

# Insufficient Water Distribution Network Coverage and Its Perceived Socioenvironmental Effects on Community Development in Nametil, Nampula, Mozambique

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## ABSTRACT

This study analyses the perceived socioenvironmental effects of inadequate water distribution network coverage on community development in Nametil, Mogovolas District, Nampula Province, Mozambique, during 2023–2025. A qualitative, descriptive, field-based approach was adopted, involving 20 household participants and 5 purposively selected key informants. Data were collected through structured questionnaires and semi-structured interviews and analyzed using frequencies, percentages, thematic categorization, and triangulation. Among household respondents, 70% considered network coverage inadequate, 20% partially adequate and 10% adequate. The main reported factors were insufficient infrastructure (35%), lack of maintenance (25%), insufficient investment (20%), and population growth (15%). Additionally, 85% reported perceived effects of inadequate water availability on household health, while 90% reported effects on daily activities. Traditional wells (45%) and rivers (30%) were the main alternative water sources. Reported consequences included reduced agricultural production; time spent searching for water, difficulties maintaining household hygiene, and school absenteeism. Key informants also reported health, agricultural, educational, social, and environmental implications. The findings indicate that inadequate network coverage is associated, in participants' accounts, with multidimensional constraints on household well-being and community development. Health effects were self-reported and were not clinically or epidemiologically verified; therefore, the study does not establish causal relationships. The study recommends network expansion and rehabilitation, improved maintenance and investment, water-quality monitoring, and greater community participation in water-resource management.

## INTRODUCTION

In Mozambique, access to safe drinking water remains an important socio-environmental and development challenge, particularly in communities where limitations in water-supply infrastructure, maintenance difficulties, and territorial inequalities in access to basic services persist [1]. At the national level, these challenges are reflected in differences in access to safe and reliable water services between urban and rural areas, with rural populations remaining particularly dependent on unimproved sources and surface water. Such inequalities demonstrate that the challenge is not limited to the physical availability of water, but also involves the coverage, quality, continuity, and operational capacity of water-supply services [1,3]. Safe water is essential for public health, hygiene, food production, education, and population well-being, while also contributing to poverty reduction and social and economic development [2].

These national challenges acquire particular significance at the provincial and local levels. In Nampula Province, limitations in basic infrastructure are combined with population growth and environmental and climatic pressures that may affect the provision and reliability of essential services [4]. The situation is particularly relevant in areas where the expansion of settlements and increasing demand place additional pressure on existing water-supply systems. In this context, access to water should be considered not only in terms of whether infrastructure exists, but also in terms of whether that infrastructure provides effective, sufficient, and continuous access to the population.

Inadequate water-supply services may produce consequences that extend beyond the health dimension. Where formal systems do not adequately meet household needs, populations may depend on alternative sources such as traditional wells and rivers. The use of such sources may increase exposure to potential water-quality risks and may complicate the adoption of appropriate hygiene and

sanitation practices [2,5]. At the same time, the time and resources required to search for and collect water may interfere with domestic, productive, and educational activities, with implications for household well-being and productivity [2]. Reliable access to safe and affordable water is therefore relevant to health, hygiene, education, and other dimensions of everyday life [2,6].

Within Nampula Province, these issues are particularly relevant in Mogovolas District and its administrative centre, Nametil. According to the District Service for Planning and Infrastructure, Nametil has 111 water-supply sources, including 101 boreholes and 10 wells or springs, of which 106 were reported to be operational. The town's water-supply system had 1,168 connections, of which 986 were active [7]. These figures indicate the existence of a formal water-supply infrastructure while also pointing to limitations in effective network coverage and operational capacity. Consequently, the presence of water infrastructure does not necessarily mean that all households have sufficient or continuous access to the formal distribution system.

The local situation therefore raises a specific socio-environmental problem: when the formal distribution network is insufficient to meet household needs, residents may resort to alternative water sources and develop strategies to secure access to water. Such strategies may have implications for household health, hygiene, domestic activities, agricultural production, education, time use, and economic conditions. From this perspective, the water-supply problem in Nametil needs to be understood not only through the existence of infrastructure, but also through its effective coverage, functionality, maintenance, operational capacity, and capacity to respond to changing demand.

