**Journal of Applied Research and Multidisciplinary Studies (JARMS)**
**Volume 4 Issue 2, Fall 2023**
ISSN$_{(P)}$: 2707-5087, ISSN$_{(E)}$: 2707-5095
Homepage: https://journals.umt.edu.pk/index.php/jarms

**Article QR**


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**Author (s):** Zaryab Fatima[1], Muhammad Abubakar[2], Nida Riaz[1], Alishba Khursheed[1], Aqsa Imtiaz[1]

**Affiliation (s):** [1]University of Sargodha, Pakistan
[2]University of the Punjab, Lahore, Pakistan

**DOI:** https://doi.org/10.32350/jarms.42.04

**History:** Received: March 17, 2023, Revised: May 27, 2023, Accepted: June 16, 2023, Published: June 30, 2023

**Citation:** Fatima, Z., Abubakar, M., Riaz, N., Khursheed, A., & Imtiaz, A. (2023). The smog symphony: Navigating the psycho-social impact of smog among university students. *Journal of Applied Research and Multidisciplinary Studies*, *4*(2), 69–85. https://doi.org/10.32350/jarms.42.04



**Conflict of Interest:** Author(s) declared no conflict of interest

A publication of
School of Professional Advancements
University of Management and Technology, Lahore, Pakistan

# The Smog Symphony: Navigating the Psycho-Social Impact of Smog among University Students

Zaryab Fatima [1] , Muhammad Abubakar[2]* , Nida Riaz[1], Alishba Khursheed[1], Aqsa Imtiaz[1]

1. Department of Sociology and Criminology University of Sargodha

2. College of Earth and Environmental Sciences, University of Punjab, Lahore, Pakistan

## Abstract

The current study addressed the serious issue of air pollution with a specific focus on the pervasive problem of smog and its far-reaching implications for human health. Smog, a consequence of the interaction between toxic emissions and sunlight, has been identified by the World Health Organization (WHO) as a major contributor to enduring health issues including asthma and chronic respiratory conditions. The current qualitative study conducted interviews with 16 participants residing in heavily polluted areas, such as Lahore and Faisalabad with a specific focus on university students. This is because both cities have been recognized as the most polluted regions in Pakistan according to the latest Air Quality Index. The findings unequivocally established a direct correlation between pollution and university students' behaviors. Beyond behavioral impacts, the research also illuminated the pivotal role of air quality in shaping various aspects of students' lives, spanning mental health, social interactions, moods, attitudes, outdoor activities, and academic performances.

***Keywords:*** *Academic Performance, Behavioral Effects, Psychological Effects, Smog, University Youth*

## Introduction

In recent decades, the global rise in urbanization and industrialization has led to a concerning escalation in air pollution levels, marked by the prevalence of smog in many densely populated regions (World Health Organization [WHO], 2020). The adverse health effects of air pollution, primarily linked to respiratory and cardiovascular diseases, have been extensively studied and documented. Significant air quality challenges are increasingly being encountered by numerous developing nations. The correlation between air pollution and health problems is deeply intertwined. Air pollution represents one of the most critical ecological predicaments

afflicting contemporary society. The term "smog" originally denotes a dense amalgamation of smoke and fog. Modern-day smog results from the interaction between industrial emissions from factories, power plants, vehicles, and other sources including atmospheric heat and sunlight.

In accordance with the World Health Organization (WHO), air pollution may give rise to acute ailments, such as asthma and chronic respiratory conditions, carrying grave and lasting consequences for human health. WHO's findings indicate that in 2012, approximately 3.7 million premature deaths occurred globally due to air pollution. In addition to physical health, smog pollution impacts individuals' behaviors and psychological well-being as well (Chen et al., 2016). It is a common knowledge that air pollution leads to heightened incidences of cardiovascular and respiratory ailments, escalated mortality rates, and deteriorated physical health. Notably, mental health is also influenced by air pollution.

Existing research on the reactions of individuals to air pollution predominantly revolves around their perception of air quality in their local or national surroundings as well as the relationship between measured atmospheric pollutants, visibility-related physical attributes, and behaviors. Psychological stress perspective is one such lens which may help to understand and simulate the impact of air pollution on human behavior (Lazarus RS, Cohen J, 1978). This viewpoint posits that chronic stress conditions or cumulative stress emerge from prolonged exposure to acute levels of ambient air pollution. Heightened levels of anxiety, tension, anger, and stress are often associated with this condition. As a consequence, residing or working in a polluted environment may gradually erode one's adaptive capacity and potentially lead to psychological distress.

