Air Pollution, Behaviour, and Mental Wellbeing: Late Adolescents' Perceptions in Budapest

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Abstract

This research investigates how late adolescents in Budapest adjust their behaviour in response to perceived air pollution and their awareness of standardised air quality measurements such as the Air Quality Index, and how those behavioural patterns in turn affect their day-to-day mental wellbeing. Air pollution is a known driver of physical and psychological harm, but the awareness-to-behaviour-to-wellbeing chain is poorly understood in this age group, despite its independent exposure decisions and heightened vulnerability to mood and anxiety disorders. A triangulated mixed-methods design was used, combining a questionnaire of twenty-seven late adolescents in Budapest with eight semi-structured interviews, analysed in a cross-case framework matrix grounded in the Health Belief Model. The findings show that concern about air pollution and nominal familiarity with the Air Quality Index are widespread but rarely translate into daily planning behaviour. When behaviour does change, it takes the form of substitution, threshold-modulation or windowed mitigation rather than outright avoidance, and it is only triggered by a personal lever such as a medical history, a consequential outdoor activity, a designed-environment cue, or a digital tool that issues graded action advice. Outdoor and social activity is universally treated as core to mental wellbeing, so the protective behaviour itself competes with the activities that anchor mood, producing a real trade-off whenever any withdrawal occurs. Awareness alone is therefore not a neutral good that is only beneficial in this population: it becomes one only when paired with an actionable lever.

1. Introduction and Context

Air pollution has emerged as one of the defining environmental challenges of the twenty-first century, with the World Health Organization estimating that ambient outdoor pollution contributes to millions of premature deaths annually and remains a leading global risk factor for preventable disease (Lynch & Mirabelli, 2021a). While the physical health consequences of poor air quality like respiratory illness, cardiovascular damage, and impaired lung development are now well established in scientific literature (Alyami et al., 2025; Wallbanks et al., 2024), there is increasing scholarly and institutional attention shifting to a less-considered dimension of this crisis: air pollution's effects on human behaviour and mental wellbeing (Radua et al., 2024).

Research of Solmi et al (2021) points to late adolescence, spanning ages 18 to approximately 24 years, as a representative of a critical developmental window during which individuals begin exercising autonomy over their daily environments and routines. Decisions about outdoor activity, commuting, socialising and time spent in urban spaces are almost entirely self-directed during this period, making late adolescents both more independently exposed to environmental hazards and more capable of taking protective action. Simultaneously, this stage carries heightened psychological vulnerability, due to late adolescence being widely recognised as a peak risk period for the onset of mood and anxiety disorders.

Despite the intersection of these factors, air pollution’s effects on mental health and mental vulnerability of late adolescent, the relationship between air pollution, awareness of its standardised measurements such as the Air Quality Index (AQI) and the behaviour of late adolescents remains poorly understood and understudied. Tools designed to communicate real-time air quality data to the public have seen limited uptake among young people, and even where awareness exists, it does not reliably translate into health-protective behaviour (Lynch &

Mirabelli, 2021a). Whether this awareness-behaviour gap carries downstream consequences for mental wellbeing outcomes in late adolescents has not been systematically examined.

This research therefore sought to address the following question: How do late adolescents in Budapest adjust their behaviour based on perceived air pollution and its risks and their awareness of its measurement tools, and how they perceive this behaviour change influencing their overall mental wellbeing? The question addresses mental wellbeing instead of mental health to focus on the day to day mental state that is more easily measurable through interviews. Answering this question carries practical relevance for public health communication, educational policy, and urban environmental planning in Budapest and other cities, especially as air quality continues to deteriorate or the progress made to improve it is very slow in many of the cities where young people live and study.

This research was conducted during the internship at Clean Air Action Group (Levegő Munkacsoport) in Budapest, an NGO focused on greening transport, energy policy, urban management and development as well as the public budget and the taxation system to ensure that all people live in a healthy environment and in a dignified manner.

Air pollution remains a serious public health concern in Hungary. The Court of Justice of the European Union ruled in 2021 that the country had "systematically and persistently" breached legal daily limits for particulate matter, in some regions for as long as twelve years, and the European Environment Agency confirmed in 2024 that further efforts are still needed for Hungary to meet its air quality goals (European Environment Agency, 2025b). In Budapest specifically, road transport is the dominant pollution source, accounting for nearly 40% of PM10 emissions, with some areas of the city exceeding 50%, while solid-fuel residential heating compounds the problem significantly during winter months (Polis Network, 2025).

2. Literature Review

The literature relevant to this study spans three interconnected bodies of research: the relationship between air pollution exposure and mental health outcomes, the neurobiological mechanisms through which pollution may affect the brain, and the patterns of air quality awareness and protective behaviour documented among adolescent populations. Each strand has developed largely in isolation, and together they leave a meaningful gap unaddressed: no published study has examined the integrated pathway from awareness of standardised air quality measurements, through behavioural response, to mental wellbeing outcomes, specifically in late adolescents as a defined population. The following review maps each strand in turn before identifying this gap as the basis for the present study.

Air Pollution and Adolescent Mental Health

The relationship between exposure to ambient air pollution and mental health outcomes in young people has received increasing scholarly attention over the past decade. Roberts et al. (2019) conducted one of the most methodologically rigorous studies in this area, combining high-resolution pollution exposure estimates with longitudinal data from the Environmental Risk (E-Risk) twin cohort in London. They found that while $PM_{2.5}$ and NO_2 exposure at age 12 showed no concurrent association with mental health problems, both pollutants were significantly associated with a diagnosis of major depressive disorder at age 18, with individuals in the highest pollution quartile up to four times more likely to be diagnosed with depression in late adolescence than those in the lowest quartile, even after controlling for socioeconomic status, family psychiatric history, childhood victimisation, and prior mental health symptoms. This longitudinal pattern is important because it challenges the assumption that environmental health risks manifest only in immediate ways and instead points to more accumulation of harm across development.

These findings are broadly consistent with the wider literature on air pollution and internalising psychopathology, though that literature is far from uniform. Zundel et al. (2022) conducted a systematic review of 111 studies on air pollution, anxiety, and depression, and found that 73% reported a significant association between higher pollution exposure and elevated internalising symptoms or behaviours. Notably, however, the same review identified an imbalance in research coverage: the majority of human studies examined adulthood or the prenatal period, with adolescence remaining comparatively understudied. This is a meaningful limitation. Given that brain development continues well into the mid-twenties and that emotional regulation circuitry remains ever changing during late adolescence (Arain et al., 2013; Vijayakumar et al., 2018), combining adolescent and adult vulnerability is not scientifically appropriate.

Biological Pathways

Understanding why air pollution affects mental health requires engaging with the biological mechanisms that have been proposed in the literature. The dominant explanatory framework centres on neuroinflammation and oxidative stress. Pollutant particles such as fine and ultrafine particulate matter can cross both the olfactory epithelium and the blood-brain barrier, triggering immune-mediated inflammatory responses in brain tissue (Roberts et al., 2019). Zundel et al. (2022) found that across 95% of reviewed neurobiological studies, air pollution was associated with significant alterations in brain regions implicated in emotion regulation, namely the hippocampus, including changes in neurotransmitter activity, microglial activation, and oxidative stress markers. These processes disrupt the very circuits responsible for stress response and emotional self-regulation.

What this neurological literature reveals however, and what needs to be noted critically, is that most of its evidence comes from animal models rather than human participants. Animal studies allow experimental control and tissue-level analysis that is impossible in humans but the

degree to which they translate to late adolescent experience in real-world urban environments is limited. The human neuroimaging evidence is sparse, and almost none of it focuses specifically on the late adolescent brain under conditions of everyday, naturally occurring urban pollution exposure (Zundel et al., 2022). This gap makes it difficult to draw conclusions about whether the biological mechanisms observed in rodent studies operate in the same way and with the same magnitude in human adolescents navigating complex social and environmental contexts.

Air Quality Awareness and Behaviour in Adolescents

Even if the physiological relations between pollution and mental health are becoming clearer, the question of how young people perceive, understand, and act in response to poor air quality remains less explored. Lynch and Mirabelli (2021a) conducted a nationally representative study of U.S. adolescents aged 12–17 using the YouthStyles survey and found that while 81% were aware that outdoor air pollution could affect health, only 19% had heard of the Air Quality Index or local air quality alerts. Moreover, even among those who did believe air quality in their area was poor, fewer than 47% reported modifying their behaviour in any way. This pattern of high general awareness, low specific knowledge, and even lower protective action constitutes what the literature broadly terms an awareness-behaviour gap (Lynch & Mirabelli, 2021a), and it raises an important conceptual problem: if adolescents cannot translate awareness into actionable understanding of pollution levels, then their capacity to protect themselves from harm is severely limited regardless of how motivated they might otherwise be. This problem inspired the propositional design of the research, later described in the design section, to test whether this is true or not for the late adolescent in Budapest.

Lynch and Mirabelli (2021b) extended this analysis by examining whether the presence of asthma, a condition that creates a direct, personal stake in air quality, altered these patterns of awareness and behaviour. They found that, with few exceptions, asthma status made little meaningful difference to adolescents' awareness of the AQI or their engagement with protective

behaviours, which is a surprising finding. It suggests that even personalised health risk does not reliably motivate informed behaviour around air pollution, which points to structural or communicative barriers that go beyond individual motivation. However, both the Lynch and Mirabelli (2021a), and Lynch and Mirabelli (2021b) studies were conducted in the United States and focused exclusively on adolescents aged 12–17, making it unclear whether their findings generalise to older adolescents or to different national and cultural contexts. This is a significant gap, given that late adolescents aged 18 to approximately 24 occupy a meaningfully different position in terms of their environmental autonomy, decision-making capacity, and social exposure (Wray-Lake et al., 2010).

The Gap: Late Adolescents, Measurement Awareness, and Wellbeing

When the three strands of the existing literature are considered together: air pollution and mental health, the neurobiological mechanisms of harm, and the patterns of awareness and behaviour among adolescents, a clear and underexplored research gap emerges. Most longitudinal mental health studies, including Roberts et al. (2019), measure pollution exposure at a fixed point in childhood and assess outcomes at a later date, which means they do not examine how adolescents' understanding of pollution or their knowledge of formal measurement systems like the AQI might itself mediate or moderate psychological outcomes. The behavioural literature, meanwhile, documents the awareness-behaviour gap but largely treats mental health as outside its scope. No published study, to the researcher’s knowledge, has examined the integrated pathway from awareness of pollution measurements, through behavioural response, to mental health outcomes specifically in late adolescents as a defined population.

This absence matters for both theoretical and practical reasons. Late adolescence is the life stage at which Solmi et al. (2021) identified the highest probability of mental disorder onset globally with 62.5% of all lifetime mental health diagnoses emerging before age 25, making it the window in which environmental risk factors deserve the most careful study. It is also the

stage at which individuals are most likely to be living semi-independently, studying or working in urban environments, and making daily decisions about outdoor exposure without parental mediation. If awareness of air quality measurements can shape those decisions, and if those decisions carry consequences for mental wellbeing, then understanding this relationship has direct implications for public health communication and for how urban environments are designed and communicated about to young people.

3. Conceptual Framework

Before examining how the key concepts in this study relate to one another, it is important to define what each of them means within the scope of this research, because they are used inconsistently across different fields.

Air Pollution

Air pollution, as used in this study, refers to the presence of harmful substances in the air at concentrations sufficient to pose a risk to human health, but it is understood here not as a uniform background condition, but as a contextual one. Ambient outdoor air pollution characterised primarily by fine particulate matter ($PM_{2.5}$) and nitrogen dioxide (NO_2), varies depending on where a person lives, studies, and spends their time (Roberts et al., 2019). A late adolescent living in a quiet, green residential neighbourhood with low traffic density experiences a meaningfully different daily pollution environment than one who lives near a busy road, commutes through a congested city centre, or studies/works in a building adjacent to a highway.

This context is crucial for the research because it means that two late adolescents with the same general level of AQI awareness and AQI measurements of air quality may face very different baseline exposures of other pollutants simply by the context of where they happen to live or spend most of their time, because AQI represents ambient air quality over a large area

and there is a lot of local variation that it doesn't cover. Pollution is therefore treated in this study not as a general statistic for entirety of a specific city or area, but as a place-specific exposure that varies across the daily environments late adolescents actually inhabit.

