



Climate Change Concerns and Sickle Cell Disease Screening Intention among Singles Living in Kinshasa, DRC

Pascal Mamenepi Atuba^{1,2*}, Didier Ekibe Mangbala^{1,2}, Angel Ngongo Andjelani^{1,2}, Siméon Mokabi Egango³, Jacques Masumbuku Lofandjola¹, Félicien Kandolo Tshimungu¹

¹Higher Institute of Medical Techniques of Kinshasa, Kinshasa, DRC

²School of Management, Environmental Learner at Université Chatolique du Congo, Kinshasa, DRC

³Saint Joseph Hospital in Limete, Kinshasa, DRC

Email: *pascalatuba@gmail.com

How to cite this paper: Atuba, P.M., Mangbala, D.E., Andjelani, A.N., Egango, S.M., Lofandjola, J.M. and Tshimungu, F.K. (2025) Climate Change Concerns and Sickle Cell Disease Screening Intention among Singles Living in Kinshasa, DRC. *Open Access Library Journal*, 12: e13047.

<https://doi.org/10.4236/oalib.1113047>

Received: February 6, 2025

Accepted: April 20, 2025

Published: April 23, 2025

Copyright © 2025 by author(s) and Open Access Library Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

This cross-sectional study investigates the relationship between climate change concerns and sickle cell disease (SCD) screening intentions among 392 single individuals (aged 14 - 35) in Kinshasa, DRC. Data was collected using a questionnaire adapted from a previous study, and analyzed using descriptive statistics and logistic regression. The study found that knowledge about SCD, heat stress, exposure to extreme weather events, and climate change anxiety were significantly associated with SCD screening intentions. It highlights the importance of raising awareness about the disease, the effects of climate change, and then the psychological dimension in order to facilitate resilience in the face of this change, and thus improve the intention to screen for different pathologies and sickle cell disease in particular.

Subject Areas

Environmental Sciences, Public Health

Keywords

Climate Change, Voluntary Screening, Sickle Cell Disease

1. Introduction

According to the United Nations Environment Programme (UNEP), the Earth is experiencing a temperature increase of up to 1.2°C compared to the pre-industrial era [1]. This shows the establishment of a progressive climate change. Furthermore,

studies show that this climate change has many effects on human health in terms of various diseases [2]-[4] to the point of affecting human intentions in making decisions that concern them directly or indirectly.

Although sickle cell disease, which is a hereditary disease [5]-[7], is not directly linked to climate change, studies have highlighted the influence of environmental factors such as temperature, humidity and air quality, geographic space and many others, on its severity [8]-[11].

Along the same lines, a literature review conducted on sickle cell anemia showed that climatic variations pose significant challenges for people with sickle cell disease, affecting the prevalence, management and outcomes of the disease [12]. Thus, concerns about climate change may influence individuals' intentions to seek testing for a variety of reasons. To illustrate, concerns about climate change may lead to increased stress and anxiety. This may compromise individuals' motivation to take care of their health, including seeking testing. Individuals may feel overwhelmed by environmental issues, which may lead them to neglect their personal health [13].

Although studies demonstrating a direct link between climate change and disease are to be sought, this study finds its meaning in the various doctrinal texts available in relation to the precautionary principle. Indeed, this principle shows the need to address early on hypotheses of dangers whose existence and impact are not formally established when these dangers, if proven, represent a threat of damage to the environment and health [14].

Thus, we take the opportunity to verify the relationships that may exist between concerns or thoughts about climate change among single people and their intention to voluntarily undergo sickle anemia screening. It can help decision-makers to include pathologies of this kind in their policies relating to measures to be taken for the benefit of the population during this time of climate change.

2. Material and Method

2.1. Estimate

A cross-sectional study with a descriptive-correlational aim was conducted in the city-province of Kinshasa in November 2024.

2.2. Sampling

Using the snowball sampling method, a sample of 392 singles was collected in the provincial city of Kinshasa, capital of the Democratic Republic of Congo (DRC). However, the latter should meet the following criteria: 1) be single with the intention of procreating naturally in the future, 2) understand the French or Lingala language, 3) have not yet been pregnant or have had a pregnancy and, 4) freely agree to participate in the study.

2.3. Variables of Interest

The dependent variable was "sickle cell screening intention" among single people.

