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Social Ostracism and Criminality among Medical Waste Workers in Bangladesh: Neurobiological Aspects

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Authors' contributions

This work was carried out in collaboration between all authors. Author MAP designed the study, wrote the protocol and wrote the first draft of the manuscript. Author LQU managed the literature searches, analyses of the study performed the neuroscientific analysis. Author WTO managed the qualitative analytical process and identified the relation between qualitative perspective and neuroscience. Author MHS managed social qualitative perspective with scientific analysis. All authors read and approved the final manuscript.

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ABSTRACT

Background: Complex relationships exist between socio-economic inequality, social stratification, drug addiction, and criminality in society. A great deal is now known regarding the neurobiology underlying behaviours such as drug addiction and criminality. Most sociological and psychological theories of why such behaviours and phenomena exist have been constructed based on observations made in Western cultures. The unique social, economic, and cultural characteristics of the developing world, and in particular South Asia, have not typically been taken into account. Medical waste workers are a particularly marginalized population in this region, and are uniquely vulnerable to becoming engaged in these behaviours which are harmful to them and to society.

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Methods: Here we examine the influence of social inequality and stratification on initiation into criminality, specifically drug use, amongst medical waste operatives, in Dhaka, Bangladesh. Data were collected from a wide range of people (n = 74) involved with medical waste handling through sampling strategy to collect the required data using a variety of qualitative techniques included observation, formal and informal dialogue. Sampling strategies included formal representative sampling, purposive and authoritative sampling.
Results: Data suggests that the compounded effects of social discrimination, fatalistic belief system, socio-economic disparity and finally ostracism may interact with neurobiological predispositions to create unique drug abuse and criminality profiles amongst medical waste workers.
Conclusion: These findings challenge current models of factors contributing to drug use and criminality in society among adolescents and suggest a new framework for conceptualizing these complex issues that incorporates these complex biological, psychological, and sociological factors.

Keywords: Social inequality; stratification; fatalism; ostracism; criminality.

1. INTRODUCTION

Social inequality and ostracism are associated with lack of social capital, lack of upward mobility, or social disorganization, which combined cause higher levels of crime [1,2,3]. Criminals are more likely to come from the bottom end of the wage distribution [4]. This implies that the level of crime is greater in a community with higher inequality [5]. Crime and criminality is an emerging concern and among the most difficult of the many challenges facing the world [1,4,6]. The threat of crime creates an obstructive abject environment to productive activity.

It has been suggested that lower castes also rationalise their position through religious fatalism [7]. This is best illustrated in the Hindu epic *Mahabharata* where *Lord Rama* puts a curse on fisherman community: "…….*you will always remain in sufferings and worry"* (p: 100, Eighteenth segment of *Mahabharata*). It seems that here, caste culture and social inequality have combined to create an extreme example of social stratification which goes beyond rationalising disadvantage to the disadvantaged, it actively deters escape. Like others in their profession around the world [8] the group suffers the compounded stresses of social isolation and a uniquely unpleasant job. This can lead to dehumanisation [3]. Superimposed on this are the deprivations and exclusions associated with their position as lower members of the system [9].

Characteristics of criminalities and criminals include fraud, vandalism, theft, bullying, intimidation, arson, cruelty to animals, assault, rape, homicide and drug addiction. It has been suggested in the literature that drug addiction results in aggressive behaviour or criminality [6,10]. Over consuming alcohol leads an individual to act more aggressively through physiological, psychological, and/or sociological process [11].

Research in neuroscience and neuropsychology has shown that individuals with orbitofrontal cortex (OFC) lesions are characteristically disinhibited, socially inappropriate, misinterpret others' moods, impulsive, unconcerned with the consequences of their actions, irresponsible in everyday life, underestimate the seriousness of their condition (show lack of insight), and show a poor sense of initiative [12]. The effects of OFC lesions on social behaviour and the

