The Mental Health of Children and Adolescents Exposed to 9/11: Lessons Learned and Still to be Learned

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Introduction

The events of September 11, 2001 had, and will continue to have, a profound economic, political, and psychological impact on the entire population of the United States. However, those exposed to the events of 9/11 as children or adolescents had a very distinct experience, with unique sequelae. As Klassen et al. [1] noted in a related context, 'Children are not just small adults'. Thousands of children and adolescents had direct experience of the attack on the World Trade Center (WTC), and

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many others knew someone who was injured, killed, or directly exposed. But even those young people who lived far from New York City on 9/11 were impacted by this unprecedented disaster and continue to experience its ripple effects on their mental and physical well-being to this day [2].

A systematic review looking back over a decade of research concerning children living in the vicinity of the WTC found that they were indeed uniquely affected by this untoward event [3]. Yet, it is important to recognize that while the WTC attack generated a significant body of literature focused on its mental health impact on adults, there has been a much less thorough research approach to those exposed as children and adolescents [4, 5]. Moreover, this limitation is being perpetuated today in the disproportionately small amount of funds allocated to services and research targeting those under 18 years of age on September 11, 2001, through the Zadroga Act, a congressionally mandated mechanism created to provide services to, and an understanding of, physical and mental health-related outcomes among those exposed.

In 2019, the youngest of those exposed will reach adulthood, carrying that experience with them. It seems useful, therefore, to look back at studies that did investigate the mental health effects of 9/11 on those exposed as children or adolescents, in order to understand what was done, what might have been done differently, and what yet remains to be done. Our intention here is to provide a critical overview of the studies that investigated psychopathological outcomes attributed to the WTC attack among youth ages 0–18 years on 9/11, as well as to identify what else might have been done and what still needs to be done to fill the knowledge gaps. Because, to date, very little has been done to address the physical health-related consequences in youth, the methodologies of studies included here focus on those directly or indirectly exposed and their measured outcomes, ranging from isolated psychiatric symptoms to full psychiatric disorders and from documenting patterns of substance use to prevalence of substance use disorders (SUD). Importantly, the intentions of the investigators of those studies were always to identify which categories of youth were most affected, how they were affected, and which risk factors contributed to the outcomes. We present this overview for the purpose of asking the readers and ourselves what lessons have been learned and how might the scientific research community better serve public health in the future?

Children Are Not Just Small Adults

Obviously, children and adolescents differ from adults in multiple ways, some of which are relevant here. In particular, youth are in the process of physical and psychological development and have specific vulnerabilities depending upon where they are in this process. Second, they are dependent on their adult caregivers for their basic physical and emotional needs. Third, at least for those 4 years of age and older, their activities and social roles are largely centered around school, which can be a source of both great support and distress.

The first post-9/11 studies of adults reported that those living in the New York City (NYC) area and particularly those who directly witnessed the attack were most negatively affected [6–8]. For adults, the measure of their direct exposure, including being injured, seeing the towers burn or fall, seeing the planes hit, seeing bodies fall from the towers, being in or near the dust cloud, or being evacuated to safety became central to understanding subsequent mental health effects. Simultaneously, the initial studies investigating the effects of 9/11 on children living in NYC suggested similar results [9–11]. But it was quickly recognized that even children and adolescents not present at Ground Zero could be profoundly affected if family members were exposed, especially if exposure affected their functioning and parenting. This indirect exposure did not require the death or injury of a parent to have a negative effect. For example, if a child's home environment felt unsafe or insecure because of worry about a parents' well-being due to 9/11-related activities, such as being a first responder or having been evacuated from a WTC area building, that home and the child(ren) in it were essentially, indirectly 'infected' with 9/11 trauma. The safety of their lived environment was compromised after 9/11 for an extended period of time. Thus for research on children and adolescents, it became important to understand both direct exposure and different forms of indirect exposure, especially through family exposure.

