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Social-ecological-resilience enablers among youth residing in the air polluted Highveld Priority Area of South Africa

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ABSTRACT

Young people living in low-income settlements face numerous challenges ranging from violence to polluted environments. However, many of them find ways in which to overcome these challenges for their own growth and development. These 'ways' are known as resilience-enablers. We studied the resilience enablers of 240 adolescents living in the highly air polluted area in South Africa. Using the draw-and-write technique, this qualitative study entailed asking school-attending adolescents ($n = 240$; average age: 14.1) to make a drawing that illustrated what supported their resilience, before writing a short narrative to explain their drawing. Using a codebook-informed thematic analysis, we identified two dominant patterns in the data: most young people relied on themselves to cope well with their challenging environment; a minority also drew on social, institutional and environmental supports. Our findings are alarming because they imply that little is being done to co-facilitate the resilience of young people in polluted low-income settlements.

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Introduction

Across the world, thousands of children and adolescents live in stressed environments which undermine their growth, development, and health (Rother et al., 2019). This includes young people in African countries, including South Africa (Norman et al., 2010). Typically, these environments are characterized by a lack of basic services, high unemployment and crime, and environmental challenges. For example, exposure to hazardous environmental threats, such as water and air pollution, is correlated with considerable morbidity and mortality among young people, not only in South Africa (Goga et al., 2019) but globally (Karimi & Shokrinezhad, 2020; Katoto et al., 2019; Ou et al., 2020).

Promoting and protecting the wellbeing of young people living in stressed environments requires a detailed understanding of what might enable their resilience (i.e. their capacity to respond adaptively to risks associated with negative health and wellbeing outcomes) (Masten, 2014). More recently, resilience science has emphasized that young people's resilience draws on a combination of resources found across multiple systems (i.e. multisystemic combinations including physiological,

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psychological, social, institutional, and ecological resources) (Masten et al., 2021; Ungar & Theron, 2020). Various studies have explored what supports youth resilience in the context of stressed sub-Saharan African environments (see review by Theron et al., 2023), including stressed South African environments (see review by Van Breda & Theron, 2018). However, very few of these studies have been in communities known to be pollution hotspots or investigated the multisystemic nature of youth resilience to pollution exposure. This is problematic, given that vast numbers of South African youth live in structurally disadvantaged communities that expose them to dangerous levels of pollution (Katoto et al., 2019). In the absence of an understanding of the multisystemic supports that facilitate youth resilience to this exposure, families, communities, service providers, and policy makers will be hard pressed to provide the resources needed to mitigate exposure-related risks. This article remedies the inattention to the resilience of young people living in a South African pollution hotspot. As exploratory studies are customary when there is limited research about a topic (Kumar, 2019), this article reports an exploratory qualitative study with 240 adolescents living in the Highveld (Air Pollution) Priority Area, Mpumalanga province (South Africa).

Young people living in low-income settlements in the Highveld Priority Area face not only social, economic and other challenges associated with the surroundings, but they live in one of the most air polluted regions of the country (Wernecke et al., 2022). This air pollution hotspot has been scrutinized over the past two years in the landmark 'Deadly Air' case (Bega, 2021) in which non-governmental organizations took the Department of Forestry, Fisheries and the Environment to court for the breech of the right to clean air, with special emphasis on children's rights. The *South African National Ambient Air Quality Standards* (Department of Environmental Affairs, DEA, 2009) were set with the intention to protect human health yet are frequently exceeded in this area (Wernecke et al., 2022) putting thousands of young people at risk of asthma, respiratory illnesses and pneumonia, among other air pollution-related adverse health effects (Johnson et al., 2021; Lee et al., 2020). Poorer health is associated with diminished psychological wellbeing, including anxiety and depression (Cadenas-Sanchez et al., 2021). Moreover, child and adolescent exposure to high levels of ambient air pollution are associated with disruptive, impulse control and conduct disorders and related emotions (e.g. anger) and mood disorders and related emotions (e.g. sadness) (Theron, Abreu-Villaça, et al., 2022). Several studies have investigated the impact of environmental risks on South African communities' health – communities that include youth (e.g. John et al., 2014; Njoku et al., 2019; Wright et al., 2021) – but as already noted, very few, if any, studies have considered the resilience-enabling factors that protect the wellbeing of youth living there.