symptoms of antisocial disorders are striking. In addition to the OFC, other brain regions have been implicated in antisocial behaviour. In a recent review, [13] Raine and Yang (2006) summarize evidence that prefrontal functional and structural impairments (reduced glucose metabolism, reduced blood flow, reduced gray matter) are associated with antisocial and aggressive behaviour and psychopathy. They also report some evidence for associations between reduced gray matter volume in the temporal lobe, as well as functional impairments in temporal lobes, related to antisociality. In addition, reduced amygdala and hippocampal volume have been reported in some violent offenders. They suggest that the rule-breaking behaviours exhibited by antisocial and psychopathic individuals may be due to impairments in these brain regions [13]. Neurocognitive accounts of antisocial behaviour have also been documented. Adolescents with a form of early onset antisocial behaviour including aggression and hyperactivity, showed poorer neuropsychological test performance than those with a later onset of antisocial behaviour problems. Children with a trajectory of early onset persistent antisocial behaviour problems do appear to have neurocognitive deficits relative to other trajectories [14].

1.1 Rationality of the Study

The prevalence of violence, drug use and drug dealing, and finally criminal offence are associated with socio-economic marginalisation in urban poor neighbourhoods [15,16,17], and socio-economic deprivation, masculinity and risk behaviours [18,19]. Most studies have been focused on urban slum areas in the developed world. Few have addressed the social context surrounding initiation of injecting and risky injecting practices in developing countries [20] and limited have done so in Bangladesh. We fill this gap by examining the influence of the social inequality and stratification on initiation into criminality amongst medical waste operatives, in Dhaka, Bangladesh. Previous research typically has not been focused on relationships between social inequalities and criminalities using a qualitative approach combined with a neurobiological interpretation and explanation. It is the debate of this paper that even though neurobiological explanations of behaviour seem to be more causal and mechanistic than environmental ones, neuroscience can add to the analysis of social inequality, drug addiction, drug dealings and criminality amongst the different diverse groups of medical waste operatives in Bangladesh and this is the novelty of this study. In view of the above, the present research was designed to address the following specific questions:

1. What are the specific qualitative characteristics and behavioural deviance that contribute to criminality?
3. Can this analysis benefit from neurobiological explanations?

The purpose of this qualitative study was to gather and consider the views of different medical waste workers in Dhaka, Bangladesh where the social inequalities and stratifications are likely to be compounded to influence their aggressive behaviour converted into criminalities and substance use. Our findings also have implications for the neurobiology of criminality, in that they highlight key understudied factors in social stratifications and inequalities by using a qualitative approach. The underlying nature of qualitative research may make this method the most appropriate for studying deprived, disadvantaged and depressed populations. This research does not seek to test existing theoretical frameworks, but rather, it is deductive and aims to gain an in-depth understanding of the group under study and derive a theoretical framework from the qualitative data. Additionally, incorporating what is known about the neurobiology of criminality and antisocial behaviour into our model can help to delineate more clearly the role of biological predispositions in producing socially unacceptable behaviour. The aim of this article is to provide a discussion of the most

important discoveries in our understanding of this deprived population, review what is known regarding brain processes relevant to the study of criminality, and to sketch out a rudimentary framework for theory and research on criminal behaviour that is informed by neuroscience. The development of criminality and addictive behaviour in a deprived population, for example, can be approached from a psychological perspective (focusing on increases in frustrating reactivity that may underlie criminal attitudes and addictive behaviour), a contextual perspective (focusing on interpersonal processes that influence criminal and addictive behaviour), or a genetic perspective (focusing on the endocrinology, or genetics of sensation). All of these levels of analysis are potentially informative, and most scholars of criminal psychopathology agree that the study of psychological addictive behavioural disorder has developed using these various approaches.

Our emphasis on the neurobiology of criminality and addictive behaviour in this article is not intended to downplay the importance of studying the psychological or contextual aspects of the phenomenon. Every aspect of behaviour has a biological basis; what matters is whether understanding the biological basis helps us understand the psychological phenomenon. Our claim is that any psychological theory of a socially deprived population needs to be consistent with what we know about neurobiological functioning, and that most extant psychological theories of deprived populations do not map well onto what we know about brain function. This paper will discuss criminality and addictive behaviour of a socially deprived population from a neurobiological perspective.

