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Post-Traumatic Stress Disorder and Intellectual Function of Socioeconomically Deprived ‘Street children’ in Quito, Ecuador

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Abstract Extremely poor youths working and/or living unsupervised in urban environments are a common feature in many developing low and middle income countries. Such ‘street children’ may or may not be homeless, but all are inevitably vulnerable to exploitation and violence. Furthermore, there tends to be a high prevalence of substance abuse, particularly ‘glue sniffing’, among such populations. Despite this, little is known about their mental health or cognitive development. We performed a psychiatric and neuropsychological evaluation focusing on adverse life experiences, post-traumatic stress disorder (PTSD), substance abuse and intellectual function, with 37 former street children attending a charitable project in Quito, Ecuador’s capital city. Results revealed that the children were characterized by moderate levels of substance abuse and high rates of PTSD. Furthermore, relatively higher cognitive function was significantly linked to both PTSD and to substance abuse. Possible interpretations for these counterintuitive observations are discussed.

Keywords Substance abuse · Cognitive development · IQ · Poverty · PTSD · Trauma

‘Street children’ are those who spend much of their time unsupervised in the urban environment in the context of extreme socioeconomic deprivation. Such children are a common sight on the streets of the large cities in Ecuador, as they are in many developing countries. This is in fact a huge social issue for modern global society. However, no accurate statistics exist as to the extent of the problem worldwide, just some vague estimates that run into the tens of millions or higher (Thomas de Benitez 2011).

Not all street working children would be considered ‘street children’ by standard definitions. The definition we used in this report is one developed by UNICEF and frequently used

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in research: “*any girl or boy who has not reached adulthood, for whom the street (in the widest 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*” (Treanor 1994; pp 88–89). It can be seen that an important part of the definition is that they are inadequately protected; this necessarily means that they are vulnerable to exploitation and violence.

Exposure to violence and abuse is clearly a common feature of the lives of street children. One study of Bolivian street children found that 85 % reported being physically abused by other street children, family members or police officers, and 20 % reported having been sexually abused (Huang et al. 2004). Within Ecuador, one study of 226 homeless street children (mean age 14), found that most had experienced forced sexually activity and all had traded sex for money or drugs (Schlaefel 2005). Similar results of high levels of physical or sexual abuse and exploitation have been observed with street children in many countries, e.g. Brazil (Scivoletto et al. 2011) and Egypt (Salem and Abd el-Latif 2002). Indeed, reports by street children of mistreatment and assault are said to be strikingly similar across the world and violence within the home is common to many street children globally (Thomas de Benitez 2007).

It could be expected that a consequence of high levels of exposure to abuse and violence would be high levels of post-traumatic stress disorder (PTSD). PTSD is a syndrome involving re-experiencing a traumatic event (e.g. flashbacks or nightmares), avoidance of people or places associated with the event, emotional numbing and increased arousal (American Psychiatric Association 1994). One study of street youths in Seattle (USA) found that 83 % reported having been physically or sexually abused and 18 % fulfilled criteria for PTSD (Stewart et al. 2004). Although there are many reports of violence and abuse of street children in low and middle income countries around the world, these tend to be anecdotal or ethnographic. Indeed, the authors of a recent systematic review of the health of street children decried the fact that they could not find a single study that had measured PTSD (Woan et al. 2013). Considering the sheer number of street children in the world, and their high exposure to violence, this is a major omission from the developmental psychopathology evidence base.

If levels of PTSD were found to be high among samples of street children, this would have implications for understanding their neurocognitive development. PTSD in young people is associated with identifiable alterations to brain structures, in particular reductions in corpus callosum and frontal lobe volumes (Karl et al. 2006). Impairment to these structures has significant potential to hinder a wide range of cognitive functions.

A further challenge to neurocognitive development faced by many street children comes from substance abuse. Sniffing of solvents and glue appears to be a general feature of the lives of many street children globally, in fact, it practically constitutes ‘an inhalant use epidemic’ (Woan et al. 2013). For example, one study of street children in Bolivia found that 85 % reported abuse of paint thinners (Huang et al. 2004), a study of Ecuadorian street children found 98 % reported abusing solvents (Schlaefel 2005). High levels of inhalant abuse and other drug abuse has been reported in samples from diverse countries such as India (Praveen et al. 2012) and South Africa (Jansen et al. 1990). Solvent abuse has the potential to produce a wide range of brain abnormalities (Al-Hajri and Del Bigio 2010).

There is clearly a need for studies of the presence of PTSD among street child populations and how this might relate to other factors such as cognitive development and substance abuse. That none have previously been published is indicative of how this significant global demographic has been neglected by psychological and medical research.