One asks the question, 'What multisystemic resources makes young people living in polluted environments largely unsupportive of growth, development and health strive to survive and do well?' Drawing on reviews of resilience studies with young people living in Africa (Theron, 2020; Van Breda & Theron, 2018), it is likely that relational resources and personal strengths will be part of the answer. Supportive relationships with immediate and extended family, peers, and caring for others are pronounced in accounts of African youth resilience (Nadat & Jacobs, 2021); these relationships nurture African youth resilience by providing emotional, material and informational support. African young people's psychological agency (i.e. their capacity to take enabling action) is similarly prominent. What is less well accounted for in the aforementioned reviews is what African young people's physical environment contributes to their resilience. Recent multisystemic accounts of youth resilience report the value of physical environment resources (e.g. quality housing, accessible recreational spaces, green spaces) to young people's health and wellbeing (e.g. Masten & Motti-Stefanidi, 2020; Masten et al., 2021; Theron, Abreu-Villaça, et al., 2022).

Informed by the above insights, the study aim was to work with young people living in the Highveld Priority Area to generate exploratory insights that could inform support of existing resources and development of new initiatives and structures, even infrastructure, that will help build/sustain resilience among young people living in this pollution hotspot and possibly similar environments elsewhere. This aim was operationalized into the following research question: 'Which multisystemic resources are represented in young people's accounts of what supports resilience in a polluted environment?'

Materials and methods

Research design overview

We employed qualitative research. Qualitative research, which has become an increasingly popular mode of research (Levitt et al., 2018), uses verbal or visual methods (e.g. interviews or arts-based activities) to generate non-numerical data (e.g. textual data or visual data) about a topic of interest (Creswell & Creswell, 2023). Because the data are non-numerical, statistical analyses are replaced by typical qualitative analyses (e.g. thematic analysis; Braun & Clarke, 2022). Resilience researchers are particularly encouraged to work qualitatively in order to better understand how resource combinations are responsive to situational or cultural context (Theron & Ungar, 2023), more especially when the study is with young people (like young South Africans living in pollution hotspots) are underrepresented in the resilience literature (Li et al., 2017). A qualitative design positions youth participants as producers of knowledge (Mitchell et al., 2010), given their personal, lived experience of the topic of interest.

More specifically, the qualitative design that we used was exploratory. An exploratory qualitative approach is appropriate when the topic of interest is under-researched (Ward et al., 2018). It allows researchers to explore the under-researched topic with a limited number of participants (e.g. a small sample) in order to establish preliminary or tentative understandings (Kumar, 2019). While this understandably limits the generalizability of findings, it provides a cost-effective way for researchers to determine whether the topic warrants subsequent larger scale quantitative or mixed methods studies.

Context

The study that we report was affiliated to the Resilient Youth in Stressed Environments (RYSE) study. This multi-year, multi-site study followed cohorts of young people living in communities stressed by economic precarity and environmental challenges (Ungar, 2021). By design, resilience studies require risk exposure (e.g. living in a stressed community) (Masten, 2014; Ungar, 2019a). For this reason, the RYSE study did not include young people living in communities that were not stressed (e.g. in economically stable communities with clean air).

In South Africa, the primary RYSE site was the town of Secunda and adjacent township, eMbalenhle (Figure 1). The town of Secunda has approximately 40 000 residents (population density of 231 persons/km^2) and the adjacent community eMbalenhle has approximately 119 000 residents (6 050 persons/km^2); some 822 people per km^2. They are near coal-fired power stations, mines, and a coal liquefaction plant. The Govan Mbeki District Municipality, which includes Secunda and eMbalenhle, reported 26% unemployment and youth unemployment (15–34 years) was 34% in 2011 (no more recent statistics are available) [(Statistics South Africa, 2012)]. This percentage was higher than the national unemployment of 25% in 2011 [(Statistics South Africa, 2012)]. Crime and violence rates in Secunda and eMbalenhle are deemed to be very high (https://www.numbeo.com/crime/in/Secunda-South-Africa) with Mpumalanga province having the fifth highest number of contact crimes compared to all nine provinces between January to March 2023 (SAPS dataset).