2. METHODS

2.1 Selection of Subject Population

Initial field experience suggested that it was very difficult to motivate the respondents to participate in the study. Many subjects were concerned that participation would lead to prosecution for involvement with illegal activities, or that their identity would be published. Most of them refused to take part in the study due to fear of social discrimination. Some of them hid to avoid contact with the investigators. This was addressed by adopting an extended, informal dialogue approach by which the researcher attempted to establish contact and develop trust, allowing the purpose of the study to be explained. The adaptive sampling for roaming populations technique described above allowed the selection of alternative participants where consent was not given [21,22,23,24]. After a series of motivational meetings and further encouragement, finally 74 respondents (Table 1) agreed to be participants from different diverse groups of medical waste operatives according to their working environment. All of the participants were male and within the age range of 20-25 years old. One who were 58 years old described his son’s (aged 22 [a waste operative]) story about criminality. During the study six respondents were refused to take part in the study as they thought this will be flashed their identity in the society.

Informed consent was obtained from each participant. A number of in-depth interviews were adopted following a combination of the formal and informal approach as judged appropriate in each individual circumstance. In each case, informed consent was obtained in a manner appropriate to the interview style adopted. Confidentiality, data security, and safety for respondents were assured by standard procedures approved by the ethics committee and no identifying information was collected; pseudonyms have been used in this paper.

2.2 Data Collection Procedure

Participants were selected in different places by using a combination of adaptive sampling for roaming populations, purposive sampling and an authoritative sampling approach. A range of qualitative formal and informal interviews and a dialogue approach incorporated questions about participants' social circumstances and environment (e.g., their daily lives, social interactions, employment status, neighbours' attitudes towards them), a history and attitudes of their risk-taking behaviours, including their drug use and their initiation into injecting and finally criminal offence or any violence in which they were involved. Most interviews were tape-recorded. Five participants refused to be recorded and extensive notes were taken during their interviews. All interviews were conducted in Bengali (the Bangladeshi native language) by the first author, transcribed verbatim and translated into English. Transcripts were then translated into English also by the first author. Further confirmation of fidelity of translation for quotes chosen for publication was undertaken by an independent verifier (see acknowledgments). Analyses were done in both languages as described by [7].

2.3 Data Interpretation and Analysis

Manual line-by-line in-vivo microanalysis of the interview data was performed. The interviews were coded and categorised by the first author several times to create a system of thematic classification [25] of the collected data. A process of theoretical validation of the data was undertaken to ensure that the units of classification (themes, issues, concepts) were sensitive to the participants' description. After collection of the data, the interview transcripts and audiotapes were provided to the respondents to give them an opportunity to reflect on their thoughts a second time and to modify or add or rearrange these data in a second brief dialogue with the investigator. Thematic analysis was conducted by three steps. Themes were extracted from the transcripts; extracted themes were categorised and organised; and finally, an interpretive analysis yielded a theoretically neurobiological explanation of the social context of criminalities.

3. RESULTS

All subject populations who participated in this study (Table 1) were from lower economic backgrounds, were unemployed or underemployed and most came from similar neighbourhoods. These areas are typical of many other areas in Bangladesh, with overcrowded housing, poor hygiene and sanitation, high incidence of crime, alcohol and drug use, and high levels of unemployment. The study revealed that most of the waste operatives recognised themselves as a lower class of society and felt victimised by the social stratification (Table 2) and harassment (Table 3). This may have influenced their behavioural aggressiveness, later progressing to criminal activity and criminality.

The following section deals with each of the thematic steps one by one. To help the readers to understand the various themes better, significant direct quotes accumulated from the collected data are used for illustration of qualitative findings. The original name of the respondent was changed due to ethical consideration.