Awareness of Air Quality Measurement Tools

This is treated as distinct from general awareness that air pollution is harmful. Almost all adolescents know that pollution is bad for health (Lynch & Mirabelli, 2021a). What this study was specifically concerned with is whether young people are aware of and make use of standardised measurement tools such as the Air Quality Index, which translates pollutant concentration data into a publicly accessible daily index that can guide individual behaviour (Lyu et al., 2024). This distinction matters because, as the literature review showed, general awareness does not reliably lead to changes in behaviour, while exposure to specific, actionable information may.

Behaviour

Behaviour, as used in this study, includes two interrelated categories. The first is health-protective behaviour: deliberate actions taken in response to poor air quality, such as reducing outdoor activity, altering commuting routes, staying indoors, or wearing a mask on high-pollution days. The second category is routine daily behaviour: the everyday habits, hobbies, and activities that make up an adolescent's life. These include examples like outdoor exercise, socialising, walking to destinations, spending time on digital media or reading all of which may organically increase or decrease in frequency and duration depending on air quality conditions, whether or not the individual is consciously aware of the pollution levels driving that change.

Both categories are relevant here because they create distinct pathways to mental wellbeing. The first pathway is protective: informed behaviour can reduce physiological exposure to pollutants. The second pathway is potentially harmful in its own right: when late

adolescents curtail meaningful activities like exercise, outdoor socialisation, hobbies tied to public spaces or start repeating harmful habits like overusing digital media, regardless of whether they do so consciously or simply because the environment feels unpleasant, they lose access to the very behaviours that sustain psychological health. Physical activity, social engagement, and time outdoors are each independently associated with reduced anxiety and depression (Roberts et al., 2019); their reduction represents a secondary mechanism through which air pollution may erode mental wellbeing even before any direct biological effect occurs.

Late Adolescence

Defined here as spanning ages 18 to 24, consistent with how the developmental stage is described in the literature: a period of increasing environmental autonomy, continued neurological maturation, and peak vulnerability for the onset of mood and anxiety disorders (Solmi et al., 2021). It is the first life stage at which individuals regularly navigate urban environments largely on their own terms, making their behavioural responses to environmental conditions both more consequential and less studied than those of younger adolescents living under parental supervision.

Mental Wellbeing

Used here in its broader, positive sense: not specifically the absence of clinical disorder, but the scale to which a person can manage stress, engage meaningfully with others, and function with a sense of purpose and emotional stability. The World Health Organization (WHO, 2025) defines it as a state of well-being in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community. This definition is broader than diagnostic mental health outcomes and it allowed the research to capture the subtle day-to-day psychological

costs of pollution exposure like increased fatigue, emotional dysregulation, diminished coping capacity that may not reach a clinical threshold but still meaningfully affect quality of life.

The Conceptual Framework

The conceptual framework guiding this study is grounded in the Health Belief Model (HBM), adapted to an environmental health context. HBM was originally developed in the 1950s to explain why individuals do or do not take preventive health actions, and its core premise is that behaviour is shaped not by objective risk alone, but by how individuals perceive that risk (Alyafei & Easton-Carr, 2024). The model identifies six constructs that together predict whether a person will take a health-protective action: perceived susceptibility to harm, perceived severity of that harm, perceived benefits of acting, perceived barriers to acting, self-efficacy (confidence in one's ability to act), and cues to action, all of which are considered external triggers that activate the decision-making process.

In the context of this research, air pollution constitutes the objective environmental hazard. However, the relationship between pollution and behaviour is not direct, because it is mediated through perception. A late adolescent who is unaware that air quality in their area is poor on a given day has no basis for modifying their behaviour, regardless of the actual pollutant concentration outside. This is where awareness of air quality measurements enters the framework: the AQI and similar tools function as cues to action, the HBM construct that represents the external prompt needed to activate health-related decision-making. But awareness of the AQI does more than just trigger awareness of risk, it also shapes perceived susceptibility ("this air is dangerous to me today") and perceived severity ("this level of pollution causes real harm"), both of which the HBM identifies as prerequisites for behavioural change (Jones et al., 2015).

Behaviour sits at the centre of the framework as the outcome of informational and perceptual inputs, and simultaneously as the mediating variable between pollution exposure and mental wellbeing. This mediation operates in two directions. On one hand, deliberate protective behaviour can reduce actual pollutant exposure, reducing the neurobiological harm documented in the literature. On the other hand, both deliberate avoidance and the unconscious reduction of enjoyable outdoor routines and increase of harmful activities in their place remove the adolescent from activities that actively support mental wellbeing. This means that air pollution does not only threaten mental wellbeing through direct biological pathways, but it may also quietly worsen it by displacing the everyday behaviours that keep young people emotionally regulated and socially connected. Awareness of air quality measurements is therefore highly relevant, as a late adolescent who understands current pollution levels can make an informed trade-off, consciously choosing when outdoor exposure is worth the risk and when it is not, rather than being pushed into either uninformed overexposure or an unnecessary retreat from activities that matter to their quality of life (Lyu et al., 2024).

Mental wellbeing is the final dependent concept in the framework, being the cumulative psychological outcome shaped by both chronic pollution exposure and the degree to which the late adolescent has been able to manage that exposure through informed behaviour. As a result, the framework present four linked components:

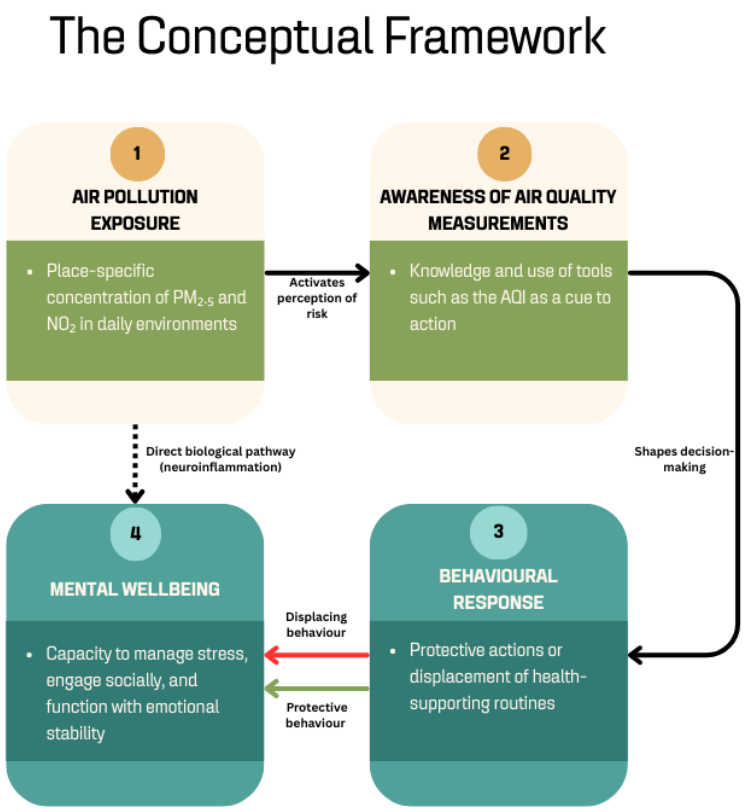
1. Objective pollution exposure ($PM_{2.5}$, NO_2 concentrations in the adolescent's environment)
2. Awareness of air quality measurements (knowledge of AQI tools, cues to action)
3. Behaviour (both deliberate health-protective actions and changes in the frequency of everyday habits and hobbies, shaped by awareness, perceived risk, barriers, and self-efficacy)

4. Mental wellbeing (emotional functioning, stress coping capacity, subjective psychological health)

Figure 1 presents the conceptual framework visually.

Figure 1

Visualisation of the Conceptual Framework



This framework does not assume a simple, linear relationship. The HBM recognises that perceived barriers (practical, social, or informational) can interrupt the path from awareness to action, and that self-efficacy determines whether even a motivated young person actually follows through. These moderating factors were explored in the empirical phase of the research through interview and a questionnaire designed to probe each of the model's constructs.

4. Research Objectives and Questions

The objective of this research is to develop an understanding of how the perception of air pollution and awareness of the standardised measurements of air pollution, and its risks shape the behaviour of late adolescents across differently polluted areas within Budapest, and how those behavioural patterns in turn affect their mental wellbeing. In doing so, the research sought to fill a gap identified in the existing literature, as no published study has examined the integrated pathway from pollution exposure, through awareness of formal measurement tools, through behavioural response, to mental wellbeing outcomes, in late adolescents as a defined population.

This objective was directly tied to the conceptual framework established in the previous section. The Health Belief Model provided the explanatory logic for why awareness of air quality measurements, through its effects on perceived susceptibility, perceived severity, and cues to action, may or may not translate into behaviour change, and why that matters for wellbeing. The research tested this logic by exploring participants' lived experience across all four components of the framework: objective pollution exposure, awareness of AQI measurements, behavioural response, and mental wellbeing.

The research was conducted in the context of an internship at the Clean Air Action Group (CAAG; Hungarian: Levegő Munkacsoport) in Budapest, and the findings are intended to directly serve the organisation's public awareness and advocacy work. The primary deliverable is this Concise Research Report (CRR) presenting the full findings across all data collection methods and offering insights relevant to CAAG's ongoing and future projects.

Central Question

How do late adolescents adjust their behaviour based on perceived air pollution and its risks and their awareness of its measurement tools, and how do they perceive this behaviour change influencing their overall mental wellbeing?

Sub-questions

Sub-question 1: How do late adolescents perceive air pollution and its risks in their immediate living and study environments, and to what extent are they aware of standardised air quality measurements such as the Air Quality Index?

This sub-question addresses the first two components of the conceptual framework: objective pollution exposure as it is experienced and contextualised by participants, and the degree to which awareness of formal measurements is present. It is foundational to the rest of the research, because without establishing what late adolescents actually know and perceive, it is impossible to assess the degree to which awareness can function as a meaningful cue to action in the HBM sense.

Sub-question 2: In what ways does late adolescents' level of awareness of air quality measurements shape their health-protective behaviours and everyday routines?

This sub-question operationalises the central link in the framework, which is the relationship between awareness and behaviour. It covers both deliberate protective actions taken in response to known pollution levels, and the conscious changes in daily habits and hobbies that occur when air quality degrades. It is here that the moderating role of perceived barriers, self-efficacy, and contextual factors becomes visible.

Sub-question 3: How do the behavioural patterns of late adolescents in relation to perceived air pollution and its risks relate to their perception of their own mental wellbeing?

This sub-question addresses the final component of the framework: mental wellbeing as an outcome. It examines whether the disruption or maintenance of meaningful daily behaviours, such as outdoor exercise, socialising, and hobbies, plays a role in how they experience and describe their emotional and psychological functioning.

5. Methodology

This research was designed as a deductive mixed methods study. In this study, the conceptual framework built around the Health Belief Model provided the starting point, where it proposed that awareness of air quality measurements functions as a cue to action that shapes health-protective and routine behaviour, and that this behavioural response mediates the effect of pollution exposure on mental wellbeing in late adolescents. The design was deductive since instead of building a theory from the ground up, this research tested whether that proposed chain of relationships and framework was reflected in the lived experience of the participants.

The qualitative approach was chosen over a purely quantitative one because the research was not primarily concerned with measuring the size of an effect, but with understanding the processes, perceptions, and meanings that shape the relationship between air pollution awareness, behaviour, and wellbeing in late adolescents. These are dimensions that numerical data alone cannot truthfully and faithfully capture.

From the conceptual framework, the following proposition has been set:

Late adolescents who are aware of air quality measurements are more likely to recognise air pollution as a personal health risk and adapt their behaviour accordingly. However, rather than this leading to better mental wellbeing, such awareness could be theorised to contribute to worse mental wellbeing outcomes: by restricting or avoiding behaviour that would otherwise support their psychological health, and replacing them with isolating or

unfulfilling alternatives, aware adolescents may remove themselves from the very behaviours that sustain emotional regulation and a sense of purpose.

Late adolescents with low awareness, may continue engaging in mentally supportive activities without restriction, at the cost of greater physiological exposure to pollutants. The net psychological outcome may therefore favour unawareness in the short term, even as it carries greater biological risk.