Despite the importance of water access for health and community development, there is limited locally grounded evidence examining, in an integrated manner, how limitations in the water distribution network are experienced by households in Nametil and what

socioenvironmental effects are reported in everyday life. It is also important to understand the alternative strategies adopted by households when formal water services are insufficient and the implications of these strategies for domestic, productive, educational, and community activities. It is within this national, provincial, and local context that the present study is situated. The study aims to analyse the perceived socioenvironmental effects of inadequate water distribution network coverage on community development in Nametil, considering limitations in the water-supply system, alternative forms of access to water, and their reported repercussions on household living conditions.

## METHODS

The study adopted a qualitative, descriptive, and field-based approach aimed at analysing the socio-environmental implications associated with inadequate water distribution network coverage in Nametil Town, Mogovolas District, Nampula Province, during the period from 2023 to 2025. This period was selected to capture recent water supply conditions in Nametil and to allow the analysis of the conditions and experiences reported by residents within a defined and contemporary timeframe, based on the availability of relevant information and field data. The study involved 20 households and 5 key informants, comprising a total of 25 participants. Household participants were selected through non-probability convenience sampling, based on their availability and direct experience with local water supply conditions. The inclusion of households sought to capture residents' experiences regarding access to the distribution network, the use of alternative water sources, and the perceived effects of water availability on health, agriculture, education, hygiene, and daily activities. Key informants were purposively selected according to their institutional or community involvement in water supply and local development. They comprised two community leaders, one technician responsible for the water supply system, one health professional, and one local manager. The structured questionnaire was developed specifically for this study based on the research objectives and the main dimensions identified in the literature and local context. It included questions on the perceived adequacy of the water distribution network, factors contributing to inadequate coverage, alternative water sources used by households, reported health problems, effects on agricultural and domestic activities, school attendance, hygiene, and other dimensions of everyday life. The questionnaire also included

questions designed to identify participants' perceptions of the causes and consequences of inadequate water supply. The semi-structured interview guide was developed around complementary themes, including the causes of inadequate network coverage, institutional and infrastructural constraints, perceived health and socioeconomic consequences, and possible measures for improving water supply. Data were collected through structured questionnaires administered to the 20 households and semi-structured interviews conducted with the 5 key informants. Quantitative responses were processed using Microsoft Excel and organized into frequencies and percentages. Qualitative information obtained from the interviews was analyzed through thematic categorization, covering the dimensions of health, agriculture, education, household economy, environment, and social relations. Subsequently, triangulation was performed by comparing information from the questionnaires, interviews, and documentary sources, allowing the identification of convergences and complementary findings. Because the health information was based on participants' reports and was not obtained from clinical records, laboratory analyses, or official epidemiological databases, the reported health problems are treated in this study as perceived or self-reported health outcomes, rather than independently verified epidemiological outcomes. Accordingly, the findings do not establish a causal relationship between inadequate water supply and specific diseases.

## RESULTS

### Participant Profile

Regarding the sex distribution of the participants, 40% were women and 60% were men, indicating a higher proportion of male participants in the sample. This distribution reflects the composition of the study participants and provides perspectives from both women and men regarding access to water supply and its implications for household and community life. Regarding the age distribution, the highest concentration of participants was observed in the 36–45 age group (30%), followed by those aged 26–35 years (25%) and 46–60 years (20%). Participants aged 18–25 years accounted for 15%, while those over 60 years represented 10%. Overall, 75% of the participants were between 26 and 60 years of age, indicating a predominantly adult composition of the sample, as shown in Figure 1.