Researcher positionality

There were no prior relationships between the research team who conducted this study and the four schools, their principals or the children attending these schools. Still, the entire team (most of whom are South African and all of whom have spent time in South Africa) is familiar with the South African reality of disadvantaged and polluted communities. Our long-standing involvement in research on the effects of pollution and/or the determinants of child and adolescent resilience resulted in us anticipating few reports of environmental resources. Our familiarity with the South African resilience literature and traditional African culture's valuing of connectedness led us to expect that participants would emphasize relational resources.

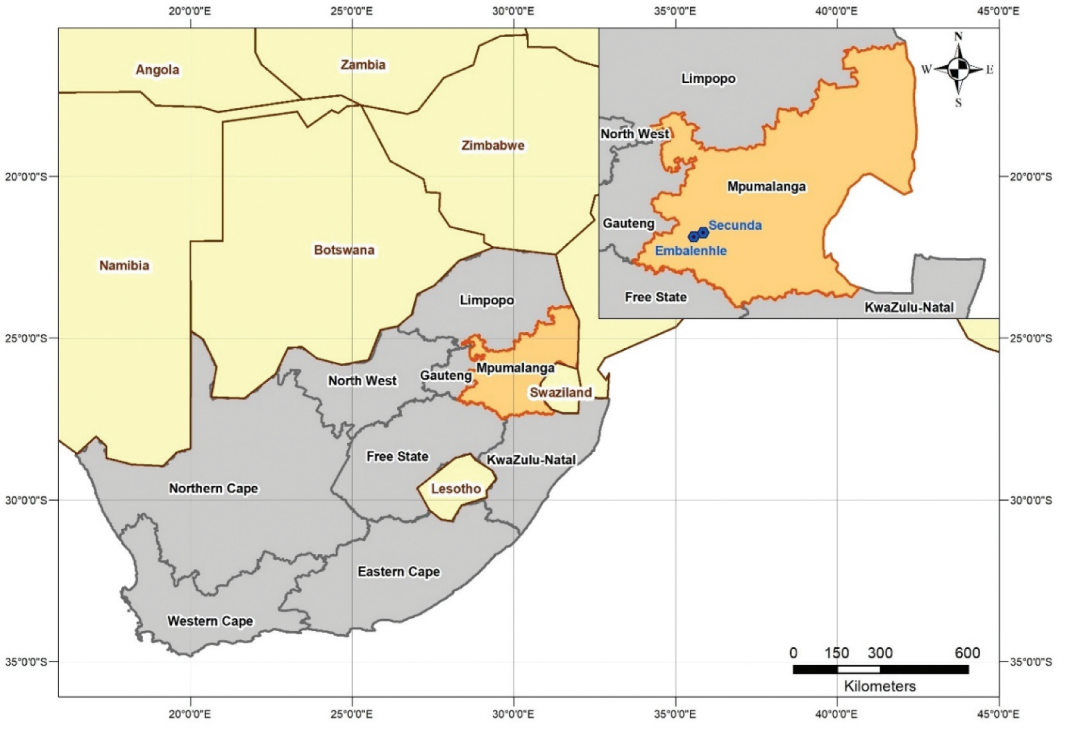

Figure 1. Location of Secunda and eMbalenhle in Mpumalanga province of South Africa.

Participants

We recruited adolescents from Grades 8 to 10 attending one of four schools and living in the Secunda/eMbalenle area of the Highveld Priority Area. We did not recruit from Grade 11 and Grade 12 since these grades have many demands on students preparing for the final examinations in Grade 12.

Following the advice of RYSE gatekeepers about how best to recruit young people, we worked via local schools. Using the Department of Basic Education list of public schools, we invited participation from those schools whose pupils were not already enrolled in the multi-year RYSE study (i.e. we wished to avoid school/participant fatigue).