Table 1. Participants of the study and their living circumstances

Group of Medical waste operatives	Number of the respondents	Living circumstances
a) Individuals involved directly in patient care.	6	Living in a commercial slum[1] area.
b) Individuals transferring waste from HCE inside bins to roadside bins.	9	5 of them living in a slum area and 4 middle class mixed area.
c) '*Dome*'[2]- Mortuary assistants	12	4 living in a Pakistani *Bihari*[3] refugee camp which is called Geneva Camp, 5 living in middle class mixed area[1] and 3 in slum area.
d) Operators at authorised medical waste treatment centres	2	Living in outskirt of the city in a slum area.
e) Medical waste scavenger	25	Homelessness and street involved[4]
f) Medical waste recycling operator	20	Living in densely populated slum area
Total	74	Slum 49%, Homeless 34%, Refugee 5% and Middles class 12%

[1]*Patwary et al., 2009b [26]*
[2]*Patwary et al., 2010 [7]*
[3,4]*Patwaryet al., 2012 [27]*

Table 2. Reported socioeconomic deprivation from different point of the respondents

Reported deprivation	Respondent	Present observation
Harassment in school experience	54 (73%)	Depressed, deprived, drug addicted and involved in criminal activities
Neighbourhood harassment	35 (47%)	
Neighbourhood assault	26 (35%)	
Socially assault in the community	56 (76%)	
Sexually assault	12 (16%)	
Neglected from job	16 (22%)	
Rejected from job	46 (62%)	
Harassment in daily livelihood	62 (84%)	

Table 3. Reported inequality in different level of the respondents

Reported inequalities	Respondent	Present observation
Inequality in national institute	62 (84%)	Depressed, deprived, drug addicted and involved in criminal activities
Inequality in health system	43 (58%)	
Inequality in hotel and restaurant	28 (38%)	
Inequality in recreation place	15 (20%)	
Inequality in national voter list	17 (23%)	
Inequality in social institution	35 (47%)	
Inequality in law enforcement	21 (28%)	

3.1 Social Stratification

The social stratification of the participants' links to involvement with underground grey trading for illicit earning and drug abuse, associated with criminality. 'Jibon' a dome respondent [Male, aged 25] provided a story when asked the reason for staying in this occupation as a mortuary worker, "*what should I do? Will you provide me any job where I can earn more money and live like an upper class people in the society…? I know not only you nobody can provide* [job] *due to our identity* [as I am from dome background]. *This is not one day story, we are discriminated generation by generation*." 'Julhash' [Male, aged 23] explained his school life experience, whispering, " *I always try to hid my identity from my school friends as my family said, but when my friends knew that I was a dalit and from medical waste worker family, they were not interested to play with me or even speak with me. After some days I leave my school. I thought I have no way to leave out of the cycle of exploitation and this is my fate as I born in a dalit family. From my early childhood I am victimised by social stratification and I am frustrated. But I found myself a very popular person in my adulthood when I spent lots of money in my friend circle. I thought I have to earn more money by any how to maintain my friend circle. I involved with a robbery group and now I earn more money. But till now I am frustrated about my identity and therefore I use alcohol and drugs to cheer up my depressing mind*". 'Moktar' [Male, aged 48], a dalit waste operative who told a frustrating story about his son's (aged 22) involvement with drug selling business: "*…… my son tried to get a better work, but failed. He was frustrated and addicted on drug. Now he is a drug dealer and earning more. How can I stop him*?" He added his voice, "……*if they don't get any job in day light, they have to engage in dark light job* (underground business)."

In the context of marital bondage within lower class *dalit* waste operative families, those from similar classes are generally not interested and upper classes are totally prohibited. However, nowadays some people from similar classes such as other *dalits* have shown interest in getting married. However, the groom often demands heavy dowry from the bride's parents. One medical waste worker 'Poran' [Male, aged 24] shared his tragic experience about his sister's marriage ceremony: "……..*one rickshaw puller wanted to marry my sister.*

but demands heavy dowry. I agreed but I couldn't manage the amount he demands before the occasion. Therefore, he went back from the ceremony. This is the ill-fated experience in my sister's life. People of other communities do not like to have relationships with them. They are severely abused with slang and typical words for scolding. Other community people never invite them for any occasions or community festivals.

3.2 Fatalism

In some cases, they seemed to start the work and continue with it, due to a sense of fatalism and a need for the economic benefits.