Data Collection

The data required to answer the central research question and its sub-questions has been collected through two complementary research instruments: semi-structured interviews and a self-administered questionnaire. Together, these instruments were designed to address all four components of the conceptual framework, mapping awareness, behaviour, pollution context, and mental wellbeing across a sample of late adolescents from varying environmental backgrounds.

Semi-Structured Interviews

The primary instrument consisted of eight semi-structured interviews with late adolescents aged 18 to 24. Each interview followed a consistent opening protocol before moving into the main conversation. At the start, the researcher introduced themselves and explained the purpose and structure of the interview. The Table 1 presents an overview of the interviewees and their neighbourhoods.

Table 1

Overview of the interviewees and their neighbourhoods

Interviewee	Age	Gender	Neighbourhood
Interviewee 1	23	Female	Relatively quiet neighbourhood close to the centre
Interviewee 2	23	Female	Main boulevard, heavy traffic
Interviewee 3	23	Female	Heavy traffic, main intersection in the city
Interviewee 4	22	Female	Centre, next to a transport hub, pockets of green present
Interviewee 5	22	Female	Busy, noisy and dangerous
Interviewee 6	22	Female	Far from the centre, calm neighbourhood
Interviewee 7	21	Female	Moderately busy and quiet
Interviewee 8	23	Male	Busy street, but apartment on the back side, making it quiet

The main body of the interview was semi-structured in nature, meaning that a core set of topics and questions guided each conversation, but the researcher remained free to probe, follow unexpected threads, and adapt questions to the individual interviewee's context and responses. The interview protocol can be found in Appendix A. This flexibility was essential for a

deductive qualitative design, because while the framework set out the relationships to be tested, interviewees' lived experience rarely followed a set theoretical sequence, and the interview instrument had to be sensitive enough to capture where and how their experience diverged from what the model predicted.

The core topics explored included: the interviewee's daily familiarity with and use of AQI tools or other air quality information sources; whether and how they adjusted the planning of their day when they knew or suspected air quality was poor; the degree to which they felt concerned about or restricted by deteriorating air quality in their environment; how they perceived outdoor physical activities, social habits, and personal hobbies as relating to their sense of mental wellbeing; and whether they have noticed changes in those activities, consciously or not, on days or in periods of high pollution. They have also been asked specific questions that served as means of drawing conclusions on the presented proposition, specifically, presenting the statement representing the proposition and asking if they aligned with it.

Afterwards, the researcher has recorded the interviewee's current location and retrieved the AQI reading for that location at the time of the interview. Then, the interviewee has been asked two brief ending questions: how they were feeling mentally at that moment, and whether they were aware of the air quality in their area on the day of the interview. These opening data points were not intended as the primary evidence for any finding, but they served a useful supplementary function, in which they allowed the researcher to note, across all eight interviews, whether there was any observable pattern between real-time pollution levels, interviewees' awareness of those levels, and their self-reported immediate state of wellbeing.

Questionnaire

The second instrument was a self-administered questionnaire providing a supplementary quantitative dimension to the predominantly qualitative study. While still investigating the same topics as the interviews, the questionnaire focused more on the second category of behaviour described in the conceptual framework: routine daily behaviour, the everyday habits, hobbies, and activities that make up and support adolescent's life. After asking how much attention they paid and adjusted their plans based on AQI measurements, or air quality overall, the questionnaire asked how they perceived that changes in their everyday routines affected their mental wellbeing. It was designed in a structured, closed-response format, with optional descriptive alternatives, that allowed for basic descriptive analysis and pattern identification across a larger number of respondents. The link to the full questionnaire is shown in Appendix A.

Sampling

Eight participants for the semi-structured interviews were recruited in a convenience/snowballing sampling manner. These were students or workers living in Budapest or around it, all falling within the late adolescent age range of 18 to 24 years, selected to represent a range of pollution environments, from relatively clean residential neighbourhoods with low traffic density, to highly polluted urban settings near busy roads, congested city centres, or industrial zones.

The questionnaire was distributed mostly to students in Budapest, using the CAAG networks of teachers, interns and students they have worked with in the past. Because all questionnaire respondents shared the same city-level pollution context, variation in their responses could be confidently attributed to differences in responses regarding individual awareness, behaviour, residence within the city and wellbeing rather than to environmental

differences. A minimum of 30 completed responses was required for the questionnaire data to be considered analytically useful, with 27 responses being achieved for the final analysis, which will be considered in the limitations section of the discussion.

Data Analysis

The interview data was analysed using the Framework Method, as described by Gale et al. (2013) and taught by the Global Project and Change Management curriculum at Windesheim. The Framework Method is a systematic approach to qualitative analysis that organises data into a matrix structure, where each row represents an individual interviewee and each column represents a theme or category, allowing the researcher to compare data both within individual cases and across the entire data set without losing the context of each interviewee's account. Gale et al. (2013) describe five core stages: transcribing and familiarising with the data, inductively coding a selection of transcripts to generate initial labels, developing a working analytical framework by grouping codes into categories, applying that framework consistently across all transcripts, and finally interpreting the charted data to identify patterns, typologies, and connections between categories. These steps led to the creation of the Framework Method Workbook Excel file that served as the primary database used for reporting the results.

This method was particularly well suited to this study for two reasons. First, it is designed for interview data and for research with a clearly defined question, making it perfect for a study guided by a conceptual framework with a predetermined preposition to test. Second, Gale et al. (2013) note that the Framework Method can accommodate deductive, inductive, or combined analytical approaches, therefore the researcher could begin with theoretically derived codes drawn from the Health Belief Model, such as perceived susceptibility, cues to action, and perceived barriers, while still remaining open to categories emerging directly from participants' own language and experience that the framework did not anticipate. Where participants'

accounts differed from or complicate the proposition, these deviations were treated as analytically significant rather than problematic.

The questionnaire data was analysed descriptively, using frequency distributions and basic cross-tabulations to identify patterns in awareness, behaviour, and self-reported wellbeing across the Budapest late adolescent sample. These findings were interpreted alongside the interview themes, meant to further contextualise or add a broader dimension to what the interviews revealed.

Quality Assurance

Credibility was supported through the use of interview structure feedback from both the in-organisation mentor and the student counsellor before data collection began, ensuring that the questions were aligned with the research questions and conceptual framework. Member checking was also enabled where possible, allowing participants to review summaries of their interview and questionnaire responses and confirm that their views have been accurately represented.

Transferability was supported by providing detailed descriptions of each interviewee's pollution context and background, so that readers can judge for themselves how applicable the findings might be to other settings. Dependability was maintained through transparent and consistent documentation of the coding process within the Framework Method Workbook database. This documentation is available on request and will be kept by the researcher. For validity and reliability purposes, the semi-structured interview protocol along with the link to the questionnaire are provided as Appendix A for reference. They allow the readers to see what type of questions guided the conversation during the interview and what response options where available in the questionnaire.

Finally, confirmability was strengthened by the researcher maintaining reflexive awareness of their own position and assumptions throughout the analysis, acknowledging that conducting research for an environmental advocacy organisation may have introduced a degree of directional expectation that had to be consciously accounted for in the interpretation of findings. To that end, the Framework Method Workbook database contains a reflexive memo section, serving as a journal of decisions and reflections throughout the coding phase, included as Appendix B.

Ethical Considerations

All participation was entirely voluntary: no individual was recruited under any form of pressure or obligation, and all interviewees were made clearly aware that they may withdraw at any point before or during the interview without consequence. Prior to each interview, interviewees were provided with a written informed consent form explaining the purpose of the research, how their data was to be used, who would have access to it, and how their anonymity would be protected. No participant was identified by name in any published output; pseudonyms or non-identifying descriptors were used throughout the Concise Research Report, transcripts, database and the research articles.

Given that the interview topics touched on mental wellbeing and daily psychological experience, the researcher paid attention to making it clear at the start that interviewees were free to decline to answer any question and to pause or end the conversation at any time. All data, including audio recordings and transcripts, was stored securely and retained only for the duration of the project, and will be deleted after the approval of the Concise Research Report. The research was conducted in full accordance with the ethical guidelines of Windesheim Honours College.

6. Discussion of the Research Results

This section presents the findings from the eight semi-structured interviews and the supplementary questionnaire (N = 27). Rather than reporting every code that emerged from the framework analysis, the discussion is organised around the three sub-questions of the study, and within each sub-question the most compelling and analytically useful findings are presented, explained, illustrated with data, and then evaluated against the relevant part of the conceptual framework and in the end evaluated against the central research question. The results of proposition testing are also described in his section. Where the questionnaire and the interview data converge, they are reported together. Where they diverge, the divergence itself is treated as a finding. Throughout the discussion the abbreviation AQ refers to air quality in general, and AQI refers specifically to the standardised Air Quality Index that the conceptual framework treats as the awareness measure of interest.

Perception of Air Pollution and Awareness of Measurement Tools

The first sub-question asked how late adolescents perceive air pollution and its risks in their immediate environments, and to what extent they are aware of standardised air quality measurement tools. The interviews and the questionnaire together pointed to a pattern in which perception of air pollution as a problem is, in this group, primarily sensory and place based, while familiarity with the AQI as a formal measurement is partial and rarely tied to its actual interpretive use.

Across the eight interviewees, descriptions of bad air quality were almost always anchored to immediate sensory experience and to the urban setting in which it was felt, rather than to numerical thresholds. Interviewees described bad air through smell, visible exhaust, the sensation of suffocation in heavy traffic, and physical symptoms such as headaches in the first week of living in central Budapest. Interviewee 1 said that bad air quality was “when I walk on a

street and I smell the exhaust of a car … and then I breathe that in, and it's super disgusting," and Interviewee 2 similarly described "a lot of cars" producing an atmosphere where "you suffocate, even if you don't feel it because you breathe normally." These accounts are consistent with the broader finding that the interviewees drew their working definitions of air pollution from their lived urban experience, particularly proximity to traffic and lack of green space. Two inductive themes recurred within these sensory accounts: several interviewees drew on prior experience of cleaner places (Alaska, the French countryside, smaller European cities) as a comparative baseline against which Budapest air was evaluated, and several interviewees blended air pollution with noise pollution as part of one perceptual package, which suggests that what is being responded to is the cumulative urban load rather than chemical concentration alone.

The questionnaire data converged on this pattern. Most respondents lived in environments where they were routinely exposed to traffic-related pollution: 33% lived in busy urban areas with heavy traffic nearby, an additional 37% in mixed areas with some traffic and some green space, and only 22% in quiet residential neighbourhoods. Concern about air pollution as a health issue averaged 3.26 on the 1–5 scale, with 44% selecting a concern level of 4 or 5, suggesting that a clear majority recognise air pollution as an important issue at some level.

Awareness of the AQI as a measurement tool, however, was less uniform and considerably more fragmented than awareness of pollution as a problem. In the questionnaire, 48% of respondents reported that they had heard of the AQI and knew what it measures, 30% had heard of it but were unsure of what it measures or had not paid attention to it, and 22% had never heard of it at all. This distribution is misleading on its own, because the interview data showed that several interviewees who would likely have ticked "Yes, knows" in the questionnaire were in fact only loosely familiar with the index: Interviewee 1 described the AQI

as something she “might have heard about,” and Interviewee 6 recognised colour ratings on maps without recognising the name. Only Interviewee 8, who has a history of asthma, and to a lesser extent Interviewee 2 and Interviewee 7 used the AQI in a way that resembled the policy-oriented description in the literature: as a categorical, interpretable tool that maps onto action. Interviewee 8 explained that the app he uses “really gives you good information … there’s like specifically recommendations if the air is really bad.” For the rest of the interview sample, AQI awareness existed at the level of recognition rather than at the level of working interpretation.

Behaviour around checking the index reinforced this pattern. In the questionnaire, only 26% checked air quality information at least a few times a week, while 37% checked rarely and 22% never. Among interviewees, only three checked AQI with any regularity, and of these only one checked daily on a dedicated app rather than as a side panel within a weather app.

A complementary reality check was built into the interviews through a snapshot exercise. At the end of every interview the actual AQI at the interviewee’s location was retrieved, and the interviewee was asked whether they could estimate the current air quality of the day they were in. AQI is generally measured on a scale from 0 to 500. Lower numbers indicate cleaner, safer air, while higher numbers indicate greater levels of pollution and increased health concerns Table 2 summarises the results of the snapshot.

Table 2

End-of-interview snapshot: actual AQI at the interviewee’s location, the interviewee’s mood, and whether they could correctly estimate today’s AQI (N = 8).