Studies of Directly Exposed New York City Children and Adolescents

It has been estimated that 25,000 children were in close proximity to the WTC on 9/11 [12], and many child-focused studies explored the relationship between direct exposure and subsequent mental health outcomes. A study looking at early effects found that 1–2 months after September 11, 60% of parents in NYC reported that their children were upset by the attacks [8]. Similarly, a study of children living in NYC 4 months after 9/11 found that, according to parental reports, 18% had very high levels of PTSD symptoms, while another 66% had moderate PTSD symptoms [13]. A citywide investigation of 8236 NYC public school children, known as the World Trade Center-Board of Education (WTC-BOE) Study, examined a representative sample of NYC public school students in grades 4–12 using students' self-report rather than parental impressions and was conducted 6 months after 9/11. It found that 28.6% of the sample had probable anxiety or depressive disorders [10]. Another study of NYC school children, with high rates of pre-9/11 exposure to trauma, found that 2.5 years after the WTC attack, 35% met criteria for PTSD. In addition, almost half of these students could be classified as functionally impaired [11].

Moreover, direct or high-level exposure was identified by a number of studies as a particularly salient risk factor, establishing a dose-response relationship. For example, the WTC-BOE Study found that level of exposure was associated with high rates of probable disorders [10]: probable PTSD was 10.6% for the full sample

but 18.4% for those with severe exposures. Similarly, for probable major depression, it was 8.1% (overall) and 11% (severe exposure), probable agoraphobia 14.8% (overall) and 21.8% (severe exposure), probable separation anxiety 12.3% (overall) and 20.1% (severe exposure), probable generalized anxiety disorder 10.3% (overall) and 14.1% (severe exposure), probable panic disorder 8.7% (overall) and 13.0% (severe exposure), and probable conduct disorder 12.8% (overall) and 14.3% (severe exposure). For those in grades 6–12, probable alcohol abuse/dependence was at 4.5% (overall) and 6.0% (severe exposure). These rates were up to three times higher compared with rates in same-aged youth pre-9/11 according to epidemiological studies [10].

A study investigating lower Manhattan pre-schoolers operationalized 'high-intensity' exposure as directly witnessing the towers collapsing, injured or dead people, or people jumping out of the towers. It was found that pre-schoolers who had witnessed at least one high-intensity exposure were nearly three times as likely to be either depressed or anxious and nearly five times as likely to have sleep problems [14]. Another study of lower Manhattan pre-schoolers similarly found that higher exposure was associated with more PTSD symptoms [9].

Direct exposure was also associated with an increased risk of behavioral problems among adolescents 6–7 years after 9/11, who were aged 5–12 at the time of the attack [5], as well as with an increased risk of substance use in these adolescents. Compared with adolescents who had not been exposed, those with one exposure-related risk factor were five times more likely to report substance use, those with two exposure-related risk factors had eight times greater risk, while those reporting three or more exposure-related risk factors had nearly 19 times increased risk of substance use [15].

A number of studies found that proximity to the WTC was associated with higher levels of symptoms (e.g. [13]). Interestingly, however, the WTC-BOE Study found that children attending schools very close to the WTC actually had lower rates of anxiety or depressive disorders compared with students attending school in other areas of New York City. The authors speculated that this might have been due to the high level of mental health and general support services that were specifically targeted at this population of youth in the immediate aftermath of the attacks [10].

In summary, these findings established that direct exposure to 9/11 as a child or adolescent resulted in elevated rates of a range of psychiatric and behavioural problems, not just PTSD, and that the outcomes showed a dose response to the intensity of exposure. These studies also illustrate gaps in the research approach. For example, exposure intensity was identified as being important yet was often measured by recall months after the event. It would be helpful to be prepared for the next disaster so that researchers could measure exposure as soon after a disaster as possible using self-report and possibly also other observational measures.

It would also be helpful to measure the effects of the exposure longitudinally, starting as early as possible. This might have documented, for example, that children nearest Ground Zero had high rates of distress soon after the disaster but that they were eased by services that were made available. While we conjecture this pattern, to be able to prove it would help the design of future interventions.