Furthermore, individuals living in areas with high air pollution levels might struggle to cope with subsequent environmental demands, resulting in fatigue, helplessness, anxiety, and reduced responsiveness to such demands (Evans GW, Tafalla R, Koelega HS, 1987). Several factors including psychological traits, age, stressful life events, chronic illnesses, and limited socioeconomic resources have been suggested to heighten an individual's vulnerability to air pollution (Evans GW, Jacobs SV, Frager NB, 1982). As urban areas grapple with worsening air quality, university campuses have become microcosms where the consequences of environmental smog are acutely experienced. Universities, often situated in metropolitan centers, serve as crucibles of diverse social interactions,

intellectual pursuits, and personal development. Exploring the nuanced impact of environmental stressors, such as smog, on the mental health of students within this dynamic setting is warranted. Previous studies have illuminated the potential links between air pollution and mental health issues including anxiety, depression, and cognitive decline.

Reports indicate a strong connection between heightened ozone exposure and increased anxiety levels. The susceptibility of young individuals to pollution's impacts surpasses adults. Moreover, the exposure to environmental toxins during crucial developmental phases may lead to persistent physical and mental health complications. Notably, a substantial portion of these adults experience severe sleep disturbances and mental health issues due to environmental pollution. Extensive research underscores the significant impact of environmental pollution on the well-being, growth, and mental health. University students, who frequently engage in outdoor activities, might be particularly susceptible to the repercussions of smog exposure (Wang et al., 2019). Consequently, it is crucial to explore how this environmental factor can influence students' academic and social engagements as well as delve into psychological and behavioral consequences of smog on university students.

## Theoretical and Conceptual Framework

Bronfenbrenner's Ecological Systems Theory serves as a foundational framework to understand the complexity of factors contributing to the psycho-social impact of environmental smog on university students. This theory is rooted in the idea that individuals are deeply embedded within a series of interconnected environmental systems. This theory posits that the development and well-being of an individual is influenced by various layers of their surroundings. These layers are known as microsystems, mesosystem, exosystem, and macrosystem which collectively contribute to shape an individual's experiences and, consequently, their psychological and social functioning (Bronfenbrenner, 1979). At microsystem level, the immediate environments of students including their university campuses and dormitories represent crucial spheres where direct interactions with smog occur. The current study considered how air quality within these microsystems is influenced by environmental policies and campus infrastructure which, in turn, affects the daily experiences and well-being of students.

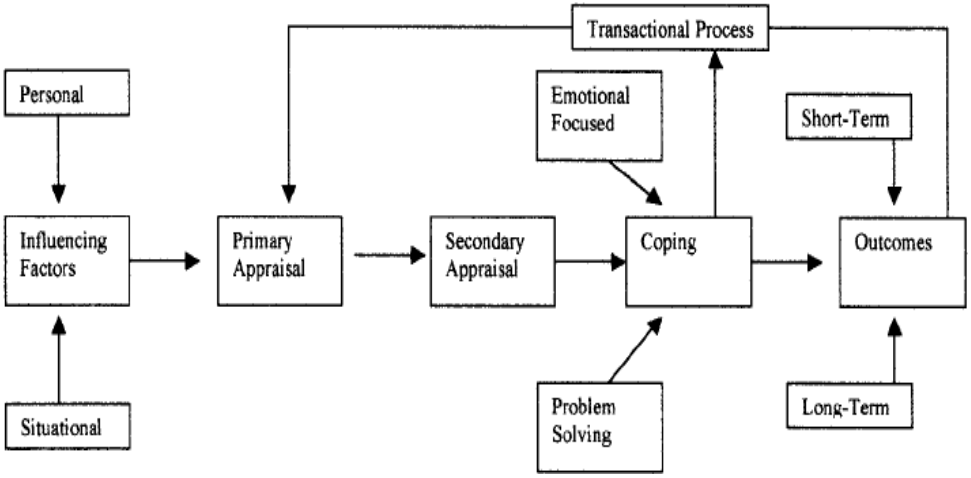
Whereas, the interactions between various microsystems become pivotal in the mesosystem. The current study explored the intricate connections between university environment, students' families, and their communities. For instance, family support, or lack thereof, in dealing with the psycho-social challenges induced by smog can significantly impact students' coping mechanisms. The study also considered the role of community engagement and awareness campaigns to foster a collective response to environmental challenges. The exosystem layer extends the analysis to external factors, indirectly influencing the students. This includes university policies, governmental regulations, and broader societal attitudes towards environmental issues. Moreover, the study also examined how institutional policies, such as those related to sustainable practices or urban planning, can shape the exposure and response of students towards environmental smog. Additionally, governmental initiatives addressing air quality and public awareness campaigns form part of the exosystem impacts that contribute to the broader context within which university students navigate the smog symphony. Finally, the macrosystem encompasses the broader cultural, economic, and political contexts that shape attitudes and norms related to environmental issues. The study considered how cultural beliefs regarding environmental responsibility, economic considerations impacting pollution levels, and political actions addressing air quality collectively form a macro systemic backdrop influencing the experiences of university students.