Interviewee	Interview AQI	Mood	Aware of today’s AQ?
Interviewee 1	44	Very good	No
Interviewee 2	17	Very good	No

Interviewee 3	17	Good	Yes — inaccurate
Interviewee 4	17	Quite good	No (assumed good)
Interviewee 5	22	Good	No
Interviewee 6	22	Good	No (assumed good)
Interviewee 7	22	Pretty stable	No
Interviewee 8	28	Good, productive	Yes — accurate

Two findings emerge from the snapshot. First, six of the eight interviewees could not estimate the actual air quality of the day in which they were being interviewed about air quality, even though several of these same interviewees had described themselves earlier in the conversation as at least loosely familiar with the AQI. Second, of the two interviewees who did offer an estimate, only one was accurate. Interviewee 3 believed the day was polluted because of the heat, when in fact the AQI at her location was 17, which is within the World Health Organization's acceptable band. Interviewee 8, the only daily dedicated app checker in the sample, estimated the AQI accurately within a tight range. The snapshot therefore acts as a partial check on the more confident accounts of awareness offered earlier in the same interviews and supports the conclusion that nominal AQI recognition rarely translates into operational, present moment awareness.

Discussion for Sub-question 1

Sub-question 1 therefore yields a layered answer. The late adolescents in this study perceive air pollution primarily as a sensory, urban, and contextual phenomenon, and most recognise it as a health concern at a moderate to high level. Their awareness of the AQI as a standardised measurement tool, however, is mostly thin: recognition is widespread but

interpretive use is rare. These findings are strongly consistent with, and extend, what Lynch and Mirabelli (2021a) found for U.S. adolescents aged 12–17, where 81% were aware that air pollution could harm health yet only 19% had encountered the AQI by name. The present study's Budapest sample shows a comparable structural split: concern is moderate to high, but the interpretive use of the index that would allow it to function as the HBM's cue to action is nearly absent except in participants with a personal health stake (Alyafei & Easton-Carr, 2024). The snapshot exercise, showing that six of eight participants could not estimate the actual AQI on the day of their interview, deepens this finding beyond what survey based studies capture, and supports Lyu et al.'s (2024) observation that the knowledge–attitude–behaviour gap in air quality is not merely a matter of unfamiliarity with a label but of the inability to translate a number into present moment, place specific judgement. Notably, the blending of air pollution and noise pollution into a single perceptual urban load has not been systematically documented in the adolescent awareness literature and represents an inductive contribution beyond what Lynch and Mirabelli's quantitative instrument could surface.

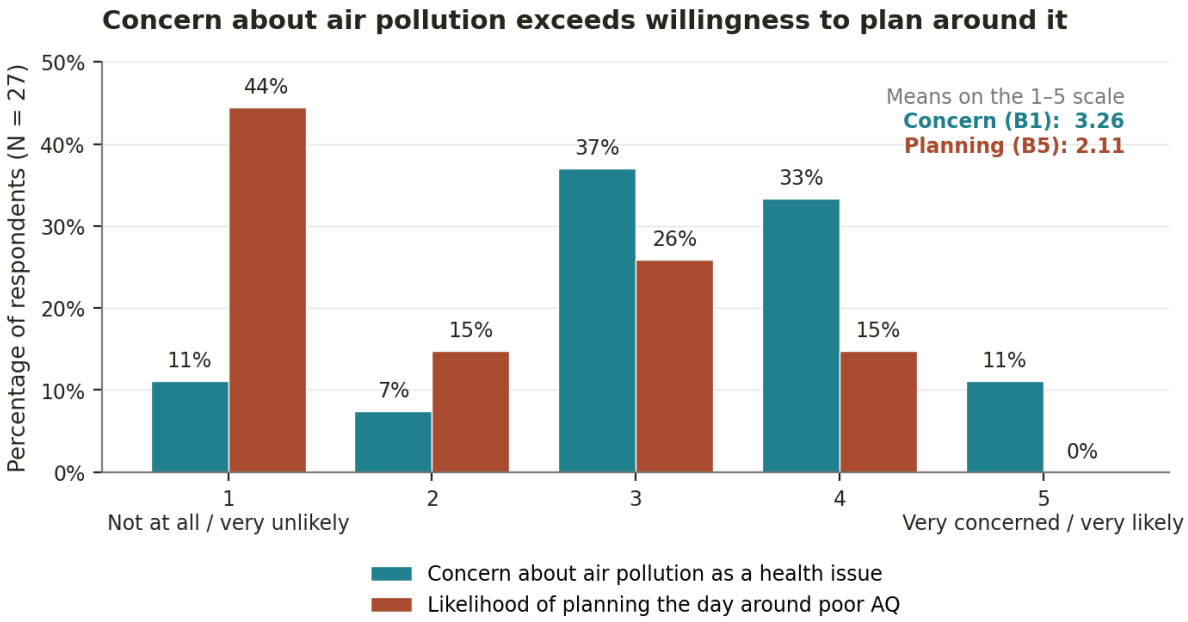
Awareness and Behaviour

The second sub-question asked how the level of awareness of air quality measurements shapes health protective behaviours and everyday routines. The expectation derived from the conceptual framework was that more aware respondents would be more likely to translate that awareness into action. The data, taken together, complicates this expectation in a way that turns out to be the central finding of the questionnaire.

The most striking pattern in the questionnaire is the gap between stated concern about air pollution and willingness to plan around it. Although the mean concern score (B1) was 3.26 on the 1–5 scale, the mean likelihood of planning the day around poor air quality (B5) was only 2.11, with 44% of respondents selecting the lowest option “very unlikely” and not a single respondent selecting “very likely”. This is visualised in Figure 2.

Figure 2

Concern about air pollution as a health issue (B1) compared with likelihood of planning the day around poor air quality (B5), N = 27.



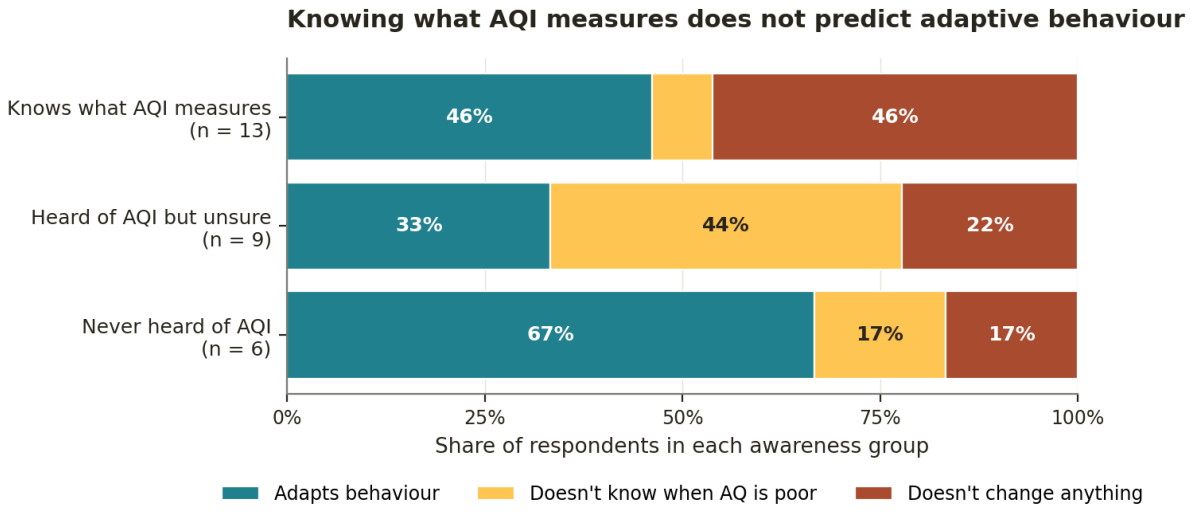
The size of this difference is not subtle, as more than half of the respondents who place themselves at the upper end of the concern scale nevertheless place themselves at the lower end of the planning scale. This translation gap is the questionnaire's clearest single finding, and it directly parallels what the interviewees described in their own words. Interviewee 2, who lives on a major boulevard and considers air pollution one of the most serious problems facing European cities, explained that her own non-adaptation was a matter of "probably laziness and habits … I'm used to take this road so I will not maybe bother changing it." Interviewee 3 acknowledged that pollution had given her headaches in her first week in Budapest but said that even when the air was bad, she still wanted to go outside, "even if it can be dangerous for my health," because her habits and need for socialisation and to spend time outside overrode the protective consideration. The questionnaire data on what respondents actually do during a poor air day make this gap concrete: 33% reported that they do not change their behaviour at all and

an additional 26% reported that they do not usually know when air quality is poor, meaning that in roughly six out of every ten respondents the protective response is either absent or operationally unavailable. The barriers section of the questionnaire (C5) names two reasons in particular: 30% selected “I don’t know when air quality is poor” and 26% selected “People around me don’t take it seriously either”, which together reframe the translation gap as a problem of information access and social norm rather than of motivation alone.

When questionnaire respondents were grouped by level of AQI awareness and compared on their behaviour on poor air days, the relationship between awareness and adaptation turned out to be weaker still. Adaptation here is defined, following the workbook coding, as ticking any of the restrictive actions in C1 (reducing outdoor time, avoiding outdoor exercise, staying indoors, closing windows, or changing commute). Figure 3 shows that 46% of respondents who reported knowing what the AQI measures adapt their behaviour, compared with 33% of those who had heard of the AQI but were unsure of its meaning and, perhaps counter intuitively, 67% of those who had never heard of the AQI at all.

Figure 3

AQI familiarity (B2) cross-tabulated with behaviour on poor-air days (C1), shown as a share within each awareness group. Adaptation = any restrictive action in C1. The total in the table sums to 28 because one respondent ticked both “adapts” and “doesn’t know when AQ is poor”, so this respondent appears in both columns.



The finding is small in absolute numbers, given the sample size, but the direction is meaningful: knowing what the AQI is, does not, in this group, predict adaptive behaviour. The middle group, who recognise the AQI without being able to interpret it, is in fact the most likely to report that they simply do not know when air quality is poor, which is consistent with the interview observation that nominal recognition of the AQI does not translate into interpretive use. When the cross-tabulation of adaptative behaviour is run against frequency of air quality checking, rather than against named awareness, a slightly clearer pattern emerges: of the seven respondents who check air quality at least a few times a week, six adapt their behaviour. This suggests that the operational behaviour of checking is a stronger predictor of action than the cognitive state of recognising the index.

A complementary item in the questionnaire asked respondents to rate, on a 1–5 scale, how much control they felt they had over their own exposure to air pollution. The mean was 2.33, and only one of the 27 respondents rated their control at 4 or 5. When this item is broken down by residential area, every single respondent who rated their control at 4 or above (n = 1) lived in a mixed area; in the quiet-residential and busy-traffic groups no respondent reported a high sense of control. The pattern is consistent across area types: respondents do not feel they have meaningful leverage over their personal exposure. This finding belongs to the self-efficacy

component of the Health Belief Model, which the present data suggests is the thinnest part of the framework for this population: belief in susceptibility and severity is widely present, but belief in the capacity to act on them is not.

The interviews show what shapes which kind of awareness becomes operational. Interviewee 4 was a clear case of calibrated adaptation, she checked air quality before going running because the activity made the issue concrete and consequential, and she would substitute hiking for running when the reading was bad. Interviewee 8 in contrast, treated air quality as a year round, daily input into decisions about which outdoor hobbies to do, an awareness pattern that was anchored in his asthma history and reinforced by an app that issued explicit recommendations. On the other end, Interviewee 5 was explicit that she could not, and would not, manage her life around air quality: “If I have to go out, like leave the apartment, I will do it anyway, no matter what the weather is like.” What these three cases together suggest is that awareness translates into action when one of three conditions is present: a personal stake (asthma), a specific activity for which AQ is consequential (running), or a tool that closes the interpretive gap with explicit recommendations.