Family Exposure

Many children who did not live in the immediate vicinity of the WTC, and who therefore did not directly witness the attack, nevertheless had high levels of indirect exposure by having family members or friends who were in or near the WTC during the attack. Family exposure, defined as having a family member who was killed or injured or who was in or near the WTC at the time of the attack, was more strongly associated with psychopathology than direct exposure, in some studies [10]. A latent class analysis of the WTC-BOE data identified four classes of participants and found that indirect exposure was associated with membership in the class with the most severe profile of psychopathology and impairment [16]. As mentioned above, this may be understood as chronic exposure, in the home, to the effects of 9/11 through loss of a parent, dysfunction in a parent, illness in a parent, or unemployment of a parent, to name a few examples of 9/11 sequelae on families.

It has been estimated that more than 3250 children lost at least one parent in the attack [17]. Understandably, bereavement had a particularly strong impact on mental health, with significantly more bereaved children having at least one psychiatric disorder compared with non-bereaved children [18]. The differences were particularly remarkable for PTSD (29.6% bereaved vs 2.9% non-bereaved). Fortunately, the rates for all disorders declined for both groups over time. Another analysis of selected data from the WTC-BOE Study [10] found 16% of children who had a family member or friend who died in the attack screened positive for probable PTSD, compared with 7% of those who did not [19]. Another analysis reported PTSD rates of 17.6% among children who lost a family member in the attack [20]. In that analysis, an interaction effect was found among those who had both direct exposure and had a family member die in the attack, resulting in rates of 36.4% of probable PTSD.

There were, of course, many more children who were non-bereaved but whose parents were involved in 9/11 in some way, either by being present at Ground Zero, being evacuated from the WTC itself, or through their work as FRs, and these children and adolescents also showed significant psychological effects. As mentioned, the WTC-BOE Study found that the children and adolescents of WTC evacuees and FRs had even higher rates of mental health problems than directly exposed children and adolescents, as well as having elevated rates of substance use/abuse [10, 21, 22]. Researchers note that the mechanism by which parental trauma contributes to their offspring's psychopathology is unknown. However, the finding is of vital importance as this mode of transmission has not been a focus of post-disaster service intervention in the past.

The WTC-BOE Study also examined the differential impact of 9/11 on children of different types of FRs. The highest rate was among children of emergency medical technicians (18.9%), the next highest was among children of police officers (10.6%), and the lowest rate was found among children of firefighters (5.6%) [23]. The authors suggested that these differences could partially be explained by a

combination of selective demographics of these professions, as well as rates of parental exposure. They also suggested that the appraisal of firefighters as 'heroes' may have been a factor that moderated distress among their children.

Kaitz et al. [24] reviewed several proposed mechanisms for the transmission of trauma, including parental distress, altered parenting behaviors, more general disturbances in parental thinking and behaviors, and growing up in a stressed household environment that may operate not only psychologically but biologically through cortisol and the HPA axis. Yehuda and Bierer [25] report that the transgenerational transmission of trauma has been described in a number of different types of parental trauma, ranging from combat to the Holocaust to sexual abuse. They argue that in addition to an environmental transmission, based on parents' behaviors, there may also be, for those born after the trauma, an epigenetic modality of transmission, in which a parent's epigenetic profile might be modified by trauma and/ or PTSD, and this modification passed along to offspring.

Yet another modality of transmission involves pregnant mothers exposed to a trauma. While not directly relevant to the central concern of this chapter, namely, the population of children and adolescents who were born prior to 9/11 and exposed between ages 0–18, the issues related to prenatal exposure are complex and might also include epigenetics and may prove important for a more complete understanding of the multifactorial transmission of trauma. A burgeoning body of literature does indicate that the effects of stress exposure on pregnant mothers can be passed onto fetuses. Studies have also indicated that pregnant mothers exposed to the WTC attack were more likely to have low birth weight babies [26], while lower cortisol levels were observed among babies born to mothers who developed PTSD in response to 9/11 while pregnant [27].