To address these issues we assessed the frequency of PTSD in a sample of Ecuadorian street children. We also administered block design and matrix reasoning tasks, two tests that closely index general cognitive performance. As childhood trauma has been linked to reduced cognitive

function in other low socioeconomic status populations (Pluck et al. 2011) we wished to investigate how PTSD could be associated with delayed or impaired cognitive development.

Method

Setting

The children in this study were all former street children recruited from a charitable social project for at-risk children in Quito, Ecuador. The project, ‘Su Cambio por el Cambio’, offers all-day care for poor children. It provides them with meals, health and dental care, washing facilities and a structured program of daily sports activities and practical education classes. The children attend the project 5 days a week from 7:30 am until 5:30 pm. Only children living in significant socioeconomic hardship, by local standards, are accepted by the project.

Participants and Selection Procedure

At the time of the commencement of the research there were approximately 300 children attending the social project regularly. Children were selected for inclusion if they were aged from 10 to 17 and clearly fulfilled our definition of ‘street child’ prior to their acceptance by the project. The exclusion criteria were having a physical disability that would prevent assessment and not having a legal representative who could consent to their participation. Potential participants were selected by the project psychologist based on her knowledge of the children and a review of records. In the initial screen a convenience sample of 40 children were identified as potential participants and we were able to recruit 37 of them, a participation rate of 92.5 %.

The mean age of the recruited sample was 13.5 ($SD=1.62$, range=10–16) and 28/37 (75.7 %) were male. All but one were Ecuadorian, the exception was a refugee from Colombia. Regarding ethnicity, 28 were classified as ‘mestizo’ (mixed Spanish and indigenous ancestry), seven were black and two were indigenous Americans. As a group they had spent a mean of 20.9 months at the social project ($SD=19.9$, range=4–84). Twenty-one (56.8 %) were known to have been street-workers before entering the project (e.g. selling candies on buses or shining shoes). A cessation of street working is a condition of entering the project. Also, it takes up much of their time, which keeps them out of the street environment. However, it is notable that five (13.5 %) would still be considered ‘street children’ due to their continuing connections to street life. Only one child was an orphan but another seven had been abandoned by their parents. Most, 26/37 (70.3 %), were currently living with a parent. The others were living with members of their extended families.

Assessments

All the children were assessed on three basic domains; 1) adverse life events and PTSD 2) substance abuse and 3) cognitive function.

To assess adverse life events, all of the participating children were asked to describe an event that had happened in the past that they found particularly frightening, violent or dangerous. Responses were categorized by the principal investigator after all data collection was completed. We used the UCLA PTSD Index for DSM IV -Adolescent Version Spanish (Steinberg et al. 2013) to detect probable PTSD based on this frightening/violent/dangerous event. This is a 49 item semi-structured interview for detecting the presence of probable PTSD based on DSM-IV criteria. A validation study of this tool with 6,291 young people (Steinberg

et al. 2013) revealed good internal consistency (Cronbach's α scores between .88 and .91) and convergent validity via its strong correlation ($r=.75$) with the Trauma Symptom Checklist for Children (Briere 1989). Additional psychometric and validity studies of this instrument are reported in Steinberg et al. (2004).

As a measure of past polysubstance abuse participants were asked if they had ever used (even only once); alcohol, tobacco, cannabis, heroin, amphetamine, cocaine, hallucinogens, glue /other inhalants, or any other substances not listed. They were asked in language appropriate for their age and various street names were given. Despite its simplicity, the sum of substances ever tried has been shown to be a good measure of polysubstance abuse and we have previously found it an effective summary variable of complex histories in populations associated with substance abuse (Pluck et al. 2012a; Pluck et al. 2012c). To screen for actual problematic substance abuse all were administered the Spanish version of the CRAFFT Screening Test as part of the interview. This was given in its structured interview format. On this brief screen, a score of two or more has been shown to have good sensitivity (0.76) and specificity (0.94) at identifying problematic substance abuse (Knight et al. 2002). Finally, they were asked if they had used any substances other than alcohol or tobacco in the past fortnight as a measure of recent illicit substance abuse.

To assess general intellectual function we used the two performance IQ subtests of the Wechsler Abbreviated Scale of Intelligence (WASI). These are the block design and matrix reasoning tasks. The test manufacturers selected these two for their abbreviated scale as they are the two subtests with the highest loadings on g , or general intellectual functioning. They have good reliability in youth samples, with split-half coefficients ranging from .84 to .96, 1-month test-retest coefficients of .77 and .81 and good construct validity as shown by a correlation of .76 with the 'gold standard' WISC-III (Wechsler 1999).