Discussion for Sub-question 2

Sub-question 2 is answered as follows. Awareness of air quality measurements, in the sense of recognising the AQI, does not by itself produce health protective behaviour in this population. What appears to matter more is whether the awareness is operationalised through a routine (checking before a consequential activity), through a personal vulnerability (asthma), or through a tool that includes actionable recommendations. Where these conditions are absent, even high stated concern fails to translate into changes in everyday routine. This pattern converges closely with the conceptual prediction of the Health Belief Model that perceived susceptibility and severity are insufficient on their own to produce protective behaviour: the model requires a concrete cue to action and an adequate level of self-efficacy to bridge belief

and conduct (Alyafei & Easton-Carr, 2024; Jones et al., 2015). The data here show precisely that configuration: where the cue is present, as such with a daily-use app that issues graded recommendations, a medical diagnosis of asthma, or a consequential outdoor event, the behaviour adjusts, where it is absent, even respondents who rate their concern at 4 or 5 out of 5 are unlikely to plan their day around air quality (questionnaire mean 2.11). This aligns with Lynch and Mirabelli's (2021b) counterintuitive finding that even asthma status did not meaningfully improve AQI engagement for most adolescents, though the present study adds the nuance that the one participant with asthma who also had a habit based checking routine did behave protectively, suggesting it is the combination of personal vulnerability and an actionable tool, not vulnerability alone, that closes the gap. The inductive IND-5 code (deliberate awareness-without-action rationalised through words like “laziness” or “can't manage my life around it”) points to a cognitive dissonance dynamic that the HBM does not straightforwardly predict and that has not been documented in this form in the adolescent air quality literature reviewed here.

Behaviour and Mental Wellbeing

The third sub-question asked how the behavioural patterns of late adolescents in relation to perceived air pollution relate to their perception of their own mental wellbeing. Two findings emerged here. The first concerns the centrality of outdoor activity to the participants’ mental wellbeing, and the cost of reducing or stopping it. The second concerns the dual psychological effect of awareness itself, which acts as both a source of anxiety and a source of perceived control.

Outdoor activity, and in particular time in green space, is described by virtually all participants as essential to their day-to-day mental wellbeing. In the questionnaire, 67% of respondents rated time in nature or green spaces as very important or essential to their emotional functioning, and 63% gave the same rating to outdoor socialising. When asked how

they felt on days when their outdoor activities were reduced or avoided, 52% reported feeling somewhat or much worse mentally. The interview data are even more pointed: Interviewee 1 described being “the happiest” when she lived surrounded by nature in another country and “claustrophobic” in dense urban Budapest; Interviewee 4 described days spent indoors as “rotting in bed days … those are not good”; and Interviewee 8 described feeling “unfulfilled … lazy … disconnected from the world” when sustained pollution kept him indoors. Across the eight interviews this was the most consistent finding of the entire dataset: outdoor activity is treated as a crucial component of daily mental wellbeing, not an optional one.

This explains why protective restriction itself carries a wellbeing cost. If outdoor exercise, social time outdoors, and time in green spaces are integral to mood regulation, then any behaviour pattern that systematically reduces these activities will have a mental wellbeing downside that runs alongside the physical health upside. The participants who adapted their behaviour most actively were also those who described the most awareness of this trade off. Interviewee 7 quantified it as “30% bad and 70% good,” meaning that awareness produced some gloomy thoughts but also gave her “more instruments” to act. Interviewee 8 described it as “another burden” layered onto the daily decision, but one that he preferred to make consciously rather than passively. Interviewee 4 used the word “reassurance” for the mental effect of acting on what she knew.

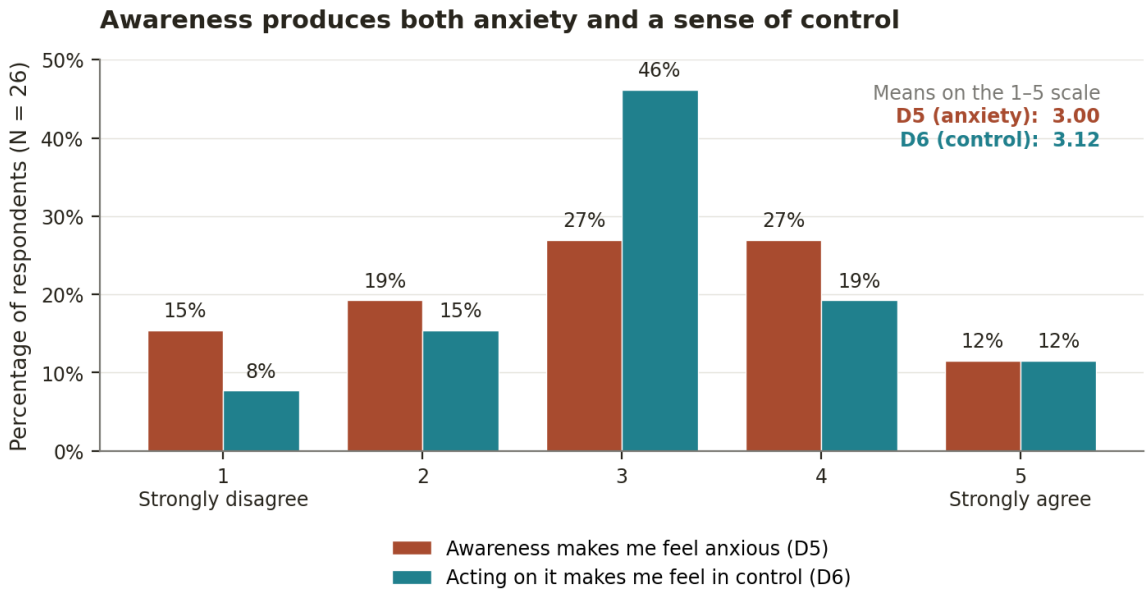
The questionnaire registers this cost directly. When asked what they tend to do indoors on bad air days (C3), 30% of respondents reported feeling more tired or low on energy and 30% reported staying home instead of going out socially, while 22% reported spending more time on their phone or social media. A slim majority (52%) said they did not notice a difference, which is consistent with the broader finding that most respondents do not register day-to-day air quality variation in their conscious decision-making, but among the respondents who do notice, the downstream pattern is one of withdrawal and reduced activation rather than active

compensation. The D4 item asked respondents whether air pollution or awareness of it had ever affected their mood, and 35% answered yes or yes I think so, with a further 27% answering maybe. Considered together, these items suggest that an appreciable minority of the sample experiences air pollution as a felt influence on mood, and that this influence operates through the curtailment of outdoor activity rather than through a direct physiological route the respondents could articulate.

It can be said that the questionnaire visualises a related, and more counter intuitive, pattern: awareness has both anxiogenic and control restoring effects, and these often coexist in the same respondents. Figure 4 plots the distributions of D5 (“Knowing about poor air quality makes me feel more anxious or stressed”) and D6 (“Paying attention to air quality and making protective choices helps me feel more in control”).

Figure 4

Distributions of D5 (anxiety associated with awareness) and D6 (sense of control from acting on awareness), 1 = strongly disagree to 5 = strongly agree, N = 26 (one respondent skipped both items).



Means on D5 and D6 are nearly identical (3.00 and 3.12, respectively), and 38% of respondents either agree or strongly agree with both statements. Awareness of air pollution is therefore experienced not as a binary good or bad, but as a duality that the same respondents hold simultaneously. The interview data again show why: Interviewee 7 and 8 both spoke of awareness as something that introduced worry into their day, but each also described a sense of agency that came from acting on that knowledge rather than ignoring it. Interviewee 3 said that the topic was “stressful and maybe a little scary,” while Interviewee 4 described awareness as “the reassurance” that comes from knowing she had made the right choice.

When the same item is broken out by behavioural group, the picture becomes sharper. Among respondents who actually adapt their behaviour, the mean for D6 ('action makes me feel in control') is 3.42 (SD = 0.90), compared with 2.83 (SD = 0.98) for respondents who do not know when air quality is poor, and 2.89 (SD = 1.27) for respondents who do not change their behaviour at all. The respondents who act on their awareness are also the respondents who report the strongest sense that doing so helps them feel in control. The implication is that, in this population, the wellbeing benefit of awareness is realised through the behaviour, not through the awareness alone.

Discussion for Sub-question 3

Sub-question 3 yields a more nuanced answer than the simple causal chain of the conceptual framework anticipated. Curtailing outdoor behaviour because of air pollution carries a clear mental wellbeing cost, because outdoor activity is core to participants’ emotional regulation. Awareness itself, considered separately from behaviour, produces both anxiety and a sense of control in roughly equal measure. The deciding factor between the two effects appears to be whether awareness is converted into action: those who act on what they know report a stronger sense of control and a more favourable balance between the worry and the agency that awareness creates. For the late adolescents in this study, in other words, the

wellbeing implications of awareness depend on whether they have the tools, the routines, and the personal stake required to do something with it.

This finding is consistent with the broader literature linking physical activity, social engagement, and outdoor time to reduced anxiety and depression in adolescent populations (Roberts et al., 2019). It also aligns with the theoretical logic of the conceptual framework, which identified two competing pathways: deliberate protective behaviour reduces physiological pollutant exposure, while the same curtailment removes the adolescent from the activities that anchor mood and emotional regulation. The present data confirm that this trade-off is not hypothetical, it appears in interviewees' own accounts on the same timescale as the behaviour change itself. What the data add beyond what Roberts et al. (2019) and Zundel et al. (2022) establish is the mechanism on the awareness side: the wellbeing effect of awareness is not direct but is mediated by whether the awareness is converted into action. Respondents who act on their awareness report a stronger sense of control (D6 mean 3.42 vs. 2.83–2.89 for non-actors), suggesting that it is agency, not awareness alone, that produces the psychological benefit the HBM's self-efficacy construct predicts (Alyafei & Easton-Carr, 2024). Awareness without an actionable outlet, by contrast, functions as an additional cognitive stressor, a pattern that is not captured in the existing behavioural literature but that has parallels in the broader environmental anxiety and climate worry literature (Radua et al., 2024).

Testing the Proposition

Alongside the three sub-questions, the interview protocol included a proposition designed to be tested directly with interviewees: young people who pay close attention to air quality measurements are more likely to limit or avoid outdoor activities on polluted days, but rather than this making them feel better, it might actually leave them feeling worse, because the things they stop doing, like exercise, being outside, or meeting friends, are exactly the things that keep them mentally healthy. The proposition is best read as a two-step causal claim. The

first clause links attention to behaviour change, in particular to curtailment of outdoor activity. The second clause links that curtailment to a net loss in mental wellbeing, because the activities that are given up are themselves protective. Testing the proposition therefore requires evaluating both steps against the data, rather than only asking interviewees whether they agreed with the wording.

On the first clause, the evidence is partial rather than confirming. None of the eight interviewees fully avoid outdoor activity on polluted days, and the behavioural response is a spectrum rather than a binary. Interviewees 2, 4 and 6 substitute (a greener running route, hiking instead of running, the countryside instead of the city), Interviewee 7 mitigates (closing the window, taking the metro instead of walking the commute), Interviewee 8 threshold modulates (limiting hobbies only when the air is, in his words, really bad), and Interviewees 3 and 5 explicitly refuse to limit. The interviewees who come closest to the proposition's model of attention driven curtailment are precisely the high attention cases: Interviewee 8, who checks an app daily, has asthma, and curtails his hobbies above a threshold he sets, and Interviewee 7, who stays indoors and closes the window when she is not obliged to be out. The lowest attention cases (Interviewees 1, 3 and 5) do not curtail at all. The first clause is therefore directionally supported, in that attention does sit alongside the most curtailment in the sample, but the form is substitution and threshold modulation rather than the outright avoidance implied by the proposition wording. This reflects the cue to action and perceived susceptibility pathways (Jones et al., 2015). The data only partially support it: curtailment takes the form of substitution or threshold modulation, not outright avoidance, which implies that perceived barriers (the wellbeing cost of giving up outdoor activity) and self-efficacy (the ability to find equivalent substitutes) temper the linear prediction of the model.