In summary, the findings on family transmissions of 9/11 trauma are extremely important for research into the effects of 9/11 on children and adolescents as well as a powerful validation of prior work on trauma transmission. These findings have public health consequence as well, as they identify a set of youth who were not directly exposed to 9/11 and may not have been targeted for surveillance and preventative interventions without these findings. At the same time, this research exposes important gaps in our understanding. The multiple mechanisms of this intergenerational transmission (behavioral, environmental, biological, and epigenetic) are poorly understood. We need longitudinal studies that assess the effects of trauma soon after exposure, examine the family and household structures in detail, and track how those structures are altered over time by a traumatic exposure of a parent. We also need studies that integrate biological, epigenetic, and behavioral approaches and are sensitive to developmental stage of the children and adolescents involved. Finally, we need more studies that directly assess the mental health effects on children who were in utero during the time of 9/11 and assess epigenetic transmission to progeny born years after a parental trauma exposure.

We also need studies that can capture the differences between first responder families, to ascertain what protective factors are acting in the homes of firefighters and how we can use those protective factors in all households. More generally, these

findings indicate that we need more research into preventive approaches that take the whole family into account. For example, we still do not know if just treating the traumatized parent will block the transmission of trauma.

National Effects and the Relation to Media Exposure

The effects of 9/11 were also felt by children outside of New York City [28]. One nationally representative study conducted in the first few days after the attack found that over a third of parents reported that their children had at least one stress symptom and that nearly half had been worried about their own safety or that of their loved ones [29]. Another survey conducted 1–2 months after 9/11 found that nearly half of the parents living outside of the NYC or Washington DC reported that their children were distressed by the attacks [8]. A study of children living in Seattle, Washington, conducted 2–9 weeks after 9/11, found that 77% of children reported being worried, while 68% said that they were upset by reminders of the attack [30].

In a web-based survey of a national sample of adolescents, 60% of those not living in the vicinity of the WTC reported feeling that their own life or the life of someone close to them was in danger as a result of the attack. They also reported some initial stress symptoms; however, these were reduced to a low level 1 year after the attack [31]. A national, repeated, cross-sectional survey of adolescents living in cities throughout the United States found that adolescents interviewed in Fall 2001 had 35% higher odds of experiencing presleep worry compared with those interviewed in Fall 1998 [32].

A study conducted in California compared 227 adolescents surveyed 4 weeks after 9/11 with a comparable group of Californian teenagers who had been surveyed 4 and 2 years before the WTC attack. The study found that those surveyed after 9/11 perceived their risk of dying from a natural disaster to be higher than those interviewed before 9/11 [33]. A study of 171 Californian high school students conducted 2–5 months after 9/11 reported changes in their daily life activities and in PTSD symptoms related to the attack. However, these pre-post 9/11 differences were not found when the experience sampling methods were used to measure momentary mood reports in the same sample [34].

The national effects described above may have been a result of exposure to the highly repeated and very disturbing media images and reporting in the days and weeks following 9/11. Many schoolchildren were undoubtedly exposed, through TV, to shocking images of the WTC North Tower burning, only to be further shocked by the second plane hitting the other tower and the visuals of both the towers collapsing [35]. Furthermore, in the days and weeks following the attack, videos and images of the events were featured heavily in news reports and were widely available via the internet, causing many children and adolescents to be highly exposed to these images [36]. Nevertheless, the mental health consequence of exposure to distressing media images has been the subject of much debate [4].

Interestingly, among those living in NYC, more exposure to distressing media images was associated with more severe posttraumatic reactions in children [13] and adolescents [37]. However, analysis of the WTC-BOE data found that the association between intensive media use and PTSD was more likely to occur among those who were not directly exposed to the attacks [36]. Similarly, among elementary schoolchildren in Washington DC, who were not directly exposed, greater television exposure to the events of 9/11 was associated with increased distress [38]. Most importantly, studies conducted among children not living near NYC or Washington DC (both 9/11 attack sites) also reported an association between greater media exposure and increased symptoms of PTSD in children [29, 35].