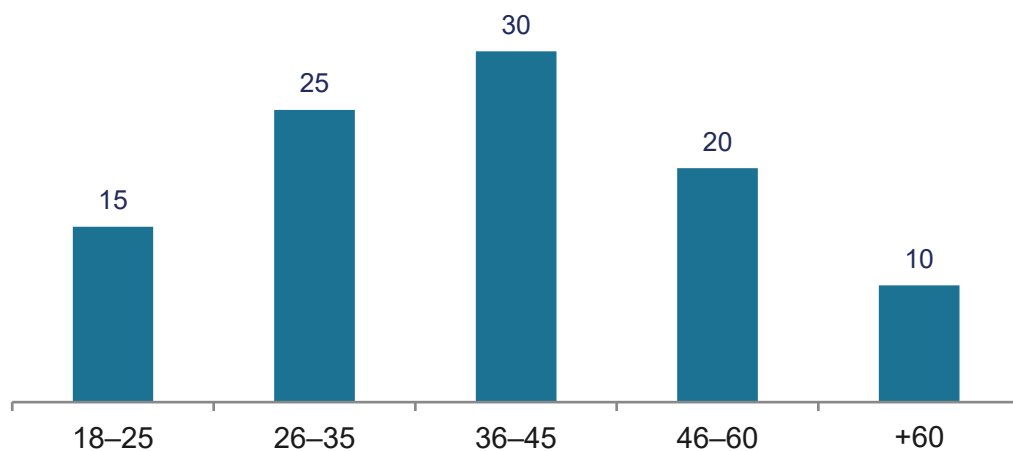
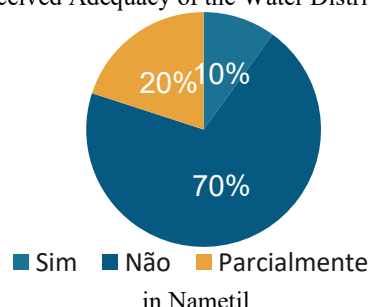


Figure 1: Distribution of participants by age group (%)

# Coverage and Causes

The data reveal a predominantly negative assessment of water distribution network coverage, with 70% of participants considering the network inadequate, 20% considering it partially adequate, and only 10% considering it adequate. The main causes identified were insufficient infrastructure (35%), lack of maintenance (25%), and insufficient investment (20%), which together accounted for 80% of the reported responses, as shown in Figure 2.

Figure 2: Perceived Adequacy of the Water Distribution Network



The results demonstrate that inadequate water distribution network coverage in Nametil is predominantly associated with structural, technical, and financial factors. Insufficient infrastructure was identified by 35% of participants, constituting the main cause, followed by lack of maintenance (25%) and insufficient investment (20%). Population growth was reported by 15% of participants, while other causes accounted for 5%. The concentration of 80% of the responses in the first three factors indicates that the system's limitations are strongly related to installed capacity, infrastructure maintenance, and the availability of resources for its expansion and operation.

# Alternative Water Sources and Reported Health Problems

The results show that participants perceived a relationship between inadequate water availability and household health. Among the 20 household respondents, 85% (17 participants) reported perceived effects of inadequate water availability on household health, while 15% (3 participants) did not report such an effect. Among the health problems reported, diarrhea was mentioned 9 times, skin diseases 5 times, gastrointestinal infections 4 times, and other health conditions 2 times. These figures represent the frequency of

mentions recorded in participants' responses rather than the number of participants affected, as individual respondents could mention more than one health problem. Therefore, the total number of mentions does not correspond to the number of household respondents and should not be interpreted as the prevalence of specific health conditions. The reported health problems were based exclusively on participants' accounts and were not clinically confirmed or independently verified through health records, laboratory analyses, or epidemiological data. Regarding alternative water sources, traditional wells were the most frequently reported source, accounting for 45% of responses, followed by rivers (30%) and water purchased from neighbours (20%). Other sources accounted for 5%. Thus, 75% of household respondents reported using traditional wells or rivers as alternative sources of water. These sources may present potential contamination risks depending on their sanitary and environmental conditions. However, since this study did not include laboratory analyses of water quality, it is not possible to confirm whether the specific sources used by participants were contaminated.

# Limitations of the Water Supply System in Nametil

The limitations of the water supply system in Nametil were analysed through the triangulation of information obtained from the 20 households and the five key informants who participated in the study. The household information reflects the perceptions and experiences of community members regarding access to water, the adequacy of the distribution network, the use of alternative water sources, and the effects of water scarcity on health and daily activities. The qualitative information was obtained from different community and institutional perspectives, including two community leaders, a water supply technician, a health professional, and a local manager. The inclusion of these different participants made it possible to examine the limitations of the water supply system from complementary perspectives, encompassing community experiences, technical and operational aspects, health-related concerns, and local management. The triangulation focused on the main dimensions identified in the study, including network coverage, infrastructure, maintenance, investment, population growth, health, alternative water sources, daily activities, and institutional responses, as presented in Table 1.