On the second clause, the evidence is substantially stronger and largely confirms the proposition. All eight interviewees describe outdoor and social activity as central to their mental

wellbeing, and the interviewees who do curtail or substitute also describe a wellbeing cost that is directly attributable to the activities they have given up. Interviewee 6, who substitutes city activity for the countryside or stays in on bad days, said that on days when she wanted to be outside but could not, the result was that she would eat at night, sleep worse, and feel more angry and emotionally susceptible. Interviewee 4, the clearest substituter, described an indoor day as a rotting in bed day and said those days were not good for her. Interviewee 8 articulated the trade off most fully: he feels unfulfilled, lazy, unproductive and disconnected from the world when pollution driven indoor stretches accumulate, and when he does still exercise on a high pollution day the activity itself, in his words, feels fifty percent less healthy. Interviewee 2, who has not been able to test the proposition on her own behaviour, reached for the COVID quarantine as the closest analogue and noted that people, at least in cities, were unhappy when the choice to stay in was taken from them. Across the dataset, the same activities the proposition names, exercise, time outside, and meeting friends, are exactly the activities interviewees identify as their primary regulators of mood, sleep and a sense of agency, and the wellbeing cost of giving them up shows up immediately or within the same day in most cases and cumulatively in Interviewee 8's account. This is well supported and is consistent with Roberts et al.'s (2019) longitudinal evidence that reduced outdoor and physical engagement is an independent pathway through which environmental conditions erode psychological health.

Two further patterns refine, rather than contradict, the proposition. The first is that for the highest attention interviewee, attention itself can become an excuse for inaction rather than a trigger for it, which still produces the wellbeing loss the proposition predicts but through a different mechanism. Interviewee 8 said that air quality sometimes serves as an excuse when he is already feeling lazy about going running, and that he had had days where he did not go somewhere because he knew the air quality was bad, then later saw how nice the weather was and regretted it. The second is that awareness can itself carry a cognitive cost, independent of

any behaviour change: multiple interviewees described thinking about poor air quality as another burden or stress that you are adding onto yourself. Both patterns enhance the proposition's second clause by showing that the wellbeing loss can be produced either by the foregone activity or by the act of attending to the threat, and sometimes by both at once.

Taken together, the proposition's second clause is well supported by the data: for interviewees who do curtail or substitute, the activities they give up are the same activities they identify as central to their mental wellbeing, and the wellbeing cost is observable. The first clause is supported only in a softer form: among these interviewees, close attention to air quality measurements is associated with partial curtailment, substitution, or threshold modulation, rather than full avoidance. The proposition is therefore best read not as a binary prediction that attentive young people will withdraw from outdoor life on polluted days, but as a description of a real trade off that becomes visible whenever they do withdraw: the protective behaviour competes with the very activities that protect their mental health, and the cost is felt.

Conclusion

The central question of this study was how late adolescents adjust their behaviour based on perceived air pollution and their awareness of its measurement, and how they perceive this behaviour change influencing their mental wellbeing. Drawing the three sub-questions together, the answer is that adjustment occurs unevenly, and that its mental wellbeing consequences are conditional on the form of the adjustment. Late adolescents in Budapest perceive air pollution mainly through sensory and contextual cues, recognise the AQI partially, and act on it consistently only when a personal vulnerability, a consequential activity, or a tool with explicit recommendations is present. When they do act, the protective behaviour competes with outdoor activity that is itself central to their mental wellbeing, and the net mental wellbeing outcome depends on whether the behaviour change is conscious and informed (where it tends to produce a sense of control) or absent and ambient (where the worry of awareness without

agency tends to dominate). The Health Belief Model thus needs, for this population, an additional emphasis on the cue to action and self-efficacy components, because perceived susceptibility and severity are already largely present but rarely sufficient on their own.

Reflection on Methodology and Limitations

The design of this study was qualitative and exploratory, and the limitations should be read in that light. The original Internship Project Proposal aimed for eight to ten semi-structured interviews and an indicative questionnaire of around thirty respondents. The realised sample, eight interviews and twenty-seven questionnaire responses, met this target at its lower end. The questionnaire sample is small enough that the cross-tabulations reported above are best interpreted as descriptive patterns rather than as statistical tests. Differences of two or three respondents between categories can move the percentages noticeably, and the cross-tabulation in Figure 3, in particular, depends on a six-respondent “never heard of AQI” cell that should not be over interpreted.

The sampling approach itself introduces a more substantive limitation. Both the interviews and the questionnaire used a convenience and snowballing strategy, and the questionnaire was distributed mainly through networks associated with the Clean Air Action Group. This means the respondents are systematically more likely to have been exposed to environmental discourse than a general sample of late adolescents in Budapest. The fact that even within this comparatively engaged sample only 26% check air quality information regularly, and only 11% report a high likelihood of planning their day around poor air quality, makes the translation gap reported in Figure 2 a conservative finding rather than an alarming outlier. A genuinely representative sample of late adolescents in Budapest would almost certainly show a wider gap.

The interviews themselves face the limitations characteristic of semi-structured qualitative research, and two of them deserve specific reflection. The first is the Hawthorne effect: interviewees who are aware that they are being interviewed about air quality may engage more with the topic during the interview than they typically do in daily life and may present a slightly more thoughtful or organised account of their behaviour than the underlying behaviour itself would justify. Although the Hawthorne effect as classically described has been re-examined and partly reinterpreted in the methodological literature (McCambridge, Witton, & Elbourne, 2014), the basic risk of reactivity to being studied remains. The end of interview snapshot reported in Sub-question 1 was designed in part to mitigate this Hawthorne reactivity by anchoring the conversation to a present-moment factual check.

The second is social desirability bias, particularly given the interviewees knew that the interviewer was working at an environmental NGO. Several interviewees explicitly raised this when discussing why their own behaviour was less protective than their stated concern would suggest; Interviewee's 2 use of "laziness and habits" and Interviewee's 3 acknowledgement that she goes outside anyway are examples of interviewees who actively pushed back against the desirability gradient. Across questionnaire responses the same effect is harder to detect, but the high concern means alongside low planning means is itself consistent with respondents offering the socially preferred answer on attitude items and the more honest answer on behaviour items (Krumpal, 2013). The combination of triangulating the interview and questionnaire data and asking interviewees directly to comment on the gap between their views and their behaviour, was the main mitigation, the bias cannot be eliminated by design.

Two analytical limitations should also be acknowledged. First, the Framework Method required the researcher to construct a coding matrix that, by its nature, structures attention towards the categories of the conceptual framework. The inductive code group described in the workbook (the IND codes) was added specifically to give space for unanticipated themes such

as the algorithmic feedback loop Interviewee 7 described and the “air quality as laziness excuse” theme Interviewee 8 raised, but the deductive starting point of the analysis nonetheless prioritises concepts already present in the Health Belief Model. Findings that do not fit any code well are vulnerable to being under recognised. To that end, the professional product articles serve as means to recognise these findings. Second, the snapshot of AQI at the interview location was retrieved at a single moment, and the interviewees’ mood ratings at the same moment were intentionally short and qualitative. The snapshot is therefore an informative cross-sectional check, not a measure of cumulative exposure or of the kind of pollution mood association that would require longitudinal data of the type used in the literature reviewed by Roberts et al. (2019) or Zundel et al. (2022).

Additionally, due to the nature of the convenience/snowball sampling while at the air pollution oriented internship organization, it should be noted that some of the participants and interviewees of this study could have been directly involved or related to the topic of air pollution, making them more aware of the implications of air pollution than the regular resident of Budapest, therefore potentially misrepresenting the study population.

Finally, the researcher’s position should be made explicit. The study was conducted during an internship at the Clean Air Action Group, with the explicit secondary purpose of producing material useful to the organisation’s communication and project work. This relationship was disclosed to interviewees, and reflexive awareness of it was maintained through the analytical process, but it inevitably shapes which findings are foregrounded and which questions are asked in the first place. Sub-question 1, on perception and awareness, is naturally aligned with the kind of information the organisation can act on, sub-question 3, on mental wellbeing, is naturally aligned with the kind of story the organisation finds communicable. Readers should weight the findings with this in mind.

7. Conclusions

The objective of this research was to develop an understanding of how the perception of air pollution and awareness of standardised air quality measurements shape the behaviour of late adolescents in differently polluted areas of Budapest, and how those behavioural patterns in turn affect their mental wellbeing. This objective has been met in the descriptive and exploratory sense intended by the design. The triangulated questionnaire and interview data have produced a picture of all four components of the conceptual framework, traced the links between them, and located the main points at which the simple causal chain anticipated by the Health Belief Model breaks down in this population. What the study does not, and was never designed to, provide is a population level estimate or a causal effect size, the contribution is a structured account of mechanisms and a set of testable patterns for further research and for the awareness and project work of CAAG.

The answer to the central research question can be stated directly. Late adolescents in Budapest adjust their behaviour in response to perceived air pollution unevenly and selectively, and the mental wellbeing consequences of that adjustment depend on the form it takes. Most respondents perceive air pollution through sensory and contextual cues rather than through numerical indicators, and although nominal familiarity with the Air Quality Index is common (48 per cent of questionnaire respondents reported knowing what it measures), it rarely translates into the daily planning behaviour the index is designed to support (questionnaire mean for planning around poor air quality was 2.11 on a 1 to 5 scale). When behaviour does change, it takes the form of substitution, threshold modulation, or windowed mitigation rather than outright avoidance, and it is reliably triggered only when a personal vulnerability, a consequential activity, or a tool with explicit recommendations is present. The mental wellbeing consequences are then conditional: when behaviour change is informed and active, awareness produces a

workable sense of control, whereas when awareness is present, but no action follows, it can become an additional source of low grade stress without the offsetting agency.

Against the conceptual framework, the central finding is that the Health Belief Model holds in broad outline but in a specific configuration for this population. Perceived susceptibility and perceived severity are largely present, and outdoor and social activity is universally recognised as central to mental wellbeing, so the framework's preconditions for behaviour change are already met. The variable that actually distinguishes adapters from non-adapters is the cue to action and self-efficacy combination: whether the interviewee has a concrete trigger (an app recommendation, a designed-environment signal, an imported habit from another country, or a medical history) and a sense that acting on that trigger is feasible without disproportionate cost to the activities that anchor their daily mood.

Regarding the proposition, its second clause, that protective behaviour leaves attentive young people feeling worse because the activities they give up (exercise, being outside, meeting friends) are themselves protective of mental health, is well supported by the data. Its first clause, that close attention to air quality measurements produces outright limitation or avoidance, needs slight adjustment, since adapters in this sample substituted, mitigated, or threshold modulated rather than fully withdrew, but the trade-off the proposition names is real and observable whenever any change occurs.

Recommendations

Several findings emerged from the analysis that this report did not highlight because they sat at the edge of the sub-questions, and these are the most natural starting points for further research and for follow up articles drawn from the same dataset.

The first is the place comparison pattern (IND-1 in the codebook), which appeared in five of the eight interviews: interviewees repeatedly used a previous place of residence, whether

Alaska, Paris, Lyon, Bayonne, or a home country, as the baseline against which Budapest air was evaluated. Future research could examine whether cross-national exposure history is a meaningful predictor of AQI literacy and protective behaviour, a question this study could only describe.

The second is the inverted cross-tab finding from the questionnaire that respondents who had never heard of the AQI adapted their behaviour at a higher rate (67 per cent) than respondents who said they knew what it measured (46 per cent); the sample is too small to support inference, but the pattern is striking enough to warrant a larger N replication.

The third is the class and equity framing (IND-7) in roughly half of the interviews, which deserves a dedicated qualitative study with a sample purposively selected for socio-economic variation rather than the convenience sample used here.

The fourth is the algorithmic information spiral described by Interviewee 7, in which social-media feeds amplified air pollution content once she engaged with it, an emerging phenomenon that would benefit from a dedicated study on media exposure and environmental anxiety.

Beyond those substantive angles, three design improvements would strengthen the next study in this line. A larger and more demographically diverse questionnaire sample, ideally above the thirty respondent threshold the original proposal set, would permit at least cautious inferential use of the cross-tabulations rather than the descriptive only reading adopted here. A short diary or experience sampling component, asking interviewees to record mood and outdoor activity over a one or two week window alongside ambient AQI readings, would address the limitation that the snapshot AQI used in this study is a single moment in time and cannot speak to cumulative exposure or to the delayed wellbeing effects Interviewee 3 described (IND-6). A structured re-test of the proposition with a balanced design, sampling deliberately across high

attention and low attention participants and across users and non-users of AQ applications, would test the two clauses of the proposition independently rather than relying on interviewees' self-classification.