In order to complementing the Bronfenbrenner's Ecological Systems Theory, the study integrated the transactional model of stress and coping developed by Richard Lazarus and Susan Folkman. This model provides valuable insights into how individuals perceive and respond to stressors, emphasizing the dynamic nature of stress-coping process (Lazarus RS, Cohen J, 1978). Moreover, this model is employed to unravel the cognitive and emotional dimensions of university students' responses towards environmental smog. The transactional model posits that individuals engage in a continuous process of appraisal where they evaluate the significance of a stressor and assess their resources and coping strategies. In the context of environmental smog, the study considered how students appraise their exposure to pollutants, whether it be as a chronic stressor or an acute environmental event. The appraisal process also involves evaluating the perceived controllability of the situation, influencing the degree of stress experienced by students.

The coping strategies employed by students represent a central focus within the transactional model. The study explored a variety of coping mechanisms adopted by students in response to psycho-social challenges induced by smog. For instance, problem-focused coping where individuals seek to address the root causes of stress and emotion-focused coping which centers on managing the emotional distress associated with environmental concerns. Furthermore, the study also delved into the role of social support as a coping mechanism, examining how relationships with peers, family, and broader community contribute to students' ability to navigate the psycho-social impact of environmental smog. By incorporating the transactional model, the study acknowledged the individual variability in response to environmental stressors, recognizing that students may exhibit a range of coping strategies based on their personal appraisals and available resources. Additionally, the dynamic nature of stress and coping was also considered, acknowledging that the effectiveness of coping strategies may evolve over time as students adapt to their environmental circumstances.

**Figure 1**

*Transactional Model*




## Research Objectives

1. To assess the levels of smog exposure among a representative sample of university students

2. To investigate the potential mediators or mechanisms through which smog exposure may impact academic performance (for instance, cognitive functioning, and absenteeism).
3. To identify behavioral changes in university students due to severity of smog exposure.

## Research Questions

The study addressed the following research questions:

1. What is the impact of smog exposure on the psychological well-being of university students?
2. How does smog exposure affect the academic performance of university students?
3. What are the behavioral changes observed in university students due to smog exposure?

## Methodology

To determine the effects of pollution on academic behaviors and mental health performance of university students', a qualitative approach was employed. A sample of 16 university students was selected from different public and private universities of Lahore and Faisalabad by using convenient sampling method. Online in-depth interviews were conducted to explore the experiences and perceptions of students regarding the impact of smog on their academic performance and mental health. Thematic analysis was used to identify common themes and patterns in participants' responses. It involved the coding of interview transcripts, identification of key themes and subthemes, and interpretation of findings in relation to research questions. The study adhered to ethical guidelines, for research involved human participants, included informed consent, and ensured participant confidentiality and privacy. Overall, the qualitative approach provided a comprehensive understanding of psychological and behavioral effects of smog on the academic performance of university students. It also helped to identify the potential interventions to mitigate these effects. The demographic profile of participants is given below:

**Table 1**

*Demographic Profile of Respondents*

| Sr# | Demographic Characteristics | Frequency |
|---|---|---|
| 1 | Age | |
| | 18-22 | 6 |
| | 23-27 | 3 |
| | 28-32 | 5 |
| | 33 & above | 2 |
| 2 | Gender | |
| | Male | 8 |
| | Female | 8 |
| 3 | Living Area | |
| | Rural | 5 |
| | Urban | 11 |
| 4 | University Type | |
| | Public | 8 |
| | Private | 8 |
| 5 | City | |
| | Lahore | 9 |
| | Faisalabad | 7 |
| 6 | Study Program | |
| | BS | 8 |
| | MS/M.Phil. | 5 |
| | PHD. | 3 |
| | Total | 16 |

## Results and Discussions

Air pollution, particularly smog, has been identified as a major environmental health risk around the world (Wang et al., 2019). The current study highlighted that smog is linked to a range of adverse health effects including respiratory and cardiovascular diseases, cognitive impairment, and behavioral problems. The findings were divided in three themes. These are:

**Figure 2**

*Thematic flowchart of results and analysis*


## Cognitive Impairments

Majority of respondents highlighted the potential cognitive impairments that occurred due to smog and these impairments negatively impacted their academic performance. As respondent 1 said

*R1 (Female, 20): "*Excessive smog in Lahore made me lazy and I was unable to memorize my lessons which ultimately lowered my grades."

Similarly, respondent 8 stated:

*R8 (Male, 27): "*I lost my focus on studies and was unable to complete the assignments on time."

Studies have consistently found that exposure to smog is associated with reduced cognitive function among university students including impairments in attention, memory, and problem-solving skills (Zhang et al., 2021). Moreover, Chen et al, (2016) found that exposure to smog was also associated with reduced working memory among university students.

In numerous studies that investigated causal or structural models, there was a focus on the mediating component and the same was applied to the current study as well (Ting Ren ,2010). The research aimed to depict the mediating effects in various ways to comprehend the process through which air pollution impacts mental health via cognitive capacity and non-cognitive ability. Comparisons were made between models with and without the mediators, separating the total effect (path c) from the direct effect (path c') to analyze the distinctions between direct and indirect effects (MacKinnon et al., 2002). Another approach involved route analysis which involved assessing the pathways from PM2.5 to depression, non-cognitive ability, and the path from depression to cognitive ability (path b1) (Ting Ren ,2010). The combined indirect effects were calculated by adding the products of

a1*b1 and a2*b2, with a1*b1* representing the indirect effect through cognitive ability and *a2*b2 representing the indirect effect through non-cognitive ability (Ting Ren 2010; MacKinnon et al., 2002). A third technique employed the Monte Carlo method, yielding the percentage of overall mediation and the ratio of total indirect to total direct effects (MacKinnon et al., 2002).

Both cognitive and non-cognitive abilities were assessed for their indirect impacts (Ting Ren 2010). By contrasting the models with and without mediators, the effect of PM2.5 on depression reduced from 0.038 (total effect, path c) to 0.028 (direct effect, path c') (Ting Ren 2010). As both cognitive and non-cognitive abilities, which were significantly and negatively linked to depression, were also significantly and negatively correlated with PM2.5, positive mediating effects were evident (Ting Ren 2010; MacKinnon et al., 2002). The indirect effect remained significantly different from zero, indicating partial mediation (Ting Ren 2010).

The relationship between PM2.5 and cognitive ability (path a1) as well as the link between cognitive ability and depression (path b1) were both negatively significant at 1% level of significance, suggesting an increase in depression and cognitive impairment when routes a1 and b1 were combined (Ting Ren 2010). This implied that the mediating effect of cognitive capacity was beneficial (MacKinnon et al., 2002). The utilization of Monte Carlo approach, as recommended by MacKinnon, Lockwood, and Williams, involved a computer simulation test of indirect influence using two independent random normal distributions for the coefficient of mediator predicted by causal variable and the coefficient of outcome predicted by mediator (MacKinnon et al., 2002). The Monte Carlo approach had advantages, such as not requiring strict normality assumptions like the delta method or Sobel test. Instead, it ensured that Central Limit Theorems were upheld by adjusting the sample size accordingly (MacKinnon et al., 2002). In summary, the current study employed qualitative methodology to investigate the mediating effects of cognitive and non-cognitive abilities in the relationship between air pollution (PM2.5) and mental health (depression) (Ting Ren 2010). The findings indicated both direct and indirect effects, showcasing the importance of considering cognitive capacity and non-cognitive ability as mediators in the context of air pollution's impact on mental health.