In summary, the findings on the national effects of the local 9/11 attacks for both adults and children/adolescents are striking in that individuals thousands of miles from the trauma site were significantly psychologically impacted. The public health consequences are immense and run counter to traditional models of local emergency response. They have even affected the very definitions of PTSD in the DSM-5 [39]. At the same time, the mechanism of this traumatization at a distance remains unclear. Marshall et al. [40] put forth potential models that include the idea of shared 'ongoing threat' that may now apply, not only to terrorism but to the increasingly frequent and ubiquitous weather and earthquake phenomena. And, while it is seems hard to develop a model of the national effect that does not include media as a traumatic transmitter, the role of media remains controversial [41]. Thus we sorely need research that can clarify the role media plays in the immediate aftermath of a mass trauma, to discover ways of limiting the traumatic contagion. In particular, we need to understand whether and how the response to mass media depictions of trauma differs between children, adolescents, and adults. Intuitively, it seems that adolescents and especially children would have fewer defences than adults against disturbing images or the fear they elicit, but this will need to be explored. We also need far more in-depth and longitudinal research across wider geographic territory to understand the ancillary mechanism of this nationalization of a local trauma for children and adolescents, as well as research on how to curb those mechanisms once they are understood.

Risk and Resilience Factors

Prior Exposure to Traumatic Events and Violence

Prior trauma exposure was associated with a substantially increased risk for PTSD symptoms in pre-schoolers [9], as probable anxiety or depressive disorders in school-aged children [10], following 9/11. Prior trauma exposure was also found to increase the impact of high-intensity exposure to the WTC attack on child behavioral problems [14]. For NYC children with low prior exposure, a dose-response impact of the WTC attack was still evident 2.5 years after the attack [11]. In contrast, for those who had higher pre-attack trauma exposure, the severity of their

post-traumatic distress 2.5 years later was best predicted by pre-9/11 trauma exposure, rather than the level of exposure on 9/11. In other words, prior trauma exposure was an important risk factor for subsequent distress and significantly compounded the effects of any exposure to 9/11. Pre-9/11 exposure to violence also emerged as a predictor of post-9/11 PTSD, depression, and conduct disorder symptoms, regardless of whether the exposure involved the adolescent as a witness or a victim of the violence [37].

Prior Mental Health Problems

Unfortunately, few studies investigated pre-9/11 mental health problems as risk factors for attack problems. However, a few ongoing longitudinal studies did include questions investigating the role of prior mental health as a predictor of distress following 9/11 [28]. Children who had exhibited higher levels of depression or anxiety 6 years prior to 9/11, when they were aged five, had higher levels of fear and anxiety in the months after the WTC attack [28]. Similarly, adolescents with a history of mental health problems were more distressed by the 9/11 events [34]. It should be noted, however, that one study did not find any moderation effect of prior mental health symptoms on the relationship between exposure to 9/11 and subsequent mental health symptom level [37].

Parental Reactions

In addition to parents' ability to transmit trauma to their unexposed children and adolescents, a number of studies indicate that parental reactions may have mediated or moderated their exposed child's reactions to 9/11. Parents reporting substantial stress symptoms in the days after the attack were more than twice as likely to report that their children had stress symptoms [29], while children whose parents had possible PTSD were found to be over four times more likely to have severe PTSD symptoms themselves [13]. Children living in NYC who saw their parents crying following the attack were also more than three times more likely to have severe PTSD symptoms than those who did not [13], and NYC adolescents who saw a parent crying were more likely to have behaviour problems 6 months after the attack compared with other adolescents [42]. It should be noted, however, that the aforementioned studies were based on parental reports which may bias the findings.

Nevertheless, other studies that did not rely on parental report reinforce the finding that parental reactions had an impact on their child's mental health response to 9/11. For example, there is evidence from a study of Lower Manhattan pre-schoolers that young children of mothers with co-occurring probable PTSD and depression were independently rated as having more behaviour problems by their teachers, compared with mothers with depression only or with neither disorder, 2–4 years

after the attack [43]. A study conducted in Washington DC showed that parents with more distress were more likely to report distress among their children, but this was consistent with the children's self-report of their own distress [30]. Finally, two adolescent studies showed that parental distress or endorsement of PTSD symptoms was associated with their teenage children's PTSD symptoms [44] and behavioral difficulties [5]. These findings indicate that parental reactions likely played an important role in moderating or mediating offspring's responses to 9/11 and were not merely the result of biased ratings provided by distressed parents. This raises a question about mechanisms. Were these children/adolescents more distressed because they had been 'infected' by their parents' traumatic reactions, or does this reflect a more general family vulnerability for distress reactions due to biological, economic, and social risk factors affecting both parent and child? Again, the answer to this question would help direct interventions more effectively.

