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SCHOOL PRINCIPALS' ATTITUDES TOWARD MANDATORY INDOOR RESTRICTION POLICIES DURING EPISODES OF EXTREME AIR POLLUTION: A CROSS-SECTIONAL SURVEY

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ABSTRACT

This study assessed the attitudes of school principals toward a proposed regulatory upgrade that would replace existing recommendations—urging students to remain indoors during episodes of extreme atmospheric pollution—with a binding mandatory prohibition. A cross-sectional survey was conducted among the principals of all 518 public schools in a Mediterranean region of southeastern Spain that is particularly prone to recurrent Saharan dust intrusion events. Using an anonymous questionnaire, respondents rated their level of agreement with a mandatory indoor confinement measure on a 10-point Likert scale. Results indicated a generally positive overall attitude, with a mean score of 0.64 (95% CI: 0.57–0.71) on a rescaled [0,1] interval. However, the distribution of responses was markedly polarized, revealing clear divergences of opinion despite an overall majority in favor. These findings suggest that significant support exists among school administrators for transforming the current voluntary recommendation into a legally binding obligation. Such a normative shift would enhance equity in the protection of children's health, reduce discretionary decision-making at the school level, and strengthen public policy responses to a recurring and preventable environmental health risk.

KEYWORDS: air pollution; schools; prevention; vulnerable population; environmental legislation; particulate matter; Saharan dust.

INTRODUCTION

According to the European Environment Agency, air pollution constitutes the greatest environmental risk to public health in Europe, with chronic exposure causally linked to or aggravating conditions including lung cancer, cardiovascular disease, asthma, and type 2 diabetes [1]. Beyond the well-documented consequences of long-term exposure, short-term peak pollution events are of particular concern for school-age populations. Epidemiological evidence indicates that brief exposures to high pollution concentrations are associated with increased hospital admissions due to acute lower

respiratory infections [2], elevated pediatric outpatient visits for atopic dermatitis [3], and adverse neurodevelopmental outcomes [4,5].

The Region of Murcia, located in southeastern Spain, is—together with the Canary Islands—among the most affected areas in Spain by Saharan dust intrusion episodes. These meteorological events dramatically elevate ambient concentrations of PM₁₀ and PM_{2.5} for periods ranging from several hours to several consecutive days, frequently exceeding the threshold levels established in current European and national legislation [6]. For instance, in 2022 and 2023, a total of 177 and 92 such episodes were recorded in southeastern Spain, respectively. In 2023 alone, the region accumulated 124 days on which the daily PM₁₀ limit value was exceeded across eight monitoring stations, including 30 days in the city of Murcia.

In response to these recurrent events, the Environmental Health Service of the Region of Murcia has established a communication protocol with schools that issues pollutant-specific recommendations during air quality alerts [7]. For PM₁₀ and PM_{2.5}, when alert levels 2 or 3 are declared, vulnerable populations—including children—are advised to avoid or reduce outdoor physical activities on days of elevated particulate concentrations, to seek medical attention if needed, and, in extreme cases, to remain indoors for the duration of the pollution episode. Crucially, because these directives take the form of recommendations rather than binding requirements, the ultimate decision regarding student outdoor activity rests entirely with the individual school principal.

The tension between precautionary recommendations and enforceable mandates is well-recognized in environmental health governance. While recommendations afford flexibility and local adaptation, they may engender inconsistent protection across institutions, particularly when school administrators lack specialized training in environmental health risk assessment. Converting a recommendation into a mandatory prohibition during verified pollution episodes could standardize protective measures, reduce inequities in children's exposure, and relieve individual school leaders of complex and potentially consequential decisions for which they may feel ill-equipped.

The objective of this study is to evaluate the attitudes of school principals—the senior administrative officers of educational institutions—toward the possibility of replacing the current recommendation with a binding prohibition against students leaving classrooms during episodes of elevated air pollution. If adopted, such a measure would establish a uniform, regionally mandated criterion applicable to all public schools, thus removing the current reliance on individual judgment.

2. METHODS

A cross-sectional survey study was conducted. The study protocol was approved by the Ethics Committee of the Universidad Politécnica de Cartagena (Expediente No. 979684Y). The eligible target population comprised the principals of all 518 public schools in the Region of Murcia.

Between October 14 and November 15, 2024, each school received an email addressed to its principal inviting voluntary participation in a study on environmental health in public schools, developed by the Universidad Politécnica de Cartagena and approved by its Ethics Committee. Participation involved completing a brief questionnaire accessible via a link to the Microsoft Forms platform. The email explicitly stated that full anonymity was guaranteed: no personal data and no IP addresses were collected, in compliance with the data protection policy of the Universidad Politécnica de Cartagena (UPCT). That policy was described in an informed consent form that participants were required to accept before responding.