It is obtained through the response provided regarding their willingness to undergo screening before marriage. In addition to sociodemographic characteristics, knowledge and attitudes towards the disease were considered as covariates of this intention. The participants' concerns or thoughts about the effects of climate change on health constituted the independent variables. Implicitly, we had: 1) information about climate change, 2) knowledge of the potential effects of this change on health, 3) exposure to extreme weather events, 4) thoughts about climate change and then, 5) the perceived influence of change on screening intention. Knowledge and attitudes were measured using a Likert scale to appreciate the attitude. This made it possible to deduce the attitude's score.

2.4. Data Collection Instrument

A questionnaire designed based on the literature and essentially on the study of Oluwole *et al.* in 2022 [15], was used after being pre-tested and adjusted just to assess participants' knowledge and attitude towards the disease. It contained 1) general information, 2) knowledge and attitudes on sickle cell screening. Another questionnaire from the literature (other studies on climate change) was used to assess concerns about these changes. To be more expeditious, this questionnaire was the subject of a form deployed on the KoboToolbox application.

2.5. Data Collection

The deployed form was shared with the target population via its link. Each participant could only answer once to avoid duplicates. Assistance in filling out the form was necessary and effective when needed.

2.6. Data Analysis

After collection, the data were exported to Jamovi version 2.6.13 for statistical analysis. First, the sample was described using percentage, mean \pm standard deviation, median with interquartile range according to the nature of the variables and/or distributions described. Then, the Chi-square test or Fisher's test (exact test) was used to verify the links between different variables analyzed at the threshold of 0.05. Finally, logistic regression made it possible to isolate with a confidence level of 95%, the concerns that most influence the intention to screen for sickle cell disease among single people. Here, only the variables significant in the first test (Fisher's Exact Test) were subject to these multivariate analyses (logistic regression).

2.7. Ethical and Regulatory Considerations

The research was conducted in accordance with the procedures. The required authorizations were previously obtained. Anonymity and confidentiality were observed throughout the collection and processing of data. Similarly, each participant had freely consented to participate in the study. In addition, there was no human manipulation in our approach.

3. Results

3.1. Participants Profile

Participants were aged 14 to 35 years with an average of 21.9 ± 3.9 years. Sex ratio of 1.5 in favor of women. The majority, 52.6%, had at least a BAC+1 and 53.1% did not have a gainful activity (still pupils or students) (See **Table 1**).

Table 1. Sociodemographic characteristics of participants

| Sociodemographic characteristics | Frequency (n = 392) | Percentage | Mean \pm SD |
|----------------------------------|------------------------|------------|---------------|
| Age (in completed years) | <18 | 25 | 6.4 |
| | 18 - 24 | 272 | 69.4 |
| | 25 and over | 95 | 24.2 |
| Sex | Female | 233 | 59.4 |
| | Male | 159 | 40.6 |
| Level of study | Primary | 3 | 0.8 |
| | Secondary | 183 | 46.7 |
| | Superior | 206 | 52.6 |
| Income generating activity | No | 208 | 53.1 |
| | Yes | 184 | 46.9 |

3.2. Knowledge about Sickle Cell Disease

Of the twenty elements appreciated, nine are known by more than 50% of participants, including: recognition of sickle cell disease as a hereditary blood disease, the ideal time for screening (before and not after marriage, and not during child-birth), the target group and common symptoms of the disease, the importance of premarital screening which aims to exclude sickle cell disease before marriage, and finally the probability of having an affected child if both parents have the trait (See **Table 2**).

3.3. Participants' Attitude towards Sickle Cell Disease

More than 50% of participants agree with all the statements examined, which reflects a positive attitude towards the disease (See **Table 3**).

3.4. Knowledge and Attitude Score

The median knowledge score on sickle cell disease was 10/20 (IQR = 5) and the median attitude score was 40/50 (IQR = 14) (See **Figure 1**).