8. Contributions to Professional Product

The professional product accompanying this research report is a blog post presenting the key findings from the whole research project, intended for publication on the host organisation's website (levego.hu) and the cleancitiescampaign.org website. The blog post is a concise, illustrative, easy to read summary of the key findings of the CRR and the two articles that explain findings outside the original scope of the CRR. It will contain the downloadable versions of the CRR and the articles. The articles were written to translate findings that the main report could not develop in depth into a format that is more accessible to a general reader, and to allow each article to stand on its own around a single phenomenon supplemented by additional desk research. The original internship project proposal anticipated two to three articles drawn from unique phenomena that surfaced in individual interviews or in the questionnaire; following the analysis, two such phenomena were selected because each has a strong argument on its own, each connects directly to the host organisation's awareness raising work, and each is supported by published literature that can extend the emerging data.

The format chosen is the short research-based blog post article with embedded data graphics, a short quote where useful, and links to the underlying report and to the external sources used in the desk research. This format was selected for two reasons. First, the host organisation publishes its public communication primarily through its website and through pieces hosted on partner outlets (like cleancitiescampaign.org), so the blog post with available articles and the report matches the channels through which the audience is reached. Second, a short blog post is the format most likely to be read in full by the kind of audience the host

organisation wants to reach with this research, namely civically interested non-specialists and journalists who may cover air quality topics in their own outlets.

9. Relevance of Research Results for the Work Field

The findings of this research relate to several adjacent fields that share the same target population and the same intervention logic: air quality advocacy organisations such as the host organisation, public health communication bodies that issue air quality warnings or behavioural advice, youth focused environmental and climate organisations, and urban health and active mobility actors who already work on the exposure side of the air quality question. Within those fields the specific work that this study informs is the design of awareness raising interventions for late adolescents and emerging adults. The contribution to the field is therefore neither an effect size nor a policy recommendation, but a structured account of where the standard awareness to behaviour model breaks down for this group, with an evidentiary basis that other organisations can use to interrogate their own assumptions before designing interventions.

Three findings from this research are sufficiently general to be useful outside Budapest and outside the host organisation. The first is the translation gap pattern: concern about air pollution is moderate and widespread in this age group, nominal familiarity with the Air Quality Index is also widespread, and yet neither variable predicts whether a young adult will actually plan their day around air quality. Any organisation whose theory of change assumes that increased AQI literacy will produce protective behaviour in late adolescents should treat this finding as a warning that the linkage is not automatic. The second is the cue to action finding: when behaviour does change in this group, it is reliably triggered not by literacy but by a concrete personal lever, specifically a medical history, a consequential outdoor activity, a designed environment cue such as a public air quality sign, or a digital tool that issues graded action advice rather than a raw number. The third is the wellbeing trade off finding: outdoor and

social activity is universally treated by this age group as core to mental wellbeing, so any intervention that asks them to limit such activity on polluted days is asking them to give up a primary mood regulator. Each of these three findings is generalisable in the sense that the underlying mechanism (literacy without translation, behaviour triggered by personal levers, the wellbeing cost of withdrawal) is not specific to Budapest and is consistent with what published research on air pollution risk perception in young populations has found in other settings (Lynch & Mirabelli, 2021a, Lyu et al., 2024).

Comparable organisations can put the newly generated knowledge to use in several practical ways. Public health and environmental communicators can use the translation gap and cue to action findings to redirect messaging effort away from explaining what the Air Quality Index is and toward pairing each measurement with a graded, concrete behavioural recommendation in the same channel where the measurement is received. Youth focused environmental organisations can use the wellbeing trade off finding to review their campaign language, replacing avoidance framings with substitution framings (greener routes, alternative outdoor settings, modal shift commuting) that align with what young adults in this sample actually did when they cared about the issue. Urban health and active mobility actors can use the designed environment evidence, particularly the smiley face air quality sign described by Interviewee 4, to support investment in passive, in environment, non-numerical signage in places where late adolescents already spend their time. Academic and student led research projects can build on the article topics flagged earlier, particularly the imported awareness pattern and the algorithmic information spiral, both of which have national and regional analogues that have not yet been studied systematically. The coding scheme, topic list interview protocol, questionnaire instrument, and cross case analytic matrix developed for this study are all replicable on small budgets and short timelines, which makes them practically transferable rather than only conceptually so.

Relevance for the Clean Air Action Group

For CAAG specifically, the findings translate into four working implications that the organisation can act on immediately, within its existing awareness raising and project mandate. First, awareness messaging aimed at this age group cannot stop at concern or at nominal AQI literacy: the data show that both are already present in the audience the organisation wants to reach, and neither translates into daily behaviour on its own. The crucial is the cue to action, so the organisation's campaigns should pair every air quality measurement with a concrete and graded behavioural recommendation in the same message, in the manner of the air quality application that Interviewee 8 relied on, rather than presenting the index as a free-standing number. Second, the most effective non-digital cue documented in this study was the smiley-face air quality sign that Interviewee 4 encountered, a passive signal that prompted action without requiring active checking. Investment in similar public realm signage near schools, parks, and transit nodes is a candidate intervention that the host organisation is well placed to advocate for and develop projects for, given its existing relationships with municipal and civic stakeholders. Third, the wellbeing trade off documented in the discussion needs to be acknowledged in the organisation's messaging rather than glossed over: telling young people to stay inside on polluted days without addressing the loss of the very activities that anchor their mental health risks producing either non-compliance or compliance with hidden cost. Messaging that frames substitution rather than avoidance is more likely to align with what young adults will actually do. Fourth, because awareness without agency can itself become a source of stress in this group, every awareness intervention should be paired with an actionable component, however small: an address to write to, a route to switch to, a window to close, or a graded recommendation to follow. Awareness alone is not a neutral good for this population, it becomes one only when it is coupled to something a young adult can do with it. Taken together, these four implications give CAAG an evidence based starting point for refining how it speaks to late

adolescents in Budapest, and further on a provable analytic position when it speaks on the same topic to its partners and to policy actors in the wider field.

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11. Appendices

Appendix A – Interview Protocol and Questionnaire Link for Validity and Reliability of the Research

Questionnaire Link for inspection

https://forms.gle/oHQVrSd1iV7bpnk57

Semi-structured interview protocol

Phase 1: Introduction

"Thank you for agreeing to participate. This interview is part of my research on how young people in Budapest relate to air pollution, their awareness of it, how it affects their daily life, and how they feel it connects to their wellbeing. There are no right or wrong answers. I'm interested in your honest experience. You can skip any question, stop at any time, and everything you share will be kept fully anonymous. Also, if you want to remove or withdraw answers at a later stage, you are free to do so, just indicate that to me."

Phase 2: Background and Pollution Context

1. Can you tell me a bit about the surroundings of where you live and where you spend most of your time day-to-day? For example, is your house located near a busy road, in a quiet neighbourhood, close to the city centre or far away? What about your work/school?
2. What do you perceive as bad air quality, in your own sense?
3. How would you describe the air quality in the places you spend the most time? Does it feel clean, noticeable through smell or visibility, or somewhere in between?
4. Have you ever experienced or noticed physical effects like irritated eyes, a scratchy throat, or difficulty breathing, that you associated with the air around you?

5. Do you feel like air pollution is a real problem for people living in Budapest, or does it feel more like a distant or abstract issue to you?

Potential Probe: Does the time of year, the street you're on, or the weather ever change how you feel about the air?

Phase 3: Awareness of Air Quality and Measurement Tools

5. When you think about air pollution, what sources or types of information come to mind? Where do you usually hear or read about it?
6. Have you ever heard of the Air Quality Index, or AQI for short? If so, what do you know about it?
7. Have you ever actively checked an app, website, or service to see what the air quality is like in your area? If yes, how often and in what context?
8. When you find out the air quality is poor, either through a tool like AQI or just by noticing it, what goes through your mind?
9. Do you feel like knowing the specific pollution level gives you useful information? If so, what do you use it for? If not, why not?

Potential Probe: Can you think of a specific moment when you became more or less aware of the air quality around you? What triggered that?

Phase 4: Behavioural Response to Air Quality

Health-Protective Behaviour

10. On days when you know or suspect the air quality is bad, do you do anything differently than usual? Can you give me some examples?

11. Have you ever avoided going outside, changed your route, worn a mask, or closed your windows because of air pollution concerns?
12. If you did make any of those changes, how confident did you feel that they were actually making a difference?

Potential probe: Did you feel like you had real control over your exposure, or did it feel like the pollution was unavoidable regardless of what you did?

Barriers to Behaviour Change

13. What, if anything, has stopped you from acting differently when you knew the air quality was poor? For example, practical reasons, social reasons, not knowing what to do?
14. Has anyone around you, like friends, family, flatmates influenced how much you think or talk about air quality and adjust your behaviour?

Routine and Everyday Behaviour

15. Thinking about your regular habits outdoor exercise, socialising, commuting, hobbies that involve being outside have you noticed any changes in how often or how freely you do them during periods of high pollution?
16. Would you say these changes were conscious decisions, or something you noticed only in hindsight?
17. When you do stay indoors or limit outdoor activities because of poor air quality, what do you tend to do instead?

Phase 5: Behaviour and Mental Wellbeing

18. How important are activities like outdoor exercise, going to parks, or social outings for how you feel emotionally day-to-day?

19. On days when you've reduced or avoided those activities, whether because of air quality or any other reason, how did you feel compared to days when you could do them freely?
20. Have you ever felt that air pollution, or your awareness of it, has affected your mood, energy levels, or general sense of wellbeing? Can you describe that?
21. Do you feel like worrying about air quality adds stress to your day, or does knowing more about it feel reassuring because you can act on it?
22. Looking back, do you think being more aware of air quality has been good for your mental wellbeing, bad for it, or a bit of both and why?

Phase 6: Proposition Testing

“I'd like to share a statement with you and get your honest reaction. You don't have to agree, I'm genuinely interested in whether this matches your experience, partly matches it, or doesn't reflect it at all.”

"Young people who pay close attention to air quality measurements are more likely to limit or avoid outdoor activities on polluted days. But rather than this making them feel better, it might actually leave them feeling worse, because the things they stop doing, like exercise, being outside, or meeting friends, are exactly the things that keep them mentally healthy."

23. Does this statement resonate with your own experience? In what ways does it, or doesn't it?
24. Do you think it matters whether the decision to stay in is a conscious, informed choice or just a vague feeling that the air is bad?
25. Can you think of a time in your life that reflects one side or the other of this tension either staying in and feeling it was the right call, or staying in and regretting it later?

Phase 7: Closing and Contextual Snapshot

26. Is there anything about the relationships of air pollution with your daily habits, or how you feel mentally that we haven't touched on, but that you think is relevant?

27. Is there anything you'd like to ask me about the research before we finish?

Snapshot Questions (as mentioned in the planning)

How are you feeling mentally right now, in this moment?

Are you aware of what the air quality is like in your area today?"

Closing Statement:

"Thank you so much for your time and openness. Your responses will be kept fully anonymous. Once my report is complete, I'll share a summary with you if you'd like. If anything comes up after today that you'd like to add or correct, you're welcome to reach out."

Appendix B – The Reflexive Memo from the Framework Method Matrix

Date	Topic	Note
4/17/2026 (P1+P2)	Initial framework	Built deductive codes from HBM constructs (HBM-1 to HBM-6) and the four conceptual-framework components in the IPP. Added a small inductive set (IND-1 to IND-5) after first read of P1 and P2 - they capture content that the HBM does not anticipate (place comparison, built environment vs. AP, noise/AP conflation, urbanism framing, awareness-without-action). These should be revisited after each new transcript.
4/20/2026 (P1+P2)	Confirmability flag	Both interviews lean toward a particular finding (low active AQI use, awareness-action gap). Need to ensure I'm not over-coding ambiguous responses as confirming the proposition. P2's clear *disagreement* with the proposition is reassuring as it shows the instrument is open enough to surface counterevidence.