School principals were telephoned, informed of the study and invited to participate. They were sent additional information (including the Mpumalanga Department of Education's approval of the RYSE study) via email to help them make an informed decision. Those principals who agreed to take part were then visited by the study team and additional information was provided to them. Children attending the schools whose principals agreed that the school may take part were invited to participate in the study. A fieldworker was invited to the school to introduce themselves to a class of potential participants and explain the study purpose and activities. Children were then invited to participate.

Purposive sampling was used to recruit participants for the study with the goal of working with adolescents from schools in the study areas. Participants were included if they attended one of four high schools and assented to participate. Informed consent was obtained from their parent/guardian. Recruitment took place between September and November 2019 in the towns of Secunda and eMbalenhle. Participants were informed of the study at school by a fieldworker and invited to participate. To ensure equality, all children from a class were invited to take part in the study. Overall, 240 adolescent participants from four local schools in the Secunda/eMbalenle area of the Highveld Priority Area participated. Adolescents were from Grades 8, 9 and 10 and were between 13–16 years of age (average age: 14.1; SD = 1.1).

Ethical considerations

The study was approved by the University of Pretoria Faculty of Health Sciences Research Ethics Committee and Faculty of Education Ethics Committee (UP17/05/01, 22 July 2019). Permission to conduct the study in schools was obtained from the Provincial Department of Education as well as the school principal of each school. Each participant's parent/guardian was asked to sign an informed consent form and each participant was asked to sign an informed assent form. Participants with both signed forms partook in the study.

Qualitative data collection

Following informed consent and assent, and in keeping with qualitative studies collecting non-numerical data (Creswell & Creswell, 2023), participants were asked to complete the Draw & Write (D&W) activity (see below for details) in their classrooms during the non-academic time allocated to the researcher by the teacher. Instructions were given by the fieldworker (a member of the research team) on a piece of paper with the text written in English and verbally translated for the different languages, i.e. isiZulu, Sesotho, spoken by the children in the class. All schools were English-speaking schools where subjects were taught in English (i.e. English medium). Each school and child were given unique identifiers and no names were recorded on the drawings/explanations. Once participants had completed the exercise, we asked each child if we could keep the drawing. All participants agreed and some took a photograph of their drawing before handing it to the researcher who placed in an envelope for safe keeping prior to analysis.

As stated above, we used the D&W technique. D&W, which is popular in exploratory studies of youth resilience in South Africa (e.g. Machenjedze et al., 2019; Malindi, 2014; Theron et al., 2023) is an arts-based method that involves a drawing and a written explanation (Mitchell et al., 2011). It invites young people to make a drawing relating to the research phenomenon and to provide a written explanation of what their drawing means. The latter reduces concerns about researcher assumptions biasing how drawings are interpreted (Angell et al., 2015).

As in previous South African studies using D&W to investigate youth resilience (Machenjedze et al., 2019; Malindi, 2014; Theron et al., 2023) we did not use the word 'resilience' in the prompt provided to participants. Instead, we asked them to make a drawing of anything that had helped them 'to do well' when life is hard. As advised by Mitchell et al. (2011), we emphasized that the quality of the drawing was unimportant (i.e. we were interested in what was drawn and not how well it was drawn). We provided participants with A4 sheets and a pencil. There was no time limit to the activity, but most participants took approximately 40 minutes to make the drawing of their choice and explain it in words. Children could write their explanation in any language – all participants wrote in English except for one participant who wrote in isiZulu. The translation from isiZulu to English was done by a member of the research team whose home language was isiZulu and the translation was checked by a second team member (also fluent in isiZulu). The narratives the children wrote were not language edited.

Qualitative data documentation

The drawings and textual explanations were scanned as one file (with two pages, first page with the drawing and second page with the explanation) and saved using a unique code for the school and the participant, e.g. KIT02. Each file was uploaded into ATLAS.ti, which is software supporting qualitative data analysis. All files were password protected.