3.5. Intention to Undergo Voluntary Screening for Sickle Cell Disease

It appears that 44.1% of participants expressed the intention to undergo voluntary

Table 2. Elements of knowledge on sickle cell disease.

| Elements of knowledge provided (Only correct answers are counted) | Frequency (n = 392) | Percentage |
|---|---------------------|------------|
| Sickle cell disease is an inherited disease | 348 | 88.8 |
| Sickle cell disease is a blood disease | 344 | 87.8 |
| Screening should be done before marriage | 331 | 84.4 |
| Sickle cell disease affects all age groups | 283 | 72.2 |
| Premarital screening is done to rule out sickle cell disease before marriage | 275 | 70.2 |
| Severe body pain and yellowing of the eyes are common symptoms of SCD | 224 | 57.1 |
| Screening has benefits | 224 | 57.1 |
| If one parent has SS and the other has AS, the baby has a 50% chance of having either SS or AS. | 213 | 54.3 |
| Screening should not wait until after delivery | 201 | 51.3 |
| Screening should only be done after marriage | 197 | 50.3 |
| Sickle cell disease cannot be transmitted by a mosquito bite | 188 | 48.0 |
| Sickle cell disease cannot be transmitted by the act of witches | 177 | 45.2 |
| Sickle cell disease cannot be transmitted through direct body contact. | 166 | 42.3 |
| It is not only the father who can pass on the gene | 163 | 41.6 |
| It is not only the mother who can pass on the gene | 144 | 36.7 |
| Sickle cell disease can be cured with medication | 83 | 21.2 |
| Sickle cell trait cannot turn into sickle cell disease over time | 74 | 18.9 |
| Screening prevents having a child with sickle cell disease | 61 | 15.6 |
| If both parents have AS syndrome, each child has a 25% chance of having SS syndrome. | 59 | 15.1 |
| If one parent is SS and the other AA, all children will be AS | 42 | 10.7 |

Table 3. Elements of attitude on sickle cell disease*.

| Attitude | Strongly disagree fr (%) | Disagree fr (%) | Neutral fr (%) | Agree fr (%) | Strongly agree fr (%) |
|--|--------------------------|-----------------|----------------|--------------|-----------------------|
| People with Sickle Cell Disease (SCD) should not be isolated | 4 (1.0) | 6 (1.5) | 14 (38.0) | 51 (13.0) | 182 (46.4) |
| It is important for two people in a relationship to undergo genetic counseling before marriage | 0 (0.0) | 10 (2.6) | 160 (40.8) | 58 (14.8) | 164 (41.8) |
| People with sickle cell disease can be invited to birthday parties | 1 (0.3) | 9 (2.3) | 129 (32.9) | 77 (19.6) | 176 (44.9) |
| The relationship should be terminated if it is discovered that the genotypes predispose two people to have children with SCD | 0 (0.0) | 23 (5.9) | 137 (34.9) | 232 (59.2) | 0 (0.0) |
| A premarital sickle cell screening test is required before consenting to marriage | 2 (0.5) | 7 (1.8) | 124 (31.6) | 76 (19.4) | 183 (46.7) |
| I will have a premarital sickle cell screening test before marriage | 2 (0.5) | 6 (1.5) | 128 (32.7) | 72 (18.4) | 184 (46.9) |
| Someone can be friends with someone with SCD | 3 (0.8) | 6 (1.5) | 126 (32.1) | 82 (20.9) | 175 (44.6) |

Continued

| | | | | | |
|--|---------|---------|------------|-----------|------------|
| You can eat with people with SCD | 3 (0.8) | 2 (0.5) | 122 (31.1) | 79 (20.2) | 186 (47.4) |
| It is good for everyone to know their genotype before marriage | 2 (0.5) | 4 (1.0) | 131 (33.4) | 81 (20.7) | 174 (44.4) |
| We can work with people with SCD | 2 (0.5) | 2 (0.5) | 125 (31.9) | 83 (21.2) | 180 (45.9) |

*fr = Frequency (n = 392).

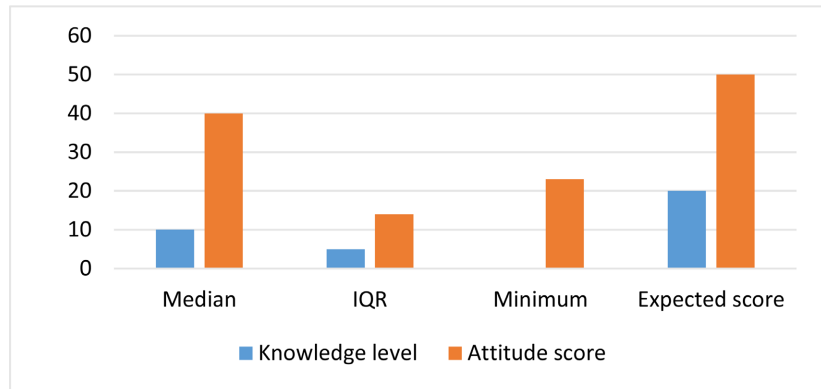


Figure 1. Description of the knowledge score and attitude towards sickle cell disease.