4/21/2026 (P1+P2)	Proposition handling	P2 introduced an important nuance: aware young people may *substitute* greener locations rather than *limit* outdoor activity. Consider whether the CRR should refine the proposition into two sub-claims - (a) avoidance vs. (b) substitution, both compatible with the HBM but with different wellbeing implications.
4/21/2026 (P1+P2)	Snapshot interpretation caveat	Both snapshot AQIs are in the clean/low range, and both moods are "very good." With N=2 I cannot infer anything. Keep tracking, if the pattern holds across all 8, it remains descriptive rather than analytic.
4/21/2026 (P1+P2)	Coding consistency check	After interviews 3 and 4 I will re-read the P1 and P2 rows to ensure the codebook has been applied consistently - adjust earlier rows if the framework definitions evolve.
4/25/2026 (P3+P4)	New inductive code added	Added IND-6 (Delayed wellbeing effect) after P3's quote "I can feel bad maybe two, three days after." Retroactively coded P1 and P2 as "not present" to maintain consistency. P4's account ('rotting in bed days") helped confirm IND-6 captures a *temporal* dimension distinct from MW-2's binary worse/better.
4/25/2026 (P3+P4)	Refining the proposition	After 4 cases, no participant cleanly matches the proposition. The dominant alternative is **substitution/modulation** (P2 greener routes, P4 hiking instead of running) rather than restriction. P3 illustrates a third path: aware participants who **refuse to restrict on principle** (political/value identity). The CRR proposition section should formally split the original claim into competing sub-mechanisms and let the data adjudicate.
4/26/2026 (P3+P4)	Awareness → mood divergence	Stark contrast: P4 finds AQ awareness reassuring, P2 and P3 find it stressful. Hypothesis to probe in remaining interviews: awareness produces stress when paired with strong values/identity engagement (politics, urbanism) but reassurance when paired with a *concrete behavioural lever* (running). This is testable in the next four interviews.

4/26/2026 (P3+P4)	Snapshot heuristic finding	Three of four participants are unaware of today's actual AQ, two of those (P3, P4) substitute weather-based heuristics - P3 says it's bad because it's hot, P4 says it's good because it's sunny+windy. With AQI=17 in both cases, they reach opposite conclusions. Worth a brief CRR observation: weather acts as a (sometimes misleading) proxy for AQ in the absence of measurement awareness.
4/27/2026 (P3+P4)	Confirmability check	P3's flat refusal to limit and her partial disagreement with the proposition show the instrument is still surfacing counterevidence. P4's 'running-only" active checking is a refinement I might have missed if I had probed more leading. Both reassuring for confirmability.
4/27/2026 (P3+P4)	Probes to add for remaining interviews	(1) Probe more directly for *delayed* vs immediate wellbeing effects (IND-6). (2) Ask whether participants substitute or curtail when AQ is bad - explicitly distinguish the two. (3) Probe environmental cues like P4's smiley-sign - are there others? (4) For participants who report AP awareness as stressful, probe what the value/identity anchor is (politics, climate, health, peers).
4/27/2026 (P3+P4)	Codebook freeze plan	Per the original plan, freeze codebook after interview 6. Current state (42 codes, 6 inductive) is workable. Will lock IND-1 to IND-6 as the inductive set unless something genuinely new appears in P5/P6/P7/P8.
4/29/2026 (P5+P6)	New inductive code added (IND-7)	Added IND-7 (Class / equity framing) anchored in P5's explicit "bad air is connected to more poor districts… it's obviously a class question" (L167) and P6's housing-affordability + vulnerable-others framing (L29, L151). Retroactively present (weakly) in P1's "luxury to live more outside" and P2's "poor neighbourhoods". The codebook is now at 43 codes (7 inductive).
4/29/2026 (P5+P6)	Codebook freeze (per IPP plan)	Per the original plan, codebook freezes after interview 6. **Frozen state: 43 codes - PC-1..5, AW-1..5, HBM-1..6, BHP-1..4, BHR-1..4, MW-1..5, PR-1..4, SN-1..3, IND-1..7.** Final two interviews (P7, P8) will be coded against this stable framework with no new codes added. If a strong novel theme emerges, it will be flagged in the memo for discussion in the report rather than added as a new code.

4/29/2026 (P5+P6)	Substitution-not-curtailment pattern is now robust	After 6 cases, **zero participants fully avoid outdoor activity due to AP**. P5 is the clearest non-restrictor ("I cannot manage my life around this"). P3 already refused on political grounds, P2/P4/P6 modulate via route, activity-swap, and location-swap. P6 introduces a new nuance: behaviour change requires *sustained* polluted periods, not single days. The proposition's "limit/avoid" premise is contradicted across the field, the report should reframe around modulation/substitution as the dominant adaptation logic.
4/29/2026 (P5+P6)	Awareness ↔ mood: dichotomy collapsing	Earlier I noted a stress-vs-reassurance split (P2/P3 stress, P4 reassurance). P5 and P6 both report **both effects simultaneously** - awareness adds stress (worry, "exhausting") AND provides informational utility ("more good… I can go somewhere", daily routine adaptation in summer). Revised hypothesis: the net wellbeing effect depends not on whether awareness exists, but on whether the participant has **any actionable lever** (route, location swap, activity swap, seasonal escape). Where a lever exists, awareness is net-positive, where it doesn't (P3's political dead-end), awareness is net-stressful.
4/29/2026 (P5+P6)	AQI checking is activity- or season-bound	Two of six participants check AQ habitually (P4 pre-running, P6 daily summer May–Oct). Neither uses AQI year-round or for general awareness. **AQI use is bound to a specific behavioural lever** - a personally meaningful trigger. This is consistent with the smiley-sign insight (P4): the design intervention that works is one that ties AQ data to a concrete activity or place, not a generic dashboard. Practical implication for CAAG: AQI tools designed for behavioural change should embed in activity-specific contexts (running apps, school-route maps, summer-heat alerts), not abstract civic information channels.
4/30/2026 (P5+P6)	Worry displacement onto vulnerable others	P5 and P6 both shift AP worry from self onto others - P5 to construction workers and children, P6 to grandparents and neighbours. This is a strong pro-social reframing of HBM-1 (perceived susceptibility): personal threat is downplayed, but the moral importance of AP is preserved by transposing the threat onto identifiable vulnerable groups. Possible implication for the report: framing AQ communication around vulnerable, other empathy may unlock more behavioural engagement than personal-risk framing for this age band.
4/30/2026 (P5+P6)	Confirmability check	P5's flat refusal ("I cannot manage my life around this") and P6's explicit "I do my own part - I cannot act on it" both push back against the proposition's avoidance premise. The instrument is continuing to surface counter-evidence rather than confirming a thesis I might prefer, this strengthens confirmability. P6's positive identification with daily-checker behaviour is the closest the field has come to confirming the proposition - but even they do not fully limit, only modulate.
4/30/2026 (P5+P6)	Probes for P7 and P8	(1) Probe daily/seasonal AQI checking (does the P6 pattern recur?). (2) Probe explicit class/equity framing (IND-7) - has it been suppressed in earlier interviews because I didn't prompt? (3) Probe whether worry is for self vs. vulnerable others (HBM-1 vs IND-7 component). (4) Probe whether substitution thresholds (single day vs sustained period - P6) are common. (5) Continue probing delayed wellbeing effects (IND-6) and the "actionable lever" hypothesis.

5/4/2026 (P7+P8)	Data collection complete (N=8)	Final two interviews coded against the frozen 43-code framework. **Codebook freeze held** - no new codes added. Two single-case observations were strong enough to flag but not strong enough to break the freeze: **(a) information spiral / algorithmic feedback** (P7) and **(b) AQ-as-laziness-excuse** (P8). Both are noted in the matrix under IND-5 and discussed in the report rather than codified separately.
5/4/2026 (P7+P8)	Saturation reflection	After 8 interviews, the major themes (substitution > curtailment, awareness with vs. without an actionable lever, AQI bound to a personal trigger, outdoor wellbeing universally protective) appear well-saturated - every new participant confirms or refines, none disconfirms structurally. The minority pattern of clear curtailment (P8 with regret) and the high-medical-anchor case (P8 asthma) appeared only once each, suggesting more interviews would likely surface further individual variants but not destabilise the overall framework. With N=8 within the IPP scope, the framework is judged sufficient for the CRR.
5/5/2026 (P7+P8)	Strongest proposition confirmation now exists	P8 gives the strongest single confirmation of the proposition in the dataset: full agreement, daily AQI checking, asthma-anchored susceptibility, AND lived regret examples ('I would still regret it'). This is a methodologically important case because it demonstrates the proposition is not empirically null - it does describe at least one real participant's experience faithfully. **The report's framing should preserve the proposition rather than abandon it**, but qualify it: the proposition holds for participants with high AQI literacy + activity-AQ coupling + medical anchoring, while a substitution model better describes the rest.
5/5/2026 (P7+P8)	Foreigner sub-cohort patterns	P7 and P8 are both foreigners in Budapest comparing it to a more polluted home reference. They diverge on whether their foreignness makes them more or less aware than locals: P7 sees herself as 'the one that thinks more' than her foreign peers, P8 says foreigners 'are not so aware of it' relative to Hungarians. The shared structural feature is that **comparative geographic experience (IND-1) is their primary AQ-literacy source**, not local civic engagement. For CAAG: foreigner-targeted AP communication may need a comparative frame ('Budapest vs your home') rather than absolute scales.
5/6/2026 (P7+P8)	Refinement of IND-5 (awareness without action)	P8's 'AQ-as-excuse' observation refines IND-5 in an unexpected direction. Originally IND-5 covered the cognitive-dissonance gap (knowing AP is bad and not acting). P8 shows the inverse: knowing AP is bad as a *justification* to skip something the participant already wanted to skip. Awareness functions as both a guilt-reducer (P8's running excuse) and a reinforcement loop (P7's algorithmic information spiral). In the report, IND-5 should be discussed as a bidirectional cognitive resource - sometimes deployed for action, sometimes for inaction.

5/6/2026 (P7+P8)	Strongest single behavioural-intervention insight	P4's smiley-sign in the park and P8's app-issued graded recommendations are the two cases where the AQI tool *actually* drives a behavioural decision. They are also the two cases with the most positive net-effect of awareness. Combined, they suggest a clear design principle for CAAG: **AQ communication that translates a number into a graded recommendation tied to a concrete activity or place is the only AQ intervention that produces behaviour change without producing net-stress**. Worth foregrounding in the report's recommendations section.
5/6/2026 (P7+P8)	Confirmability - final check	Across 8 interviews the instrument continued to surface counter-evidence (P3 refusal, P5 'cannot manage life around this', P2 partial disagree, P4 self-exemption, P7 'social barrier'). The dataset does not over-confirm the proposition. Several findings (substitution > curtailment, social plans override AQ awareness, awareness requires an actionable lever to be net-positive) emerged.
5/6/2026 (P7+P8)	Next step: writing the CRR	Data collection and framework analysis are now complete. The final state: **8 participants × 43 codes, 95 quotes, 13 cross-case dimensions, 25+ memo entries.** Per the original IPP plan, next phase is the analysis of the questionnaire results in the next sheets of this file. Afterwards, through comparisons of the two research intrument results the following will happen: refine themes, produce a synthesised narrative, link findings back to the HBM framework and the Gale et al. (2013) framework method. I will potentially organise the report around (1) substitution-not-curtailment as the dominant adaptation logic, (2) the actionable-lever hypothesis explaining when awareness helps vs harms, (3) AQI-as-tool requires activity- or place-coupling to produce behaviour, (4) the foreigner / class / vulnerable-other lens as ethical and design implications for CAAG.

Appendix C – Generative AI Declaration of (Un)use

- I confirm that all AI use has been **transparent**, **documented**, and has not replaced my intellectual work.
- I have filled in the table below - **Overview of When and How I Used AI Tools in My Learning Process for this Learning Unit:** GPCM - Bachelor Internship and Capstone (25/26)
- **I have maintained a separate record of AI Use.** I understand that part of responsible use of AI is keeping a simple record of the prompts and outputs I used during my learning process. I may be asked to share this record if there are questions about my assignment. This record assists my learning - and protects me - by showing how my ideas and writing developed step by step.

  AI used - Perplexity AI

Before writing searching reading	**YES**	Used for an extensive web search to find topic-relevant articles to read and compare the findings too.
Generating ideas	**NO**	
Planning / Outlining:	**YES**	Creating a template (table and sheet structures and formulas) in excel for Framework method workbook for the student to put the research data in and organise it himself

Developing structure	**NO**	
Editing / Grammar / Clarity:	**YES**	Used to make my own writing sound more academical and for sentences to be clearer and more coherent with each other.
In-text citations / Referencing:	**YES**	Used to check whether the formatting is correct across the document (with the final check being done by the student) and to organise the list alphabetically.
Other contexts?	**NO**	

This statement confirms how AI tools were used responsibly in completing assignments for assessment in this learning unit

Signed (student): ……Filip Kopta……. **Date**: ……June 2, 2026……