'Shusanth' [Male, aged 22] a *dome* respondent from *dalit*, told a frustrating story about involvement with drug use and dealing, and later criminal activities, "*This is my fate that I have to join in my family hereditary occupation due to my family background though I am educated. I haven't got any other job. I am frustrated, feel isolated from the society. I am drug addict due to my frustration. Due to cruelty of the society, I faced economical problem. Now I am doing different type of work to earn money whether it is legal or illegal. I prefer to do illegal earning because this is easy and no restriction and I can earn more money in a*

short time". He added when asked what kind of work he is doing to earn more money in a short period, "*sometimes I sell the preservative medicine to the open market which is normally use for dead body preservation, sometimes sell unidentified dead bodies to the particular group of people*". He also included, with guilt, "*I know this is not good, therefore I use to drink alcohol and inject drug to forget this from my mind*". A similar voice was reported by medical waste collectors, scavengers and recycle operators. People treat them as 'disease carriers', as they are involved with hazardous and infectious medical waste. 'Shamsu' [Male, 38] a scavenger, had been affected by skin rashes and itching. He had some blisters on his finger and the situation is becoming worse, as it is difficult to move his fingers easily. His voice crying, "*One day I went to a small roadside restaurant and sit down with the other people. I order for a cup of tea and some snacks. One restaurant boy who identified me and refused me to serve as he thought the disease from infectious medical waste is carrying by me. He inform his manager, and his manager came and ordered me to get away from his restaurant with misbehave. …if I need something, I have to ask the restaurant boy from outside of the restaurant. This is not fair as I am also human like others. It should be changed".* He said "*I have to do this job because I have no options, what is written in my life fate, must happen, nobody can stop it*." He said now he is neglected by other people when they see the blisters on his fingers. 'Sabudeb' [Aged 23] a medical waste collector echoed a similar voice, "*I have been working as a waste cleaner in a hospital for 2 years. I also worked as house cleaner as a servant in a family house. One day they knew that I am involved with medical waste cleaning. After that I lose my job from that house as they thought I may carry infectious disease from hospital ...this is my fate* [whispering]".

3.3 Ostracism

They often joined the profession from a family background as a hereditary occupation due to the social reality of discrimination and ostracism. 'Shumit' [Male, aged 25] was one of many who said the lower class *dalit* have been engaged in this waste related profession by family tradition. He complained about the government's apparent lack of emphasis on support and responsibility to improve their lifestyle, "...*we are the citizens of this country as like others, our forefathers fought for the independence of the country in the Mughol period, British period, Pakistan period and finally in 1971, however we are still identified as untouched dalits (Asprsya*, *Achut*, *Chandala)*, *this is our fate."* 'Kundo' [Male, aged 24] says, about facing discrimination in their life experience with an aggravated voice "……..*Bangladeshi government authorities do not officially recognize that dalits culture even exists in Bangladesh, they declare everybody is equal, unfortunately nothing is equal in our daily life*".

'Zamshed' [Male, aged 24] alleged when asked why his son has not achieved the educational background to get a good job, "……*our children are neglected and harassed in the school, therefore they loss their interest in the school and also we don't tell them to go to school as we scared about harassment of social stratification*." As a result, this waste operative community is not able to change their economic condition and they remain in the same living conditions year after year. On one hand they are treated ill as untouchables, and on the other hand they are the poorest of the poor, mentally, psychologically and in some cases economically in the community. This links to involvement with underground trading for illicit earning and drug abusing leading to criminality. The *domes* are so degraded and discriminated against that in some cases they are not even allowed to take a glass of water in a tea-shop or private house if they reveal their *dome* identity. One respondent had such an experience that his request for water in a neighbourhood restaurant was refused because of his identity. He claimed that they are treated like other animals (*occhut*) that people hate in society.

In Bangladesh the medical waste operatives from '*dalit'* communities [7] have a much lower public, economic and social profile. The concept of earned, irreversible 'purity and pollution' in one's lifetime is tied directly to occupation, diet, ritual behaviour, lifestyle and other aspects of caste *dharma.* The subject group of people medical waste operatives fall under is 'acquired congenital pollution' and their low status as particular workers is enjoined and reinforced by what Berrman terms as ideology and divine sanction.