## Psycho-Social Effects

The current study determined multiple psycho-social effects of smog on respondents that ultimately disturb them academically. These factors include depression, anxiety, and excessive mood swings (Sreeramareddy et al., 2017).

*R4 (Male, 25): "*I am a day scholar and I have to travel on daily basis from my home to university. Due to excessive exposure to smog, I become short-tempered and sometimes cannot attend classes."

Smog exposure has been found to be associated with negative impacts on the overall mental health of university students including depression and mood disturbances (Kim et al., 2019; Sreeramareddy et al., 2017). Few respondents also experienced worry and fear about the potential health impacts of smog exposure. These mental health issues may further impact their academic performance.

*R15 (Male, 22): "*I am hostilized but I have to go out several times a day in smog. It causes severe alteration in my mood."

In the realm of scientific exploration, the study conducted by Kenneth X. Xu et al. significantly contributed to our understanding of the multifaceted relationship between air pollution and its psychological impacts on individuals, particularly focusing on students and their emotional responses to the environmental challenges posed by pollution (Xu et al., 2021). The current study delved into the intricacies of how air pollution affects people's perceptions, emotions, and the overall well-being.

The study employed a comprehensive approach with data gathered from students who were asked to evaluate the severity of negative effects and the intensity of emotions they experienced due to air pollution (Xu et al., 2021). The participants were presented with a scale ranging from 0 to 4 where 0 signified a minimal feeling and 4 indicated a severe one. Notably, the study sought to discern differences between students residing in neighborhoods with high pollution levels and those in less polluted areas.

The results of the study revealed intriguing patterns that unveiled the emotional toll of air pollution on students (Xu et al., 2021). In the neighborhoods characterized by high pollution levels, students reported significantly higher mean scores for anxiety and stress, averaging 2.10 and 2.14, respectively. In stark contrast, students from cleaner neighborhoods

exhibited markedly lower mean scores for anxiety (0.42) and stress (0.26) (Xu et al., 2021). Statistical analyses conducted, by using ANOVA, further solidified these findings and indicated a strong and significant impact of pollution on both anxiety ($F$=383.28, $p$ <0.0001) and stress ($F$=606.20, $p$<0.0001) (Xu et al., 2021).

In essence, the research conducted by Kenneth X. Xu et al. underscored the pivotal role of air pollution in shaping the emotional responses and perceptions among students (Xu et al., 2021). By skillfully utilizing a range of quantitative methods, the study provided crucial insights into the complex relationship between air pollution and mental well-being of students. As societies grapple with mounting environmental challenges, such investigations become essential tools to comprehend the holistic impact of pollution on human lives. This study beckons for continued exploration, urging the scholars to explore novel avenues to understand the intricate connections between environmental factors and psychological well-being. Ultimately, the findings underlined the imperative for targeted interventions aimed at mitigating the adverse psychological effects of air pollution, particularly on the vulnerable demographic of students.

**Behavioral Effects**

Smog, a type of air pollution, has been found to have negative behavioral effects on university students. Several studies have explored the relationship between exposure to air pollution including smog and alterations in behavioral patterns (Chen et al., 2016). It is essential to recognize that behavioral effects can manifest in various domains including emotional well-being and interpersonal relationships. Majority of respondents reported the behavioral effects of smog exposure which includes changes in physical activity, sleep patterns, and social behavior.

*R6 (Female, 28):* "I am allergic to air pollution due to which I have to limit my physical activities during smog and remain inside."

*R8 (Female, 32):* "I am a social worker and in smog days I have to stop my outdoor social activities."

The study revealed that exposure to smog correlated with decreased physical activity among university students. This may be due to respiratory symptoms, such as coughing and shortness of breath caused by smog exposure. In addition, smog exposure has been linked with changes in social

behavior, such as reduced willingness to engage in social activities, particularly outdoor activities (Yan et al., 2019).

*R16 (Male, 20): "*Due to smog, I get headache which, in turn, reduces my potential to attend classes and I feel lazy and lethargic."