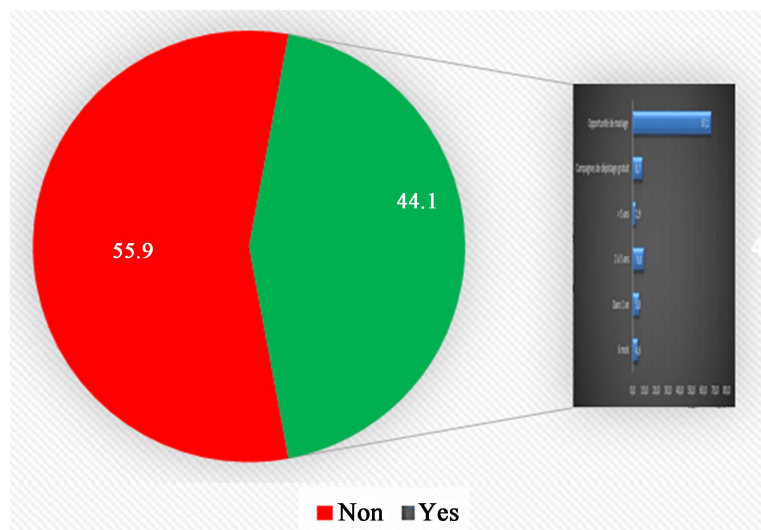


Figure 2. Proportion of single people with intention to get tested.

screening for sickle cell disease. A good portion of these, 67.1%, plan to do so as soon as the opportunity to marry arises (See **Figure 2**).

3.6. Perceptions, Thoughts and Experiences of Climate Change in Kinshasa

Regarding information, 91.3% of participants reported having already heard about climate change (CC) through various channels. In terms of knowledge about the potential effects of this change on human health, heat stress ranked first with 49.0% and mental health issues last with 7.7%. From their experience, a good number of participants, 32.4%, are already exposed to extreme weather events

such as flooding or excessive heat, etc. Furthermore, participants believe that CC has an impact on human health (65.8%) and that awareness campaigns on CC should also include information on sickle cell disease (70.9%). Ultimately, the perceived influence of CC on the intention to undergo voluntary screening for sickle cell disease is mainly summarized around anxiety linked to climatic events (34.9%), social inequalities (30.4%), concentration on the sole fact of “climate change” (26.3%) and then inaccessibility to health services (18.6%) (See **Table 4**).

Table 4. Perceptions, thoughts and experiences of climate change.

| Perceptions and experiences of climate change | | n = 392 | Percentage |
|---|---|---------|------------|
| Information | Ever heard of climate change? | 358 | 91.3 |
| | Spread of infectious diseases | 61 | 15.6 |
| | Breathing problems | 69 | 17.6 |
| | Heat stress or extreme heat | 192 | 49.0 |
| Potential health effects of CC | Malnutrition | 70 | 17.9 |
| | Mental health problem | 30 | 7.7 |
| | Forced migration | 46 | 11.7 |
| | Increase in waterborne diseases | 89 | 22.7 |
| | Other effects | 34 | 8.7 |
| Lived | Exposure to extreme weather events (floods, drought, etc.) | 127 | 32.4 |
| | CC has an impact on human health | 258 | 65.8 |
| Thoughts on Climate Change | CC increases the risk of complications | 31 | 7.9 |
| | CC could encourage screening | 29 | 7.4 |
| | CC awareness campaigns should include information about sickle cell disease | 278 | 70.9 |
| | Inaccessibility to health services | 73 | 18.6 |
| Perceived influence of CC on screening intention | Shared priorities | 33 | 8.4 |
| | Anxiety related to change | 137 | 34.9 |
| | Social inequalities | 119 | 30.4 |
| | Focus on the single fact “climate change” | 103 | 26.3 |

3.7. Climate Change Concerns Affecting Sickle Cell Screening Intention among Singles in Kinshasa

After multivariable analysis based on the binary logistic regression model, it appears that the level of knowledge about sickle cell disease is a covariate statistically associated with the intention to undergo voluntary screening for this disease (OR = 1.118 [1.048 - 1.191]; $p < 0.001$). In addition, three concerns about climate change were found to be determinants of this intention, including: heat stress as a perceived effect of CC on health (OR = 1.653 [1.044 - 2.618]; $p = 0.032$); exposure to extreme weather events (OR = 1.656 [1.002 - 2.737]; $p = 0.049$) and anxiety

related to climate change (OR = 0.480 [0.266 - 0.863]; $p < 0.014$) (See **Table 5**).