3.4 Deprivation and Desire for Revenge

Suresh [aged 25] a male dome respondent explained his revenge attitude, "...e*arning!* [mischievous laughing] *I do prefer to earn money by emotional blackmailing"*. How? When asked he replied, "*Sometimes I speak with the relatives of the deceased and give them wrong information. If I found that they are rich people I took long time to hand over the dead body, I demand a particular amount of money to hand over the dead body*. *The relatives of the deceased's are emotionally upset in general. This is the good time I think to blackmailed them and earn more money. I enjoyed this situation by drinking alcohol and this is one kind of revenge against the upper class people*." One recycle operative [Jalal, Male, aged 25] tells a story of revenging the stratification and inequality of his life. Jalal lives with his wife, son and daughter. He is a medical waste recycle operative in a local unauthorised recycle industry with monthly wages of 1200 Taka (£10.00). It is very difficult for him to survive with this income. Therefore, he started to earn extra money, about 100 Taka (£1.00) daily by doing some illegal activities. He is now a broker of many things. He infuses the poor people and street involved people to sell blood. With the help of some hospital operatives he sells this blood to the poor people without any tests and precautionary measures. He also collects some highly sensitive drugs and sedatives from hospital operatives and sells to the general people, particularly adolescents. Now he is a leader of one group who is involved in different types of criminal activities including drug dealing, blood brokering, medicine and other medical equipment stealing, robbery, burglary, mugging and others. In his group all of the members came from lower class similar backgrounds and families who are frustrated due to social discrimination and inequality. Most of the members of that group enjoy these activities as they think this is one kind of great revenge against society. Most of them said with loud aggressive voices, "*we will find our rights by anyhow, if necessary we can do hijacking or kidnapping or anything else"*.

Many of the *domes* reported that their children are engaging in black marketing, robbery, local terrorism, hijacking, groups of musclemen, '*chandabazi'* [28] and other criminal activities due to constraints to getting a proper job and negligence by the society. People from different communities emotionally abuse them in many ways. They complain against society that they are not allowed to go for schooling or any other job as many people in the society think that they are the symbol of impurity, misfortune and a curse to humanity. Due to humiliation, most of them alleged their children do not like to go school but rather prefer to live like vagabonds, drug sellers and dealers, black marketers, finally joining their parents to practice their traditional occupations as waste operatives.

Some experienced *domes* even claimed to prefer to work with dead bodies, as in general people are scared of them due to their particular identity. They enjoy their profession being a *dome* because of life security. 'Mohit's [Male, aged 43] story reveals, "...*at least a male dalit is being tortured or a female dalit is being raped everyday by terrorists or musclemen (mastan) in the country. But if anybody knows that we the people from dome community, they normally do not come with us for any unwanted clash. They are terrified us because of our identity*." There is another horrifying story behind this sacredness. In very secret cases,

they sometimes are hired as killers. When discussed informally they did not show much interest in speaking about this. Researchers also avoid this topic due to physical, mental and psychological violence. So their misery knows no bounds. In some cases people have beliefs regarding the paranormal power of the older *dome* due to handling dead bodies for a long time. Waste operative Shahin [Male, aged 34] explained this, "*they* [dome] *have bad power, they can do 'zadutona'* [Maleficium, sorcery] *and 'ban mara'* [evil spirit] by 'Tabiz', 'Kufuri Kalam' [Tabiz, amulets containing lines from the Holy Qur'an to protect from the evil spirit and sorcery (Sura YaSin, Chapter 36 of the Qur'an, while Chapters 109, 112-14 are used for its prevention), however, with the aim of causing harm to the intended victim, in this case what is written inside is not Qur'anic verse but non-islamic mantra, lines from the Qur'an written backwards, with the word order being reversed [29] and '*Nozor*' ['evil eye' literally meaning 'sight' [30]. Paranormal activity is not positive sign and also liked with criminal attitude and behaviour, and sorcery is sin punishable at death by Allah. Therefore, many people are afraid of them as they believe they can do some harm to people through paranormal power or magic. Researcher identified this as a term 'Power of Deceased's' which was supported by the other study of [7] 'Spirits of the Deceased's'. This is similar like 'Powers of Horror' [31]. This theory will be illustrated and discussed in our forthcoming paper titled 'Power of Deceased's'.