The questionnaire began with a three-sentence contextual introduction summarizing the public health significance of air pollution according to the European Environment Agency, followed by a description of the regional environmental health protocol for schools issued by the Murcian Health Service. Participants were then asked to indicate, on a 10-point Likert-type scale (1 = strongly disagree; 10 = strongly agree), their level of agreement with the following proposition: that, during episodes of atmospheric pollution, schools should be legally obligated to prevent students from leaving their classrooms for the entire school morning session, including break time—transforming the existing recommendation into a binding requirement.

For data analysis, the mean response and its associated 95% confidence interval were calculated. Given that the assumption of normality was not met, the standard error of the mean was estimated using bootstrap resampling with 1,000 replications. Prior to analysis, the original 1–10 scale was linearly rescaled to the [0,1] interval to facilitate interpretation. Descriptive statistics and graphical display of the response distribution were also produced.

3. RESULTS

Of the 518 questionnaires distributed, 91 valid responses were received, representing a participation rate of 17.6%. Figure 1 displays the distribution of responses alongside a reference normal curve. The distribution exhibits marked asymmetry and heterogeneity, reflecting a pattern of polarized opinions among respondents.

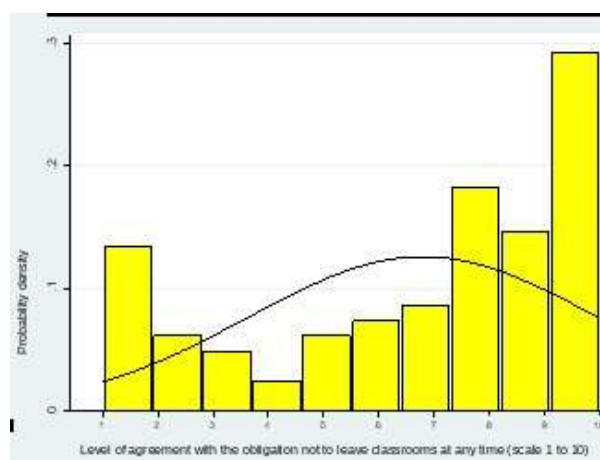


Figure 1. Level of agreement of school principals with the proposition that, during episodes of atmospheric pollution, students should be prohibited from leaving classrooms for the entire school morning (including break time).

Overall, however, the attitude of school principals was positive: on the rescaled $[0,1]$ interval, the mean agreement score was 0.64 (95% CI: 0.57–0.71), indicating a majority disposition in favor of mandating indoor confinement during severe air pollution events.

4. DISCUSSION

In July 2024, the Municipality of Murcia approved a revised action protocol for atmospheric pollution episodes, centered primarily on the dissemination of preventive recommendations to educational centers [8]. However, the results of the present study indicate that a substantial proportion of school principals believe that such recommendations should be elevated to binding normative requirements, such that decisions to keep students indoors would no longer depend on individual discretion but would instead be governed by a common regulatory directive endorsed by health and environmental authorities. This perception reflects a growing awareness of the need to protect children's health against acute environmental risks, particularly in regions where Saharan dust intrusions are recurrent meteorological phenomena rather than exceptional events.

The polarization observed in the response distribution deserves further consideration. Although a clear majority of principals expressed support for the proposed mandatory measure, a non-negligible minority expressed ambivalence or opposition, possibly reflecting concerns about the practical feasibility of implementation, potential disruptions to the educational routine, or skepticism about the regulatory reach of regional health authorities into school management. This finding suggests that, while an aggregated positive attitude is evident, the transition from recommendation to obligation would benefit from deliberate stakeholder engagement, transparent communication of the evidence base, and sensitivity to the operational realities of school administration.

From a governance perspective, harmonizing protocols across schools through a binding regional regulation would meaningfully reduce inequities in children's exposure to hazardous air quality events. Under the current voluntary framework, the level of protection afforded to students is contingent upon the individual decision-making of each principal, which may vary as a function of the principal's awareness, access to real-time air quality information, and risk tolerance. A uniform mandatory standard would eliminate this source of variability and ensure that all children, regardless of which school they attend, receive equivalent protection during declared pollution episodes.

Transforming the recommendation into an obligation during severe pollution events—particularly those involving PM₁₀ and PM_{2.5} exceedances attributable to Saharan dust intrusion—could represent a meaningful advance in local environmental health governance. Recognizing these episodes as recurrent, foreseeable phenomena rather than anomalous occurrences implies the need for stable, predictable regulatory tools in the educational sphere. Embedding such an obligation within regional normative frameworks would lend coherence, equity, and institutional resilience to public policy responses to a preventable environmental health risk, thereby reinforcing the protective function of governance in school settings.

Several limitations of the present study warrant acknowledgment. First, the response rate of 17.6%, while not uncommon for surveys of institutional leaders, may introduce non-response bias if principals with stronger opinions—either in favor of or against the measure—were systematically more likely to participate. Second, the study was conducted in a single region characterized by particularly high rates of Saharan dust intrusion; the generalizability of these findings to regions with different pollution profiles or institutional contexts may therefore be limited. Future research should replicate this inquiry across multiple geographic settings and consider qualitative methods to elucidate the reasoning underlying principals' attitudes.

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