Qualitative data analysis

In qualitative studies, researchers identify patterns or themes in the data that answer their research question (Creswell & Creswell, 2023). To that end, we chose to use a codebook-informed thematic analysis (CTA) approach to identify patterns in (i.e. make meaning of) the visual and narrative data. As explained by Braun and Clarke (2022), CTA is a structured approach that uses a coding frame. Following repeated perusal of the drawings and participant explanations of their drawings, we used the coding frame that was used by authors LT and GR and other members of the RYSE team to analyse a similarly large D&W data set generated by adolescents (average age 17 years) living in a stressed township in the Free State province of South Africa (Theron, Abreu-Villaça, et al., 2022). Like the township from which the current study's participants were drawn, that township was also challenged by economic and environmental stressors. Informed by a multisystemic resilience perspective (Masten et al., 2021; Ungar & Theron, 2020), this coding frame includes six code groups: (i) access to services/formal supports (i.e. faith-based organizational support; professional services; school-based support; social grant/financial support); (ii) constructive cognition (self-acknowledgement/powerful identity; accepting that life has ups and downs; being future oriented/thinking positively; comforting beliefs); (iii) constructive downtime (doing things they love; exercise/sport enables/destresses; keeping busy/distracting self); (iv) enabling agency (help seeking; seeking inspiration/solutions); (v) enabling opportunities (opportunity for part-time/full-time work; opportunity for education); (vi) enabling physical ecology (access to transport; nature/natural sounds; safe place; space to be alone).

Using ATLAS.ti software, GR applied the RYSE D&W codebook and shared the results with LT who scrutinized them critically. In the isolated instances where she disagreed with a coding decision, she and CYW used consensus discussions to resolve differences of opinion. During these conversations, they added corporate social investment initiatives to the first code group (access to services/formal supports) and opportunity to learn values to the fifth code group (enabling opportunities). LT then reflected on the story of the coded data and identified two overarching themes. CYW, who had done a preliminary inductive coding of the data, reviewed the themes and affirmed their fit.

Trustworthiness

To heighten the trustworthiness of the research study, we used an arts-based method that has been effectively used in multiple previous South Africa resilience studies (e.g. Machenjedze et al., 2019; Malindi, 2014; Theron et al., 2023). Furthermore, participants' explanations of their drawings added to the credibility of the method (i.e. reduced researcher bias relating to our positioning when we analysed the data). Similarly, our use of the RYSE codebook which has been previously used to make meaning of voluminous qualitative data (Theron et al., 2022; 2023), and cautious consensus discussions (between GR and LT) followed by CYW's scrutiny, all heighten belief in the trustworthiness of the data analysis process.

Results

In response to the research question, we identified two central themes. The first relates to young people reporting a combination of resources. This combination comprised multiple resources from multiple systems that co-facilitated resilience to the challenges of living in a stressed environment. However, few young people reported resource combinations. In contrast, the second theme draws attention to youth accounts of resilience that draw on resources from a single system, mostly young people's personal strengths. This second theme was reported by most participants.

Multisystemic resilience-enabling resource combinations are scarce

About one in every four participants ($n = 64$) reported multiple resources from two or more systems (i.e. resources associated with biological, psychological, social, institutional or physical environment systems) when they explained what enabled resilience. When they did, they were most likely to report psychological (e.g. constructive cognition; enabling agency) and social system resources (e.g. supportive friends or family). Some participants added enabling opportunities (typically school-related resources and related dreams for a better personal and collective future) to the combination of personal and relational resources. For instance, Participant KIT14 (a 15-year-old girl) drew herself, schoolbooks, and her family (see Figure 2) and explained:

> I told myself, books [studying] come first, friends aside and fun aside . . . school is one of the reasons why I won't give up, no matter what obstacles I face . . . my family has been there for me, especially my mom. Whenever I am down or in trouble, she finds a way to comfort me. I owe my success to her. I've got to make her and my family proud no matter how hard it is. I always tell myself, that one day I'll wipe my family's tears with my graduation gown.

Participants sometimes included community-based (e.g. youth-focused corporate social responsibility initiatives [CSRI]) and/or cultural resources (e.g. Ubuntu values such as respect for others; religiosity/spirituality) too. For instance, Participant THO08 (a 15-year-old girl) drew multiple resources from multiple systems (see Figure 3), including community-based and cultural ones. The explanation of her drawing included the following:

> My family has been a great support to me . . . They've helped me understand respect, obedience can help you in life. They have taught me that patience is virtue because in the end everyone is destined for greatness in life. My teachers have been the best teachers too because they don't just teach how to solve x and give a reason . . . they help us to think critically . . . they teach us about values . . . the DPW camp [CSRI] helped me to understand the importance of setting goals for my life, because when you have no goals, you don't learn where you want to go/direction. The Go Getter program [CSRI] helped me to understand that when you want something in life you must go get it . . . Going to church has helped me know my Lord and my level of faith.

