularly low socioeconomic status in a society score on average one standard deviation below the estimated average for the population as a whole.

This analysis cannot directly inform on the reasons for the one standard deviation effect. To some extent this may reflect a natural tendency in capitalist and meritocratic societies in which high IQ allows people to protect themselves from poverty, leaving those less able to occupy the lower socioeconomic strata. However, there are also other factors which can be identified which likely drive poor cognitive development of street children.

Substance abuse is an important issue. It has been reported to exist at very high levels among many groups of street children. Glue sniffing in particular seems to be linked to the socioeconomic deprivation and urban living of street children (e.g. Dominguez et al. 2000; Gutierrez & Vega 2003). This is perhaps due to its low cost and accessibility. Unfortunately, glue sniffing is a particularly toxic and harmful practice that can cause permanent brain damage. Indeed, one of the studies included in this analysis, from South Africa, also reported that of those street children who were glue sniffers, most had neurological signs suggestive of brain damage (Jansen et al. 1990).

Another cause of differences in cognitive function between street children and more privileged children in the general population is access to formal education. As most street children are not attending school, it could be argued that this will delay their learning and general cognitive development. Although, in many developing countries, school attendance is not necessarily the norm for most children anyway. Furthermore, in many cultures where there are street children, the children are in fact child labourers, working in the urban environment, for example selling flowers or candies

to motorists. It could be argued that their real world experience compensates for their lack of formal education in driving their cognitive development. In fact, there is some evidence for this. In Brazil, some of the street children who work as vendors have mathematical abilities comparable to those of regularly schooled children. Furthermore, for some forms of calculation, the street children are significantly better than school attending children (Saxe 1988).

In conclusion, the results of this meta-analysis suggest that there is a large degree of cultural variation in the cognitive development of street children in developing countries. However overall, the results suggest that street children tend to score about one standard deviation below what would be expected of children in general in their culture. It is unclear to what extent this reflects a natural phenomenon of capitalist societies, acquired neurocognitive impairment or delayed cognitive development. Regardless of this, the magnitude of the effect on intellectual functioning suggests that it will likely hinder attempts at bringing street children into mainstream education.

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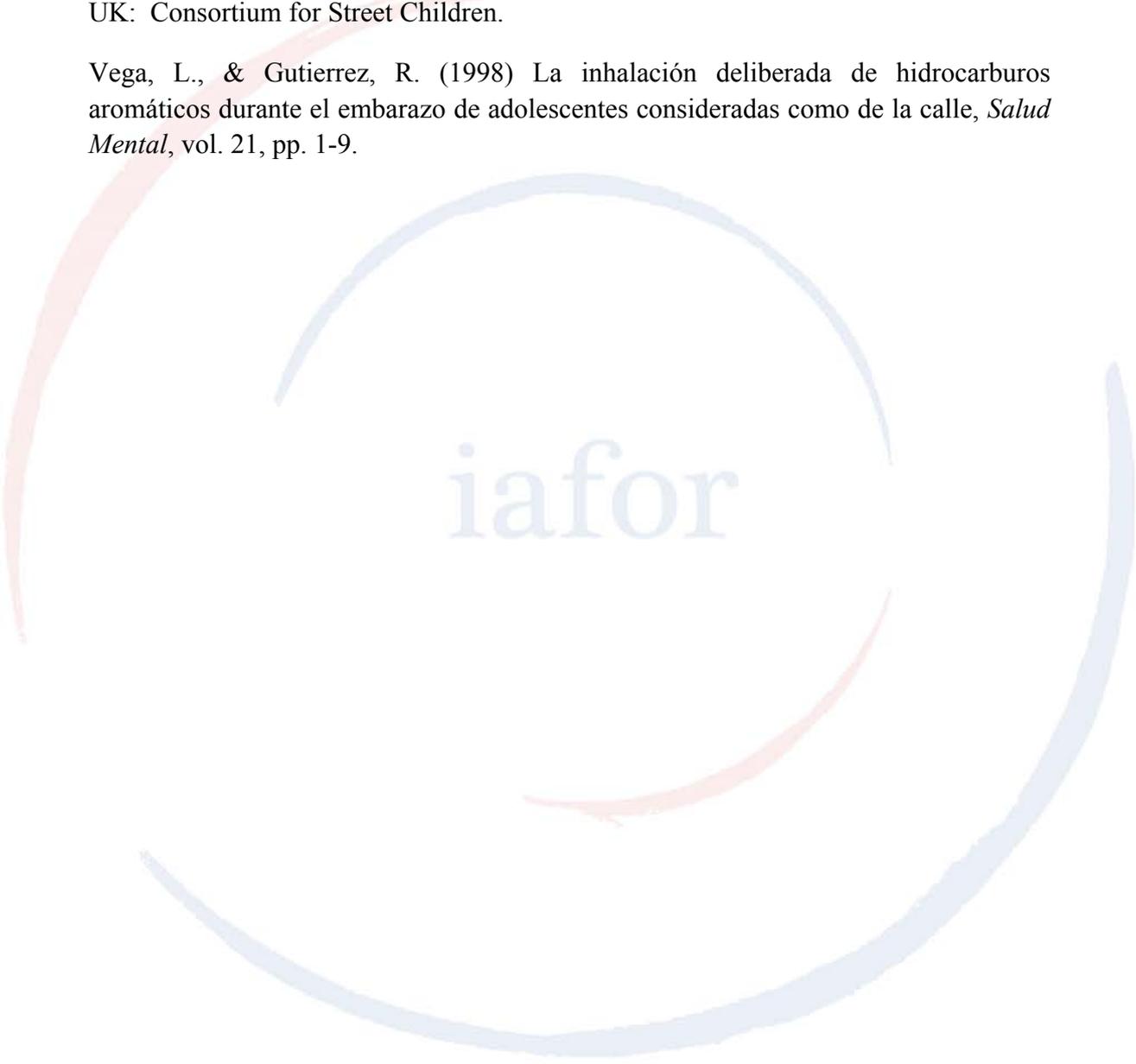
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