Economic Resources

The 9/11 attack impacted the economic stability of the United States, and many youths, most especially in NYC, found themselves affected financially. For example, in a study of high school students in Bronx County 8 months after the event, participants who reported financial difficulty as a result of the attack were five times more likely to have PTSD [45]. Many people living in the NYC area lost their jobs as a result of the attack [46], and studies investigating the impact of this on child mental health found that parental job loss was associated with higher levels of PTSD and other anxiety disorders [46], as well as being significantly associated with parental PTSD and depression [53], which in turn was associated with child anxiety and poor family relationships.

In summary, research on risk factors for mental health sequelae to 9/11 exposure have begun to identify individual, family, and contextual economic factors that predispose children/adolescents to the development of negative outcomes and could potentially serve as targets for preventive interventions. Yet these risk factors also raise many questions for public health research and intervention. Should we, for example, identify children/adolescents with prior trauma or mental health conditions for special intervention after a mass trauma? Should those treating these individuals be especially vigilant in monitoring these individuals after a mass trauma? How can we transform prior challenges into resilience-building experiences rather than deficits? Can parents be trained to respond to mass traumas in ways that are less damaging to their children? Is economic recovery a public health concern? To answer these questions will require the type of research we have been advocating throughout this chapter. We will need research that includes large representative samples with appropriate controls, the use of in-depth assessments across multiple biopsychosocial domains, a developmentally oriented longitudinal design, and timely initiation after a trauma.

Health Care Utilization by Children/Adolescents Affected by 9/11

The evidence in the studies reviewed here indicates that there was a significant mental health impact on children and adolescents from exposure to 9/11, particularly among those directly exposed or who were indirectly exposed through their families. This further suggests that there was also a significant need for mental health services to provide support and treatment for young people who were affected. Thus, an additional area of public health interest is to determine if these services were sought and how well the mental health needs were met by existing delivery systems.

Based on the WTC-BOE data, there is evidence that around 18% of children living in NYC utilized mental health services in the months following the attacks, with more than half of those receiving support services in school [49]. There was a 24% rate of mental health service use among children who were directly exposed and a 30% rate of use among those meeting criteria for probable PTSD. While this indicates that mental health service use was more likely to be provided to those in need, it still highlights the large numbers of children who met criteria for a probable disorder, yet had not sought out mental health treatment, and perhaps were not even aware of services that were and continue to be available for this population [54]. This suggests a need for greater outreach in the wake of such a disaster, perhaps school-wide interventions, and not limited to those in the immediate proximity of the event.

It should be noted, however, that those living in the immediate vicinity of the WTC attack and who were exposed to the dust cloud that was generated when the towers fell were also most likely to be at increased risk for a range of physical health problems, such as respiratory problems, gastrointestinal symptoms, allergies, and cancer, among others [48, 51, 54]. Moreover, physical health problems are risk factors for mental health problems and vice versa. These potential interactions can be seen, for example, in a cross-sectional study conducted among adolescents with asthma 10–11 years after 9/11, who had been in close proximity to the WTC at the time of the attack. The study found that probable PTSD was associated with poorly controlled asthma [12]. It is, therefore, important to think about both traumatic and toxic exposures, both physical health problems and mental health problems as all part of an interacting system, in which comorbidities are common and mutually reinforcing.