4. DISCUSSION

Amongst the individuals interviewed in the current study, several also reported substantial drug addictions. Recent neuroscientific studies have shown that repeated drug use leads to long-lasting changes in the brain that can undermine voluntary control and decision making [32]. Neurobiological theories of drug addiction and criminality have not incorporated critical sociological factors such as those described in the current study. The current study suggests that criminality and drug addiction may be exacerbated in populations that do not have the social support necessary to resist and overcome potential neurobiological predispositions to engage in such behaviours. Whereas individuals in mainstream society may have access to mental health services that can treat and prevent many behaviours that are harmful to the individual and society, those in the group currently studied have no such support or reprieve. They are not seen by others as members of the same group, and describe feeling dehumanized, scorned, feared and unappreciated.

As can be seen in the interviews, many of the individuals reported feelings of hopelessness, aggression, and frustration with their situations. Many reported resorting to drug and alcohol abuse and criminality to cope. Drug addiction is a compulsive drive to take a drug despite serious adverse consequences [33] and it is thought that the addictive process results from impairments in motivation-reward, affect regulation, and behavioural inhibition systems [34]. In the past, individuals with drug addictions were considered to have voluntarily made poor choices, leading to their addiction. More recent studies, however, show that repeated drug use leads to long-lasting changes in brain structure and function that undermine voluntary control. Thus drug addiction has come to be viewed as a disease of the brain, much like abnormal blood circulation is the result of disease of the heart. One of the brain regions most consistently shown to be altered in individuals with drug addictions and criminal behaviours is the orbit frontal cortex, which is involved in inhibitory control and compulsive behaviours. It is believed that drugs of addiction alter dopaminergic systems in the brain, making an individual less sensitive to the dopamine that is produced by natural reinforcers. Over time, cocaine addition, for example, leads to reductions in dopamine receptors and metabolism in the orbitofrontal cortex, and subsequent problems with compulsivity and control [35].

In addition to affecting brain systems involved in reward and inhibitory control, addiction is a disease of pathological learning and memory. It has been proposed that in drug addiction, neurobiological mechanisms of learning and memory become corrupted by the drugs of abuse, leading to maladaptive associative learning to drug-related stimuli, which have become more powerfully motivating than other biologically relevant stimuli. The "overlearning" of drug-acquisition behaviours may play a role in the initiation of the addiction cycle [36]. The unique circumstances faced by medical waste workers, particularly in developing countries, exacerbate the likelihood of drug use initiation and addiction and increase the probability of engaging in criminal behaviours in these individuals. Due to their position in society, these workers face fewer social constraints and thus experience less motivation to resist drug use and criminality. Likewise, their fatalistic world view contributes to a lack of motivation for controlling or curbing drug use, which they feel is a necessary coping mechanism. Medical waste workers in Bangladesh are particularly vulnerable to developing drug addictions and becoming involved in criminal behaviours due to their marginalized position in society. In addition, as they do not receive the same mental health services as other members of mainstream society, they are less likely to receive any type of treatment or to be targeted by prevention programs.

In the community of individuals participating in the current study, more than half reported experiencing harassment in schools, in the community, in the workplace, and in daily life. Additionally, many reported experiencing inequalities from national institutes, health systems, and social institutions. These factors were reported as being linked to depression, drug addiction initiation, and the decision to engage in criminal activities. Furthermore, the isolation experienced by individuals within this community presented a significant barrier to seeking alternative means of coping and treatments. Most previous studies of crime and criminality have been conducted in Western nations, where such marked socio-economic disparities are rare. The unique case of medical waste workers in Bangladesh illustrates the necessity for incorporating multiple factors (social, psychological, and others) into current models of the neurobiology of criminality and criminal behaviour.

Indeed, their hereditary living patterns and traditional attitudes towards their lives and occupations are the obstacles for them to change and improve the quality of their lives. Nevertheless, since nobody pays attention to this community, they also get frustrated and see their life as it is, continuing to be the same. According to them, there should be laws and rules for punishment of those who hate others and others' profession. Indeed, if the subject communities are properly educated, skilled, trained and supported by alternative financial resources for their subsistence, survival and substantial up gradation of their livelihoods throughout the year with countrywide programs, they are sure to produce more social good than if they are treated as liabilities.