Table 5. Concerns related to screening intention.

| Predictor | Odds ratio (OR) | 95% confidence interval | | p-value |
|--|--------------------|-------------------------|--------------|------------------|
| | | Lower | Superior | |
| Ordinate at the origin | 0.175 | 0.0501 | 0.613 | 0.006 |
| Level of study | 1.048 | 0.6660 | 1.650 | 0.838 |
| Level of knowledge about sickle cell disease | 1.118 | 1.0488 | 1.191 | <0.001 |
| Sickle cell disease attitude score | 1.031 | 0.9696 | 1.095 | 0.333 |
| Heat stress as a perceived effect of CC on human health | 1.653 | 1.0442 | 2.618 | 0.032 |
| Exposure to extreme weather events | 1.656 | 1.0023 | 2.737 | 0.049 |
| Thinking that CC increases the risk of complications | 2.218 | 0.8890 | 5.535 | 0.088 |
| Thinking that CC could encourage screening | 0.885 | 0.3389 | 2.313 | 0.804 |
| Inaccessibility to health services due to climate change | 1.448 | 0.7287 | 2.876 | 0.291 |
| Climate change anxiety | 0.480 | 0.2665 | 0.863 | 0.014 |
| Social inequalities linked to CC | 0.607 | 0.3397 | 1.086 | 0.093 |
| Focus on the single fact “climate change” | 0.985 | 0.5190 | 1.869 | 0.963 |
| Thinking that climate change has an impact on human health | 0.948 | 0.5739 | 1.566 | 0.834 |

Note. The estimate represents the log odds of “Screening Intention = Yes” vs. “Screening Intention = No”.

4. Discussion

It is crucial to remember that climate change is not a new phenomenon and always has consequences on biodiversity. Many researchers recognize this fact and therefore wish that the climate changes according to its natural rhythm of yesteryear [16], as opposed to anthropological causes (...)

This study adds concrete information on climate change and its impact on human health mainly regarding its effects on man in his thinking and decision-making capacity concerning him during this time when efforts seem to be increasingly combined for the benefit of this change. It highlights the importance of awareness on climate change that can include information on different pathologies in general, and sickle cell disease in particular, without neglecting the psychological dimension of man as a guarantee of adaptation to extreme events in life.

4.1. Sickle Cell Disease Screening Intention

The results of this research show that 44.1% of single people living in the municipality of Limete who took part in the study expressed a willingness to be screened for sickle cell anemia. Among these respondents in favor of screening, 67.1% indicated that they would undergo it once the opportunity to marry arose (see **Figure 2**).

From the attitude towards sickle cell disease prevention and premarital screen-

ing for this pathology among young single adults in an urban community of Lagos, Nigeria, recruited between July 2018 and January 2019, it was found that 43.7% of participants strongly agreed to undergo premarital screening for sickle cell disease before marriage [15]. This therefore shows a similarity between these two African cities in terms of the tendency to undergo screening in the preventive context.

The results obtained in this research show that the low intention to undergo screening for the disease studied can be justified by the fact that the participants do not have enough knowledge about sickle cell disease. The median score is ten out of twenty. This means that the latter did not provide correct answers to half of the questions asked about this disease and the majority were at eight out of twenty. However, these singles still had a positive attitude towards the disease where the majority was in favor of all the proposals relating to the ideal view of SS anemia.

These results partially oppose those obtained in Yaba in 2013 where O'Oludarei and Ogili found that 80% of participants in their study had knowledge and 86% had a positive attitude [17] but corroborate the conclusion of Olakunle *et al.* the same year, having found in Jos that knowledge on sickle cell disease is low [18].

In all these studies, we note a statistically significant association between this knowledge and the practice or intention of screening. In the present study, retained in the logistic regression model as a covariate, we found that knowledge of an element or aspect of the disease would increase by 11.8% more the chance of undergoing voluntary screening for sickle cell disease (OR = 1.118 [1.048 - 1.191]; $p < 0.001$). Modest as it may be, this increase of more than ten percent should be capitalized given that the importance of a single case in public health is known by all.