Table 1: Triangulation of Findings on Water Supply in Nametil

| Dimension analysed        | Questionnaires                                                                                                                                                                                                           | Interviews with key informants                                                                                   | Convergence / interpretation                                                                                                                                      |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Network coverage          | 70% considered the network inadequate and 20% partially adequate; only 10% considered it adequate.                                                                                                                       | Community Leader 1: the network is inadequate to meet the needs of the population.                               | Strong convergence: both sources confirm inadequate network coverage.                                                                                             |
| Infrastructure            | 35% identified insufficient infrastructure as the main cause.                                                                                                                                                            | Water Supply Technician: lack of resources for network expansion.                                                | Convergence: infrastructure limitations are related to the system's reduced capacity for expansion.                                                               |
| Maintenance               | 25% identified lack of maintenance as one of the main causes.                                                                                                                                                            | Institutional accounts indicate limitations in the system's capacity for improvement and operation.              | Partial convergence: the questionnaires directly highlight the maintenance problem, while the interviews reinforce structural and resource-related limitations.   |
| Investment                | 20% identified lack of investment as a cause of inadequate coverage.                                                                                                                                                     | Local Manager: there is an urgent need for investment; Water Supply Technician: lack of resources for expansion. | Strong convergence: both sources identify insufficient resources and investment as obstacles to improving the network.                                            |
| Population growth         | 15% identified population growth as a cause.                                                                                                                                                                             | Community Leader 2: rapid population growth increases pressure on the system.                                    | Strong convergence: population growth is perceived as a factor placing pressure on water supply capacity.                                                         |
| Health                    | 85% stated that water scarcity affects health; cases of diarrhoea, skin diseases, and gastrointestinal infections were reported.                                                                                         | Health Professional: reported an increase in water-related health problems.                                      | Convergence of reported experiences: both sources describe perceived health repercussions associated with water scarcity                                          |
| Alternative water sources | 45% rely on traditional wells, 30% on rivers, and 20% purchase water from neighbours.                                                                                                                                    | Informants highlight the inadequacy of the network and the need to expand water supply.                          | Complementarity: the questionnaires show how households respond to inadequate supply, while the interviews help explain why the network is unable to meet demand. |
| Daily activities          | 90% stated that water scarcity affects their activities; the main effects included reduced agricultural production (7), time lost in searching for water (6), difficulties with hygiene (4), and school absenteeism (3). | Informants recognise social and health consequences arising from limitations in water supply.                    | Convergence: water scarcity has effects that extend beyond access to water, affecting everyday life and community well-being.                                     |
| Institutional response    | The findings indicate the need to improve water coverage and availability.                                                                                                                                               | The technician and local manager advocate network expansion and urgent investment.                               | Strong convergence: the findings support the need for structural and institutional intervention.                                                                  |

Source: Author's own elaboration based on questionnaires administered to households and interviews conducted with key informants (2026).

### Socio-economic effects observed

Among the main socio-economic effects of water scarcity in Nametil, four consequences identified by the participants stand out. Reduced agricultural production had the highest frequency, with 7 responses, followed by time lost searching for water, reported in 6 responses. Difficulties in maintaining household hygiene were mentioned by 4 participants, while school absenteeism was reported in 3 responses.

### Socioeconomic and Community Impacts

Among the 20 household respondents, 90% reported that inadequate water availability affected their daily activities. The reported effects included reduced agricultural production; time spent searching for water, difficulties in maintaining household hygiene, and school absenteeism. These effects were mentioned 7, 6, 4, and 3 times, respectively. The frequencies represent the number of mentions recorded in the participants' responses and are not mutually exclusive, as individual respondents could report more than one effect.

Reduced agricultural production was the most frequently reported effect, followed by the time spent searching for water. Difficulties in maintaining household hygiene and school absenteeism were also reported, indicating that limitations in water availability extend beyond the immediate problem of access to water and may interfere with productive, domestic, and educational activities. These findings suggest that water-access difficulties are experienced across several dimensions of everyday household life.

The interviews with the five key informants provided complementary perspectives on the community-level implications of inadequate water availability. Self-reported health problems were mentioned in five reports, while reduced agricultural productivity and school absenteeism were each mentioned in four reports. Conflicts related to access to water were mentioned three times, and environmental degradation was mentioned twice. These frequencies represent the number of mentions made by key informants and should not be interpreted as prevalence rates or as independently verified measurements.