Very occasionally, the combination of resources that a participant identified included resources in their physical environment (e.g. a park or garden). For example, Participant K1T07 (a 14-year-old girl)

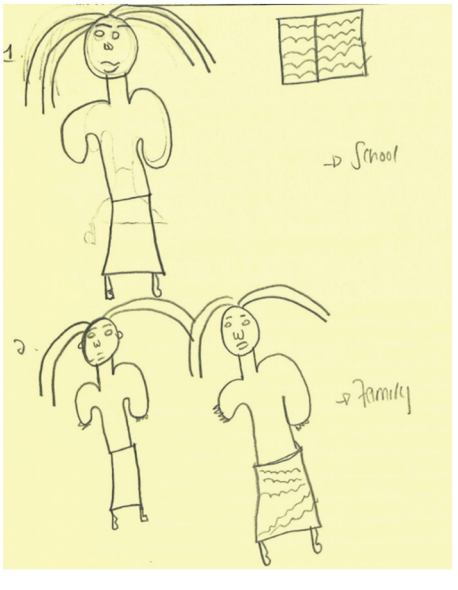

Figure 2. Self, family, and school matter for resilience.

Figure 3. Community-based resources complement personal, social and institutional ones.

drew herself engaging in various actions and herself with her friends amongst some flowers (see Figure 4) and explained:

> To read my books, listen to music, and have fun with my friends around this area (in the park) – this helps me . . . when I have a problem, I write it down or tell my friend . . . [For example] my mathematics marks were decreasing but my friend told me about Saturday extra classes which teaches maths and science.

When participants identified resource combinations, they rarely included institutional supports that were not related to education. An exception was Participant K1T12 (a 15-year-old girl). She valued education opportunities (including 'online teaching' and 'extra classes') and her parents' support in how she accounted for resilience, but she also acknowledged access to healthcare:

> I was having difficulties . . . still now I have [this] sickness problem . . . because of the air of [name of local petrochemical industry] . . . the doctors are saying I have to move [away from] here because the air of eMbalenhle is affecting me.

Personal initiative is key to young people managing exposure to a stressed environment

As illustrated in the preceding theme, most young people did not report multisystemic resilience-enabling resource combinations. Instead, about three in every four participants ($n = 176$) reported resources associated with a single system. Amongst these, personal capacity to manage everyday stresses was most prominent in their drawings and explanations.

Typically, young people took initiative to soothe negative emotion (e.g. frustration, anger, hurt, despair) related to the everyday stressors they experienced. For the most part, they did so by listening to music, watching television, expressing themselves (e.g. writing poetry or journalling), being physically active (e.g. playing sport, dancing, or exercising), or engaging actively in education. Their drawings (see Figures 5 and 6) and explanations of these activities showed an emphasis on the self in these initiatives. For example, Participant K1T11 (a 14-year-old girl) drew herself shooting

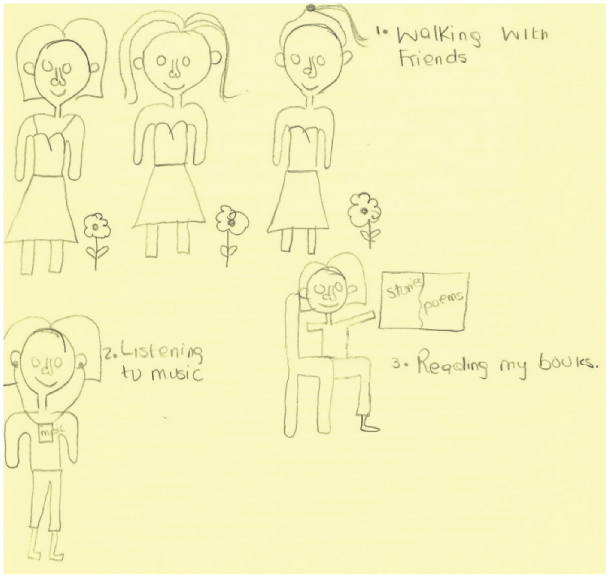

Figure 4. Outdoor space to be with friends enables resilience.