The only two existing studies published in English that the authors know of that have used intelligence tests with street children were performed with a block design task (Aptekar 1988) or with a matrix reasoning task (Jansen et al. 1990). Both are sensible choices as they are language free and are considered to be 'culture fair'. We used both a block design and a matrix reasoning task in this research providing a broader measure than using either of the tests alone.

Procedure

All the children, plus a legal guardian, gave written informed consent to participate. Each child was then interviewed individually, in Spanish, in a private office on the site of the social project. Exposure to past adverse events and the PTSD assessment were performed first followed by the cognitive tests and finally the substance abuse data was collected. The whole interview took around one h. All participants were debriefed: the reasons for the research were explained, including their role, and they were able to ask questions, the interviewer expressly enquired about anything that might have caused upset or other problems. Finally, they were offered a gift worth about US\$5; a choice of either a fanny pack or a pencil case containing color pencils etc. The protocol was approved by the research ethics committee of Universidad San Francisco de Quito.

Statistical Analysis

The main between-group comparisons were performed with ANOVA calculations. Raw scores on the cognitive tests were used in all calculations, with age entered as a covariate. Log transformations were used on data that was not normally distributed (assessed with Kolmogorov-Smirnov one sample tests). Where this failed to correct skewness, non-

parametric tests were employed. All statistical tests were two-tailed, the critical level was set at $p=.01$. This relatively stringent level was selected in order to reduce the chance of Type I errors caused by multiple comparisons. All percentages and other figures less than 100 are reported to three digits. Figures greater than 100 are given to one decimal place. All statistical analyses were performed with SPSS V21.

Results

Substance Abuse

Twenty-two children out of the full sample of 37 (59.5 %) reported any past substance abuse. In most cases this was limited to alcohol. Twelve children (32.4 %) reported tobacco use; interestingly none had tried only tobacco. The mean number of substances ever tried was 1.27 ($SD=1.43$, range=0–6). Seven children (18.9 %) reported past glue-sniffing or abuse of other solvents. Other drugs reported were cocaine (3 users), cannabis (2 users), amphetamine (1 user) and heroin (1 user). Five (13.5 %) reported substance abuse (excluding alcohol or tobacco) in the past two weeks. Thirteen of the children (35.1 %) scored positive on the CRAFFT for lifetime problematic substance abuse.

Cognitive Function

Raw scores on the block design and matrices tasks are shown in Table 1. Analyses examined differences between those with and those without current substance abuse on the measures of cognitive function. Children who reported substance abuse in the past two weeks, compared to those that did not, had significantly higher block design task scores ($M=17.8$, $SD=11.9$ vs $M=13.5$, $SD=9.4$, $F(2,34)=7.62$, $p=.002$). However, there was no significant difference between matrices scores ($p=.127$). The same pattern was found with past problematic drug use. Those who were positive on the CRAFFT scored higher on the block design task than those who did not ($M=17.5$, $SD=12.4$ vs $M=12.2$, $SD=7.5$, $F(2,34)=7.28$, $p=.002$), and there was no significant relationship to matrices scores ($p=.123$). Due to the association between substance abuse and block task performance, recent substance use was added as a covariate in further analyses involving block design task scores.

Adverse Life Events and Psychological Trauma

All of the children were asked about events they had experienced that were very frightening, violent or dangerous. One child reported undergoing an operation that frightened him and another reported being in a fire. However, the majority (28/37, 75.7 %) described incidents of interpersonal violence. Example statements by the children are (translated): “My cousin was found tortured and shot five times in a ditch” (14 year old boy); and “Some men were fighting and one had a gun, he looked like a cop, he handcuffed the other, took him to an alley, kicked him and shot him, the person died” (11 year old girl).

The most common category of response was witnessed violence. Fourteen of the thirty-seven children (37.8 %) reported witnessing a violent act that distressed them; more than half of the reports were for violence within the home, in four cases violence by their father against their mother. Three children reported witnessing murders and a fourth said that he was scared by seeing a dead body in the street. The next most common source of distress stated by the children was being the victim of violence, described by 11/37 (29.7 %). Most frequently these

Table 1 Comparison of those with and those without probable PTSD on demographic, substance abuse and cognitive variables