4.2. Do Concerns about Climate Change Affect Testing Intention among Singles in Kinshasa?

This study was initiated with the aim of being able to seek the elements of response to this question. However, it seemed useful to us to begin by describing these concerns before exploring possible links.

4.2.1. Perceptions, Experiences and Thoughts of Singles regarding Climate Change

In the broad sense of the word, we consider as concern, the thoughts, perceptions and experiences of climate change by single people living in the municipality of Limete. Thus, in the era where technology is also expanding, 91.3% of participants reported having already heard about climate change through various channels. This information is useful because it allows the population to prepare for the events that result from it [19] (see **Table 4**).

Knowledge about the potential effects of this change on human health, heat stress took first place with 49.0% and mental health problem last with 7.7%. This shows that the population would easily remember the effects that they experience

directly and would pay less attention to other aspects of health, especially the mental dimension. It is also known that heat waves cause dehydration, heat stroke and exhaustion, which have a very harmful effect on health that can even lead to death [20].

From their experience, a good number of participants, or 32.4%, are already exposed to extreme weather events. In Kinshasa, the population generally faces the problem of flooding. Each rainfall trend thus constitutes a threat to this population, which does not know how to effectively deal with this phenomenon that it itself indirectly causes through poor waste management: an ecological indiscipline that weighs. Ebi *et al.* (2021) report that long-term changes in the earth's energy balance increase the frequency and intensity of many extreme events and the probability of compound events, with trends that are expected to accelerate in certain greenhouse gas emission scenarios. This requires urgent reactions [21].

In addition, participants believe that climate change impacts human health (65.8%) and that awareness campaigns on climate change should also include information on sickle cell disease (70.9%). Recent studies confirm that climate change is a major risk factor for global health, reproductive health and, more importantly, maternal and child health [22]-[24]. These studies also highlight the importance of mass awareness.

Regarding the perceived influence of climate change on the intention to undergo voluntary screening for sickle cell disease, single people who participated in the study mainly mentioned anxiety related to climate events, social inequalities, the focus on the sole fact of "climate change" or better shared priorities, then the inaccessibility of health services. Recent publications have established a relationship between climate change and stress and highlighted the danger of this change [25]. They also show that in the era of climate change, several policies are focused on this phenomenon [26].

4.2.2. Climate Change Concerns Affecting Sickle Cell Disease Screening Intention among Single People

Here, we have focused on the results from multivariable analyses in order to retain the real concerns that predict the intention to undergo screening for SS anemia. However, it should be noted that all the elements included in the model (see **Table 5**) were initially found to be significant after bivariate analysis (Fisher's exact test). Thus, concerns about heat stress, exposure to extreme weather events and then anxiety related to climate change were retained as predictors of this intention. This therefore shows a close link between concerns about climate change and the intention to screen for sickle cell disease among single people living in the commune of Limete in Kinshasa.

In a study by Mayo, several factors were associated with sickle cell screening intention including: age, education, perceived threat, attitude, perceived norm, and perceived behavioral control [27]. Of these factors, we can see a similarity in perception and behavioral control that may reflect in one way or another respectively the heat stress perceived as an effect of climate change and then the anxiety

related to this change.

1) Heat stress and screening intention

Our results showed a positive relationship between the two variables and indicate that participants who perceived this stress as an effect of climate change are almost twice as likely to undergo screening for sickle cell disease (OR = 1.653 [1.044 - 2.618]; $p = 0.032$). The World Health Organization reports that heat stress is the leading cause of weather-related deaths; it can exacerbate underlying diseases, such as cardiovascular disease, diabetes, asthma and mental disorders, and increase the risk of accidents and transmission of certain infectious diseases [28], which could prompt individuals to seek solutions.

2) Extreme weather events and screening intention

The results of the present study show that exposure to extreme weather events increases the probability of undergoing voluntary screening for sickle cell disease by 65.6% (OR = 1.656 [1.002 - 2.737]; $p = 0.049$). These results support the ideas of Ettinger *et al.* (2023) according to which extreme weather events constitute a learning opportunity [29]. This means that this exposure would have many other consequences felt by the population, which would further motivate them to seek solutions at different levels. This is in line with the research conducted by Sisco *et al.* in 2017, which showed that extreme weather events draw attention to climate change [30] and its consequences, particularly on human health.