goals on a netball court and explained, 'When I am angry, I go to the grounds and I play netball. Even if I am alone, I will play and I will play harder because I am angry'. Participant K1T32 (a 14-year-old girl) drew a music system and wrote, 'Music makes me feel alive. When I am sad, I listen to music that will make me feel better … make me believe that one day it will be alright'. Participant KIT25 (a 14-year-old girl) drew a school and wrote: 'Education is so important … it can make you to be on the next level … with education I can make my home a better place, a wonderful place.'

Participant explanations of using their own initiative to cope with what was stressing them clarified that doing so often distracted them from their challenging reality:

> When I am depressed or having stress, I play soccer. Soccer helps me de-stress because when I play, I feel safe from the things that hurt me inside. Soccer helps me forget … if I've eaten or not or it's dark (Participant KUS59, a 14-year-old girl)

Figure 5. Most participants emphasize personal initiative when they account for resilience.

Figure 6. Listening to music may support resilience.

> Exercising means a lot to me because when I am exercising, I forget things that happened … and it helps me avoid diseases … I get fit (Participant KUS46, a 13-year-old boy)

> Music makes me feel better, no matter what is on my mind … once I hear music, the thing that made me furious, just disappears … I just feel happy and free (Participant KIT54, a 14-year-old boy)

> I like reading poems or I sometimes write my own poems, and music … this makes me feel stronger and helps me to ignore other bad things or what is happening in my life (Participant KIT08, a 15-year-old girl)

Discussion

As is typical in exploratory qualitative studies, the study we report was directed by a single question (i.e. which multisystemic resources are represented in young people's accounts of what supports resilience in a polluted environment?). Our thematic analysis identified two answers to this question. First, some young people did report multisystemic combinations meaning they reported resources associated with biological, psychological, social, institutional or physical environment systems when they explained how they managed the risks associated with their pollution-exposed community. However, far more young people reported resources that were limited to a single system (typically personal initiative). The discussion has been structured according to these two findings.

Young people draw on biological, psychological, social, institutional or physical environment resources to manage risk exposure

As presaged by multisystemic accounts of resilience that point to various resources from multiple systems informing a young person's capacity for adaptive responses (Masten et al., 2021; Ungar & Theron, 2020), we found that one in four participants used multiple resources from multiple systems to cope well with the stresses common when living in an environmentally polluted environment accompanied with social and other stresses. These included resources associated with biological, psychological, social, institutional or physical environment systems. Some of these resources were provided by corporations with plants/factories operating in the area. For example, power producers as well as liquid to gas producers have a large presence in the areas surrounding Secunda and eMbalenhle and conduct several corporate social responsibility initiatives (CSRIs) as a means to 'give back' to the communities. Both corporations produce and emit air pollution; a Chinese study found that a firm located in an air polluted area was more likely to conduct CSRIs in the communities compared to a firm where air pollution was not visible or gustable (Tan et al., 2020).

Among those who mentioned multiple resources, few young people made use of green space, such as parks or gardens, as a means of coping. While many resilience studies have been inattentive to environmental resources (Ungar & Theron, 2020), also in Africa (Theron & Van Breda, 2021), green

space is typically uncommon in low-income settlements such as eMbalenhle due to poor planning and the need for space for housing. Also, such spaces are not properly maintained and may be perceived as undesirable when overgrown, or occupied by homeless people (Adegun, 2018). If young people are to make use of green space as a means to increase resilience, more space is needed and this space needs to be properly maintained and serviced, together with adequate security in place to ensure safety.

Similarly, most young people did not report seeing a doctor or nurse, or visiting a healthcare facility for help when they are ill. This may be because the state of the healthcare system in Mpumalanga province is dire: it is under-staffed, under-resourced and overburdened (Lefafa, 2022). Patient queues are long and time-consuming (around 4 hours of waiting time) and patients feel ill-treated. Nevertheless, this is concerning, not least because some participants mentioned experiencing sickness which is unsurprising given that the study areas are located in one of the most air polluted regions in South Africa.