	Whole sample	With probable PTSD	Without probable PTSD	Significance
n	37	22	15	
Age (mean+SD)	13.5 (1.6)	13.3 (1.9)	13.3 (1.7)	ns
Male	28 (76 %)	16 (73 %)	12 (80 %)	ns
Ethnicity	28 (76 %)	17 (77 %)	11 (50 %)	ns
Mestizo	7 (19 %)	4 (18 %)	3 (14 %)	
Black	2 (5 %)	1 (5 %)	1 (7 %)	
Indigenous	5 (14 %)	1 (5 %)	4 (27 %)	ns
Current 'street child'	1 (3 %)	0 (0 %)	1 (7 %)	ns
Orphan	21 (57 %)	12 (55 %)	9 (41 %)	ns
Former street worker	1 (3 %)	1 (5 %)	0 (0 %)	ns
Refugee	1 (3 %)	1 (5 %)	0 (0 %)	ns
Current housing (%)	26 (70 %)	16 (73 %)	10 (67 %)	ns
With parents	11 (30 %)	6 (27 %)	5 (33 %)	
With extended family	7 (19 %)	5 (23 %)	2 (13 %)	ns
Abandoned by parents (%)	20.6 (19.9)	19.2 (21.1)	22.6 (18.7)	ns
Duration of attendance in months (mean+SD)	11 (30 %)	9 (41 %)	4 (27 %)	ns
Substance abuse	1.27 (1.43)	1.45 (1.54)	1.00 (1.25)	ns
Problem substance abuse (% CRAFFT positive)	5 (14 %)	4 (18 %)	1 (7 %)	ns
Polysubstance abuse (number of substances tried, mean+SD)	14.1 (9.7)	16.1 (11.2)	11.1 (6.1)	$p=.004$
Recent substance abuse use (% in past fortnight)	9.5 (5.4)	11.1(5.5)	7.0 (4.4)	ns
Cognitive function				
Block design (mean score+SD)				
Matrix reasoning (score+SD)				

were beatings, but one child reported that he had been shot. Of the 11 children who reported being victims of violence, five specifically described being beaten by members of their family. Other sources of potential distress were; death of family members, reported by four children, and sexual abuse, reported by two.

In fact on the binary response questions probing experiences of 12 different types of potentially traumatic events on the UCLA-PTSD Index, all of the children reported experience of at least one, and most (31/37, 83.8 %) reported more than one. These items include things such as being sexually abused, seeing a family member being hit with force or experiencing an earthquake that damaged the building they were in. The mean number of potentially traumatic events reported was 4.41, (SD=2.55), with nearly half of the sample (18/37, 48.6 %) reporting at least 5. The most common were violence at home, with 23/37 (62.1 %) reporting having been struck forcefully at home and 22/37 (59.5 %) reporting seeing a family member struck forcefully. In addition 16/37 (43.2 %) said they had seen a dead body in the city.

Despite all of the children having some level of traumatic event exposure, only 22 fulfilled DSM-IV criteria for PTSD based on their responses in the UCLA-PTSD Index interview; 59.5 % of the sample. Details of the children with probable PTSD are given in Table 1, where they can be compared to those children without probable PTSD. There were no significant differences between the children with and without probable PTSD for any of the demographic or substance abuse variables. However, those with PTSD performed significantly better than those without on the block design task. This was true whether or not substance use variables were included as covariates. Scores for matrix reasoning showed a similar pattern, but were not significantly different at the critical level used in this research ($p=.023$).

Discussion

We found that probable PTSD was common in our sample of street children and that its presence was linked to cognitive function. In fact 60 % fulfilled DSM-IV criteria for PTSD. The psychiatric effects of exposure to violence on street children have not been explored previously, so it is not possible to compare our high observed prevalence with other samples. Though 60 % should not be surprising considering that according to the NGO Consortium for Street Children “[street] children survive abuse at home in fragile families, live in poverty-afflicted, chaotic neighborhoods, their access to educational and health services is erratic, discriminatory and exclusionary; they confront risks in the street, experiencing violence in their premature entry into the world of work; subjected to abuse and neglect in detention centres and welfare homes designed to protect them, they are stigmatized and shunned by mainstream society” (Thomas de Benitez 2007; p6). Nevertheless, this research was not an epidemiological prevalence survey and as such the 60 % figure should also be interpreted cautiously.

The division into groups with or without probable PTSD was primarily performed to examine the relationship between trauma and demographic and cognitive function. Although no demographic or substance abuse related differences were observed between those with and those without probable PTSD, a link to cognitive function was noted. This was evident in the block design but not the matrix reasoning task. This concurs with previous work that has identified multiple links between PTSD and cognitive processing (Buckley et al. 2000).