Taken together, the household and key-informant accounts indicate that inadequate water availability is perceived as having multidimensional implications involving health, agricultural production, education, household activities, social relations, and environmental conditions. The convergence between these sources provides contextual evidence that water-access difficulties are experienced not only as an infrastructure or service-delivery issue, but also as a concern affecting everyday household and community life. However, these findings reflect reported experiences and perceptions and should be interpreted within the limitations of the study sample and data-collection methods. The main pathways identified from participants' accounts, linking inadequate water supply with the reported socioenvironmental effects in Nametil, are presented in Figure 3. The figure represents an interpretive framework based on reported experiences and does not imply empirically established causal relationships.

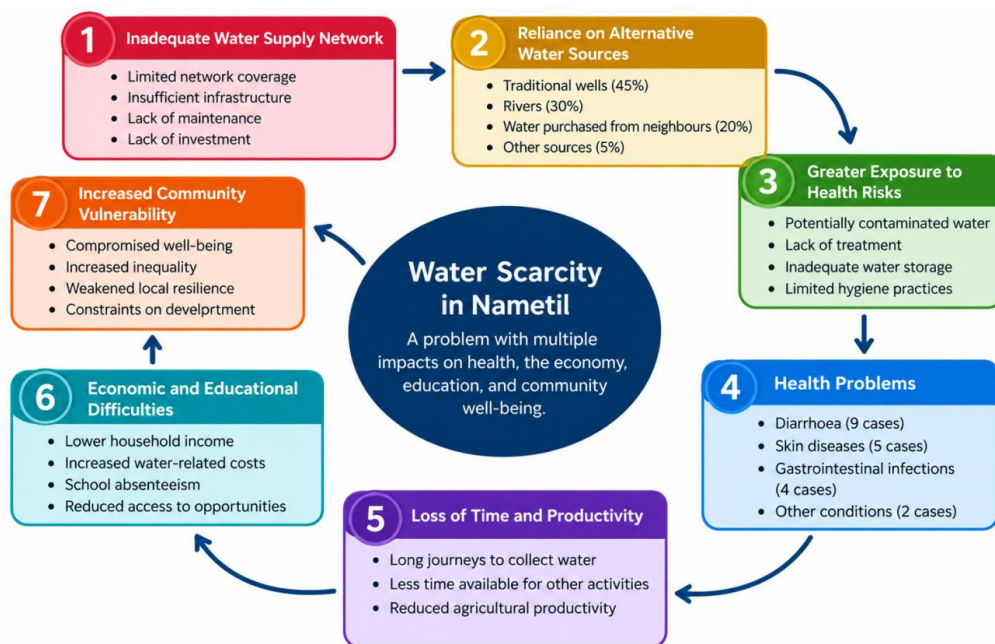


Figure 3: Reported Pathways Linking Inadequate Water Supply to Socioenvironmental Effects in Nametil.

### DISCUSSION

The findings indicate that the water-supply challenge in Nametil is not limited to the physical existence of infrastructure, but concerns the extent to which the existing system provides effective, sufficient, and continuous access to households. This distinction between formal infrastructure and effective access is central to interpreting the results. Although Nametil has a formal water-supply system, including 1,168 connections, of which 986 were reported as active, most household participants perceived the network as inadequate. The factors identified by participants, particularly insufficient infrastructure, lack of maintenance, and insufficient investment, suggest that the availability of infrastructure alone does not ensure adequate service provision. In this sense, the findings point to a gap

between the existence of a formal water-supply system and its capacity to respond consistently to household demand. This interpretation is consistent with the broader literature on water-supply challenges in Mozambique, where access to basic services is influenced not only by infrastructure availability but also by service continuity, operational capacity, and territorial inequalities [1–3].

The distinction between infrastructure and effective access also helps explain why households reported using alternative water sources. Traditional wells and rivers constituted important complementary sources of water, indicating that households develop alternative strategies when the formal distribution system does not fully meet their needs. This dependence should not

automatically be interpreted as evidence of unsafe water, since the present study did not include laboratory analyses of the sources used. Rather, it demonstrates the importance of examining the conditions under which households secure water when formal services are perceived as insufficient. From a socioenvironmental perspective, dependence on alternative sources may also increase the time and effort required to obtain water and may expose households to different environmental and sanitary conditions depending on the characteristics and protection of each source [2,5]. The findings therefore suggest that improving formal network coverage needs to be considered together with the conditions of the alternative sources on which households currently depend.