Personal initiative, rather than multisystemic combinations, is key to young people living in a polluted environment

In contrast to those young people making use of multiple resources from multiple systems, three in four participants drew or spoke about relying on their own strengths to cope (a single system). They 'self-soothed' using personal activities such as listening to music, watching TV, playing sport, or writing. This over-emphasis on the self is worrying – resilience is not a 'do-it-yourself' job (Ungar, 2019b). While it is possible that young people emphasized personal strengths because of the self-focus that is typical of adolescence, it is equally possible that their resource-constrained environment prompted self-reliance (Van Breda & Theron, 2018). Whatever the reason, the take home message (both locally and internationally) is that much more needs to be done to construct social and physical ecologies that co-facilitate the capacity of young people living in pollution hotspots, such as eMbalenhle, to survive and thrive. Ideally, and in keeping with multisystemic understandings of resilience (Masten et al., 2021; Ungar & Theron, 2020), this should include ready access to healthcare services and spaces and places that can accommodate safe outdoor and indoor recreation and that are well maintained.

Limitations and recommendations

Several study limitations should be noted. When children were making their drawings, we did not have the facilities to create private spaces. Other children could have been watching them and this may have altered or influenced what the child drew. The presence of the researcher and/or teacher in the room may also have affected the children's responses. Future studies should consider private screens for children to complete their drawings, as was done in Machenjedze et al. (2019).

Children only drew one drawing/set of drawings on one day; had they responded to the study instrument again on another day their drawing(s) may have been different. Future researchers may consider asking participants to draw more than once with some additional days/weeks between assessments to look for commonalities, differences or additional resilience-enablers. Doing so would fit better with the changeable or dynamic nature of resilience (Masten, 2014).

Finally, we employed an exploratory qualitative research design. As explained by methodologists (Creswell & Creswell, 2023; Kumar, 2019), the value of this approach is that offers a cost-effective means of gaining initial insights into an under-researched topic. In the case of our study, it showed that a minority of young people report a combination of resources whilst the majority rely on their personal initiative. This is puzzling, given that the study participants were residents of the same community. To investigate these insights further, this exploratory work needs to be followed up with a robust quantitative study to ascertain whether the same pattern (i.e. minimal resource combinations versus reliance on own initiative) persists in larger samples and in more diverse samples. Ideally, follow-up studies are needed with young people in multiple pollution hotspots and in areas with limited pollution (as a control) to understand which multisystemic factors more, or less, in these different settings.

Conclusion

Directed by our interest in what makes young people living in polluted environments largely unsupportive of growth, development and health strive to survive and do well, we used an arts-based qualitative approach (D&W) to explore the resilience of young people living in an air polluted environment in Mpumalanga. The D&W technique enabled us to document participants' lived experiences of these resilience enablers and to portray their leading knowledge producer role (Mitchell et al., 2010). While the participants completed the D&W activity, we observed their enthusiasm and even excitement at being asked to draw. Moreover, their visual artefacts and explanations offer rare insight into the resilience of youth growing up in an air pollution hotspot. Recent reviews of child and youth resilience across sub-Saharan Africa (i.e. Theron, 2020; Van Breda & Theron, 2018) are silent about the resilience of adolescents' exposure to environmental pollution. Our study offers a first step to redressing this inattention and encourages large scale follow-up studies, both locally and internationally, to expand on the nascent insights we contributed.

In addition to the above contribution, our study shows that the majority of young people living in a structurally disadvantaged pollution hotspot relied on self-initiated, personal/individual activities to show resilience to the challenges that characterized their everyday environment/circumstances. In so doing, our study highlights a pressing concern and prompts action. Areas with environmental pollution where young people live should enhance existing resources and develop new initiatives and structures, even infrastructure, to help build and sustain resilience among young people. CSRI is one way in which this may be implemented, however, households, schools, faith-based organizations, and government departments should be conscientized about the need for appropriate mechanisms to encourage use of multiple resources from multiple systems for resilience among youth in places with environmental pollution.

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