However, the relationship between PTSD and cognitive function is complex. Those children with probable PTSD appeared to have better cognitive performance than those without. This could be taken to suggest a protective effect of relatively low intellectual function and is the opposite of the more commonly observed relationship. For example,

studies of former prisoners of war suggest that IQ scores over about 116 protect against the development of PTSD (Hart et al. 2008). Similar findings have been observed in neglected children (De Bellis et al. 2009). However, although relatively high cognitive functioning being protective is commonly observed, it is not the only pattern. Several studies have failed to find an association between PTSD and cognitive function, and one modeling study has suggested that with children, different trauma contexts are associated with either relatively higher or lower intellectual abilities (Kira et al. 2012).

Nevertheless, our observation of relatively better cognitive performance being linked to probable PTSD status may have other explanations. Rather than relatively lower function being protective, it may simply tend to produce underreporting of symptoms, perhaps due to misunderstanding questions or recall issues. On the other hand, several authors have described the remarkable resilience of some street-connected children who despite adversity sometimes display notably high cognitive functioning (Pluck 2014).

The children also seemed to have a relatively high level of substance abuse. Using a very wide definition, including alcohol or tobacco, 60 % of the children had tried at least one substance. If alcohol and tobacco are excluded only 27 % of the sample had tried illicit substances. The most common was glue (or other solvent) sniffing; 19 % admitted to past use. Although any substance misuse by children is a concern, our findings are actually quite low compared to other reports from Latin America. Within Ecuador one study reported that of their sample of homeless street children, 95 % had used cannabis, 98 % cocaine and 98 % solvents (Schlaefler 2005). One study of Bolivian street children reported that 88 % of their sample abused paint thinner and 40 % abused glue. Indeed, the abuse of glue and other solvents is associated with socioeconomically deprived youth globally. It may be that the children in our sample were somewhat protected from exposure to drug culture through their attendance at the project. Nevertheless, 19 % lifetime solvent abuse is still high. A survey of substance misuse across American countries estimated that less than 6 % of Ecuadorian secondary school students have abused solvents (Hynes-Dowell et al. 2011). When substance abuse was considered, irrespective of the substance, the CRAFFT screen revealed that about 35 % of our sample had lifetime problematic substance abuse.

Interestingly, those with recent substance abuse had significantly higher cognitive test scores than those without. As with the cognitive association with PTSD, this was evident with the blocks test, but not the matrix reasoning test. Although contrary to the simple interpretation of substance abuse suppressing cognitive function (e.g., Pluck et al. 2012b), such a pattern is not uncommon in psychiatry. For example, young adults with schizophrenia who abuse drugs tend to score higher on cognitive tests than those who do not abuse drugs (Potvin et al. 2012). One possible explanation that has been proposed in the case of schizophrenia is that better cognitive functions facilitate the acquisition of illicit substances. Another possible explanation for our observation may be the possibility of self-medication. Stimulant drugs for example improve cognitive functions in children with attention deficit hyperactivity disorder (ADHD; Kempton et al. 1999). We did not measure ADHD, but it is conceivable that a similar mechanism could be responsible in our traumatized children.

However, more simply, the relationship between better cognitive function and substance misuse may indicate that those children in our sample who continue to use drugs differ in some basic ways from the other children. Perhaps poor cognitive function and substance abuse are two independent contributing factors for children requiring assistance from centers such as the one we recruited from. If so, this represents a limitation to the current research as our service-based sample may have differed from the population of street children who do not attend such services. However, accessing that population is pragmatically very difficult.

Also, our sample was relatively small and the results should all be considered preliminary. Finally, the current research lacks a control group, this is an important limitation, as we cannot

say what the ‘normal’ prevalence of PTSD is in similar populations without street connectedness nor can we say what the exact ‘normal’ level of cognitive performance would be. Future studies would benefit from larger samples and the inclusion of a comparison group.

Overall, our findings suggest a complex combination of problems in these formerly at-risk children from the streets of Quito. Many of the children, in fact a majority, appear to suffer from PTSD. A smaller proportion has exposure to illicit substance use. Assessment and if necessary treatment of PTSD should be considered by agencies dealing with street children. In this regard, trauma-focused cognitive behavioral therapy may be beneficial. It has shown high efficacy in the treatment of childhood PTSD and can be effectively delivered in school and community based settings (Smith et al. 2013).

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Conflict of interest Graham Pluck, Daniel Banda-Cruz, Victoria Andrade-Guimaraes, Sofia Ricaurte-Diaz, and Teresita Borja-Alvarez declare that they have no conflict of interest.

Informed consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all participants for being included in the study.

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