The reported effects further indicate that limitations in water access extend beyond the immediate question of water availability. Participants described repercussions involving agricultural production; time spent searching for water, household hygiene, and school attendance. These accounts suggest that access to water is connected to the organization of household time, productive activities, educational participation, and everyday well-being. The importance of these dimensions is consistent with the broader understanding that reliable water services contribute to hygiene, education, household welfare, and productive activities [2,6]. At the same time, the health-related findings require particular caution. Participants reported perceived health repercussions and mentioned conditions such as diarrhea, skin diseases, and gastrointestinal infections; however, these reports were not verified through clinical records, laboratory analyses, or epidemiological databases. Consequently, the findings should be understood as reported experiences associated with inadequate water availability rather than as evidence that insufficient water supply caused specific diseases.

The perspectives of the five key informants reinforce the multidimensional character of the problem. Their accounts identified perceived repercussions involving health, agricultural productivity, education, social relations, and environmental conditions. The convergence between household and key-informant accounts provides contextual support for understanding water access as a community-development concern rather than as an isolated infrastructure issue. Nevertheless, this convergence should be interpreted as convergence of reported experiences and perspectives, not as independent verification of the reported effects. The small and non-probabilistic sample also limits the extent to which these findings can be generalised to the entire population of Nametil.

From a management and community-development perspective, the findings point to the need to consider water supply as a service system requiring coordinated attention to infrastructure expansion, maintenance, investment, operational capacity, water-quality monitoring, and community participation. The results do not indicate that network expansion alone would resolve all reported difficulties. Rather, they suggest that effective provision depends on the interaction between physical infrastructure, system operation, maintenance, resource availability, and the capacity of the service to respond to local demand. Community participation is also relevant because households are already actively developing strategies to secure access to water when formal provision is perceived as insufficient. Strengthening these dimensions could contribute to reducing the dependence on alternative sources and the reported disruptions to household, productive, educational, and social activities.

Overall, the findings contribute locally grounded evidence that the water-supply challenge in Nametil involves a gap between formal infrastructure and effective access, reliance on alternative sources, and perceived repercussions across several dimensions of everyday life. The study therefore supports an interpretation of water access as an integrated socioenvironmental and community-development issue. Further research using larger samples, systematic water-

quality assessments, and epidemiological data would be necessary to determine the magnitude and distribution of these effects and to examine potential causal relationships more rigorously.

## CONCLUSION

This study found that inadequate water distribution network coverage in Nametil is experienced by participants as a multidimensional socioenvironmental and community-development challenge. Although a formal water-supply system exists, household accounts indicate a gap between the presence of infrastructure and effective access to sufficient and continuous water services. Participants also reported reliance on alternative sources, particularly traditional wells and rivers, when formal provision was perceived as insufficient. The reported effects extended beyond access to water itself, involving household activities, agricultural production, education, hygiene, health, and social relations. These findings indicate that water-supply limitations should be considered not only as an infrastructure issue but also in relation to the capacity of the service system to respond to local demand, maintain infrastructure, and ensure reliable access. The study does not establish causal relationships between inadequate water supply and specific health conditions. The health findings are based on participants' self-reported experiences and were not verified through clinical records, laboratory analyses, or epidemiological data. Moreover, the small non-probabilistic sample limits the generalization of the findings to the wider population of Nametil. Improving water access in Nametil therefore requires attention to network expansion and rehabilitation, maintenance, investment, water-quality monitoring, and community participation. Further research involving larger samples, systematic assessment of water quality, and epidemiological data would help to establish more robust evidence on the health and socioenvironmental implications of water-supply conditions.

## Conflict of Interest Statement

The authors declare that there are no financial, institutional, or personal conflicts of interest that could have influenced the development, analysis, or presentation of the results of this study.

## Data Availability Statement

The data underpinning the findings of this study were obtained from households and key informants as part of the field research conducted in Nametil. Due to the nature of the information collected and the need to protect the confidentiality and privacy of the participants, individual-level data are not publicly available. Additional information or aggregated data may be made available by the corresponding author upon reasonable request and in accordance with applicable ethical principles.

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