Individuals suffering mental health problems as a result of their exposure to 9/11 are now known to be at increased likelihood of presenting to primary care physicians [50, 52]. Primary care physicians working in the NYC area should consider asking their patients whether they were exposed to the attacks, and what the nature of their exposure was, as this information may help them to better diagnose and treat their patients with both physical and mental disorders. In this respect, the NYC Department of Health have developed a set of clinical guidelines for physicians that clarify potential reactions to 9/11 among children and adolescents and include treatment recommendations [47].

In summary, from a population perspective, we know very little about the unmet mental and physical health care needs of children/adolescents exposed to 9/11. While we are gaining knowledge about their physical and mental health outcomes despite the small and generally unrepresentative samples, we know less about service utilization and its effectiveness. One barrier to research has been that the services that are accessed are distributed across a complex health care system with poor central communication. Nevertheless, we need to find creative ways to answer these questions, so we might better serve those already suffering from 9/11-related traumatic exposures as children and adolescents, as well as those who will become exposed to other mass traumas in the future.

Conclusions

In each of the sections above, we attempted to summarize the most relevant findings, as well as critique limitations of the existing relevant research, and to make recommendations for future investigations. We conclude with an overview of what we have learned, what we have missed, and how we might better proceed in the future to protect our most vulnerable and most precious citizens, our youth, in the face of mass trauma.

What emerges from the literature is that many individuals throughout the United States who were children or adolescents on 9/11 were and continue to be profoundly affected in a myriad of ways as a result of that event. Not surprisingly, distress was highest among children and adolescents who lived in close proximity to the WTC and were either exposed directly or were living away from Ground Zero but were indirectly exposed through their families. For many living outside of New York with neither direct nor indirect exposure, the attack impacted their sense of safety and well-being nevertheless, and some developed mental health symptoms in reaction to the attack, particularly those with greater media exposure. Having prior trauma or mental health issues and having a parent who developed PTSD or other distress were associated with higher levels of child mental health problems. Low socioeconomic status and life disruptions resulting from 9/11, including parental job loss and physical health problems, also compounded the distress of children and adolescents. Comorbidities between traumatic exposures and toxic exposures on and immediately following 9/11, as well as other physical-mental health comorbidities, are just beginning to be recognized in those exposed during childhood or adolescence and who are now entering young adulthood or are already into the third decade of life. Although many have utilized mental health services, there clearly remains a large unmet need for mental and physical health services that are appropriately targeted and effective.

The existing body of research has significant limitations, partly because a focus on children/adolescents was possibly viewed as less important than on adults, many of whom died. Many research studies did not begin immediately after 9/11, as would have been ideal, and subsequently, much of it was conducted within 2 years

of the disaster and then stopped. Consequently, much of the research has been too little, too late, without planned follow-up, insufficiently powered samples, and with almost a total lack of valid comparison groups. Most importantly, we cannot learn from information never collected.

We need to proceed based on a life course perspective that recognizes that childhood is a vulnerable, developmental period and that well-being during childhood often determines successful educational, occupational, and social functioning into adulthood. Individual development takes place in a context that influences how children process their experiences, and, therefore, understanding the consequences of events in childhood requires repeated contextual, physical, and psychosocial assessments that are sensitive to developmental phases across the life course.

Based on these principles, we advocate for research that contains meaningful representative samples with matched controls and that is longitudinal in design and developmentally focused. The research needs to be based on the best practice of epidemiologic research in terms of field-based, face-to-face evaluations with multiple informants and valid, reliable measures of mental health symptoms and conditions, as well as of other key constructs. These studies must include comprehensive biopsychosocial assessments that address the crucial factors that the existing literature has identified as important, such as neighbourhood characteristics; school characteristics; family context; parenting styles before and after the event; prior mental, physical, and learning challenges; in-depth assessment as to the nature of the exposure; and thorough assessment of physical, psychiatric, behavioral, and role-functioning outcomes. To capture the interface biologically and psychologically, we will need to conduct thorough physical assessments and to collect key biomarkers such as genetics, epigenetics, inflammatory signals, and stress-related hormones, as well as a judicious use of neuroimaging.

While this is a formidable challenge, the closer we come to achieving it, the better we will be prepared to support the next generation as it faces the challenges of past and future trauma.

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