Fig. 1 research on the neurobiology of antisocial and criminal behaviour has implicated abnormalities in the following brain regions that may contribute to such behaviours: anterior cingulate and medial prefrontal cortex, orbitofrontal cortex, amygdala and hippocampus. Our research suggests that a number of contributing factors such as environment, work-related stress, and socio-economic status may combine with neural vulnerabilities in the above-mentioned brain regions to produce drug addiction and criminal behaviour in the individuals studied".

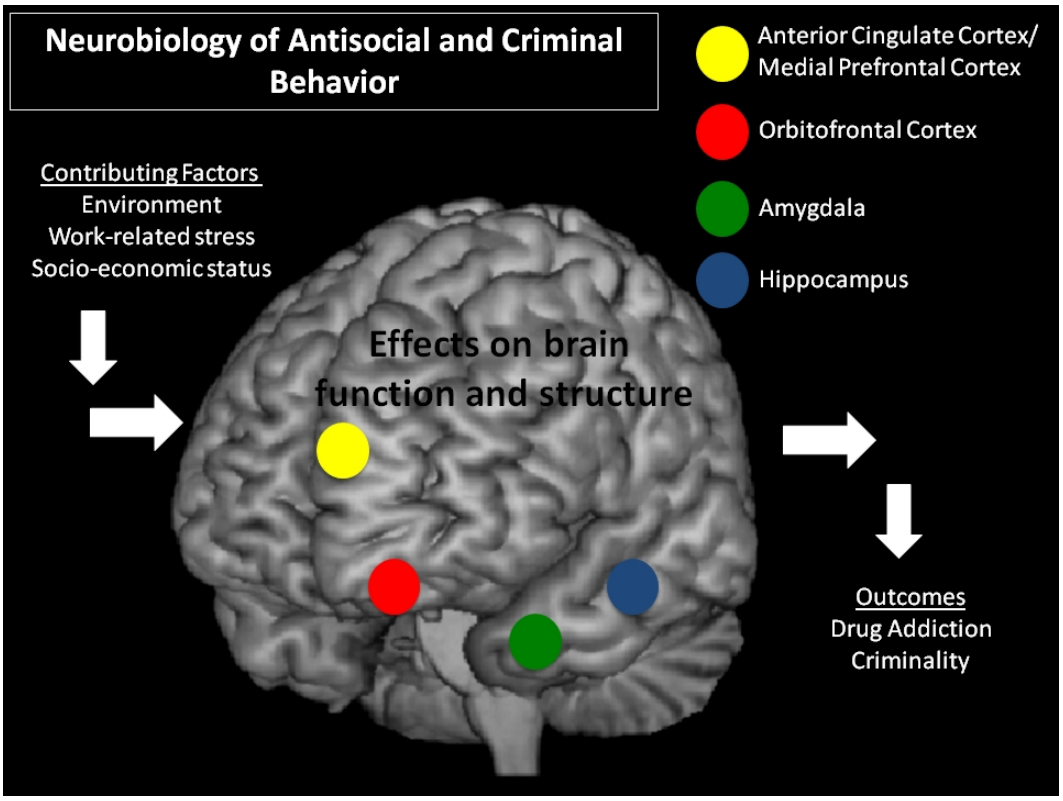

Fig. 1. Research on the neurobiology of antisocial and criminal behaviour

5. CONCLUSION

Here we present a scientific qualitative report of the day-to-day experiences of young medical waste workers in Dhaka, Bangladesh. These phenomena are echoing the scenario of the adolescents' behaviour in the present society. The individuals within this marginalized community report a host of sociological and psychological factors that may interact with untreated neurobiological predispositions to engage in criminal behaviours and drug abuse. Programs designed to prevent and treat drug abuse and criminality among members of this underserved population must take into account the unique social and cultural factors that these individuals face. Current models must be expanded to include such factors as fatalistic beliefs, discrimination in society and the potential contributions of neurobiological factors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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