Research has linked air pollution with increased levels of anxiety and depression. Hu et al. (2021) found a positive association between exposure to air pollution and the prevalence of mental health issues among university students. The emotional toll of smog may be particularly pronounced in academic settings where students already grapple with stressors related to exams, deadlines, and societal expectations. Societal attitudes and behaviors regarding environmental responsibility may also be influenced by the prevalence of smog, contributing to a broader cultural shift in how communities respond to environmental challenges.

## Discussion

The current study marked the inaugural exploration into the coping mechanisms, assessment processes, and psycho-social responses of adolescents to air pollution. The study also unearthed a significant connection between pollution and cognitive function, thereby impacting the overall well-being of individuals (Evans GW, 1998). The findings illuminated a direct and adverse effect of escalated air pollution on physical and psychological health of adolescents, a generation poised to shape and refine the future of our society. Their perceptions and reactions to air pollution are likely to persist over time and the observed familial behaviors may extend similar attitudes and behaviors to subsequent generations.

Notably, the study aligns with the conclusions drawn by Evans, where a reduction in outdoor activity as a response to smog was identified (Evans GW, 1998). This reinforces the idea that increasing air pollution curtails outdoor engagement and reinforces the shift towards indoor activities. In fact, children tend to spend less time outdoors, particularly in areas characterized by high traffic and air pollution (Lercher et al., 2002). Consequently, students often find themselves focusing more effectively on their indoor tasks, devoid of the distractions and allure of the external environment.

The current study unearthed a connection between rise in online activities and decline in social connections, attributed to higher air pollution levels. These findings suggest a plausible future where technological

immersion would impel youth to favor online interaction over face-to-face engagement (Mohai and Pastor, 2008). This paradigm shift could lead to a scenario where adolescents may spend more time indoors, inadvertently reducing social interactions and intensifying communication barriers due to an amplified reliance on technology.

Contrary to prevailing notions, the current study contended that heightened air pollution levels may correlate with an increased productivity, challenging the conventional wisdom that associates such conditions with decreased efficiency. This unconventional perspective posits that smog could potentially enhance students' learning output by eliminating cognitive distractions associated with optimal air quality. These distractions may stem from outdoor activities, causing difficulties in maintaining focus and concentration.

In terms of academic performance, the current study presented a nuanced perspective. On the other hand, research conducted by Mohai and Pastor (2008) suggested that escalating air toxicity and pollution levels may lead to a decline in academic achievement. The findings revealed that students acknowledged heightened productivity despite the evident adverse impacts of air pollution. This variance underscores the intricate interplay between environmental factors and academic outcomes, reflecting the diverse values upheld within our society.

In conclusion, the pioneering study conducted here unraveled the intricate tapestry of adolescents' responses to air pollution, offering valuable insights into coping strategies, emotional responses, and shifts in behavior. These findings are helpful to reflect on the nuanced connections between air quality, psychological well-being, and academic performance, influencing not only the current generation but potentially shaping the trajectory of future societies as well.

## Conclusion

The study conducted on the psychological and behavioral effects of smog on university students sheds light on the intricate relationship between air pollution and its impact on the mental and behavioral well-being of this critical demographic. Through a comprehensive analysis of various psychological factors and behavioral patterns, the research provided valuable insights into the multifaceted repercussions of smog exposure on university students. It underscored the significant role that air pollution,

specifically smog, plays in influencing the psychological state of university students. The detrimental effects on mental health including heightened anxiety, stress, and even rage reveal the extent to which smog can influence the emotional well-being. Additionally, the study delves into the role of cognitive capacity and non-cognitive abilities as mediators in the relationship between smog and mental health, revealing a more profound comprehension of the mechanisms by which air pollution impacts students' psychological well-being. The behavioral implications elucidated by the research offer a broader perspective on the consequences of smog exposure. The study revealed that students' outdoor activities are constrained in response to high smog levels, potentially leading to reduced engagement with the external environment. This behavioral shift aligns with prior research that highlights the impact of air pollution on limiting outdoor pursuits.

## Limitations

While the existing research on the psychological and behavioral effects of smog on academic performance among university students provides valuable insights, there are some limitations to be noted as well.

### *Limited Geographical Coverage*

The study was conducted in Lahore and Faisalabad regions which limited the generalizability of findings to other regions.

### *Methodological Issues*

The current study used a qualitative approach which limits the ability to establish a significant causal relationship between smog exposure and academic performance.

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