3) Climate change anxiety and screening intention

The last predictor of screening intention highlighted in our context is anxiety perceived as a threat to this intention. It is noted that each unit increase in this anxiety leads to a decrease in the intention to undergo voluntary screening of around 52%. The study carried out by Jalin *et al.* (2024) showed the importance of eco-anxiety on human health and in health decision-making [31]. Other studies also show that anxiety related to climate change can lead to decision paralysis pushing individuals to a demotivation that would limit initiatives favorable to their health.

Senn *et al.* (2022) point out that in a context of increasing vulnerability of human beings and human societies to climate change and the collapse of biodiversity, it is becoming essential to conduct in-depth reflection on the complex links between the environment and our health [32].

4.3. Limitations and Strengths of the Study

The main limitation of the present study is the fact of considering only the declarations made by the participants. It would have been desirable to verify for example the exposure to extreme climatic events and the declared anxiety respectively using a follow-up study and a psychological test of anxiety. One of the positive points is the representativeness of the population whose sample size was calculated using an adapted formula. The other strength is the rigor in the treatment of the data where the conclusions are drawn on the basis of in-depth analyses (logistic regression) and with a usual confidence level of 95%.

4.4. Implications of the Study

The interest of the study then lies in the implications and applications which can result from it, particularly in terms of policies aimed at taking into account the psychological dimension in raising awareness of climate change.

The study also serves as a wake-up call to a phenomenon that can distract from any thinking. Specifically, we believe that with climate change, it is important not only to focus on the pathologies directly influenced by climate change, but also to consider those whose complications may be influenced by it.

Our fear is therefore the diversion of the population's attention from the prevention of genetic diseases which, not being linked to climate change, could then affect a large number of people who are already weakened and the consequences risk being enormous.

5. Conclusion

This study first shows that single people living in the city province of Kinshasa and who took part in the study have insufficient knowledge about sickle cell disease but have a positive attitude towards the disease. Then, the intention to undergo screening is not zero although below average. Finally, there is a statistically significant link between concerns about climate change and the intention to screen for sickle cell disease in this municipality. These results thus show the importance of mass awareness on climate change and its consequences on human health. This awareness should also take into consideration the psychological aspect in order to facilitate resilience in the face of this change.

Authors' Contributions

All authors participated in the conduct of the study. They have read and accepted the published version of the manuscript.

Acknowledgements

We thank the single people living in Kinshasa who freely agreed to participate in the study. We also thank the relevant authorities for allowing the study to be carried out in the city.

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] UNEP (2021) Global Temperature Rises Are Alarming. [https://www.unep.org/fr/actualites-et-recits/recit/laugmentation-des-temperatures-mondiales-est-alarmante#:~:text=2016%2C%202019%20et%202020%20sont,%C3%A8re%20pr%C3%A9industrielle%20\(1880\)](https://www.unep.org/fr/actualites-et-recits/recit/laugmentation-des-temperatures-mondiales-est-alarmante#:~:text=2016%2C%202019%20et%202020%20sont,%C3%A8re%20pr%C3%A9industrielle%20(1880))
- [2] Campbell-Lendrum, D., Neville, T., Schweizer, C. and Neira, M. (2023) Climate

- Change and Health: Three Grand Challenges. *Nature Medicine*, **29**, 1631-1638. <https://doi.org/10.1038/s41591-023-02438-w>
- [3] Wade, R. (2023) Climate Change and Healthcare: Creating a Sustainable and Climate-Resilient Health Delivery System. *Journal of Healthcare Management*, **68**, 227-238. <https://doi.org/10.1097/jhm-d-23-00096>
- [4] Baugh, J., Kemen, K., Messervy, J. and Biddinger, P. (2021) Beyond the Hazard Vulnerability Analysis: Preparing Health Systems for Climate Change. *Rhode Island Medical Journal*, **104**, 55-59.
- [5] Elendu, C., Amaechi, D.C., Alakwe-Ojimba, C.E., Elendu, T.C., Elendu, R.C., Ayabazu, C.P., et al. (2023) Understanding Sickle Cell Disease: Causes, Symptoms, and Treatment Options. *Medicine*, **102**, e35237. <https://doi.org/10.1097/md.00000000000035237>
- [6] Clarke, K.A., Moussa, M., Hall, M.A.K. and Shin, Y.M. (2024) Length of Stay, Readmission Rates, and Mortality Are Similar between Hospitalized Individuals with Sickle Cell Disease with and without COVID-19. *Cureus*, **16**, e70567. <https://doi.org/10.7759/cureus.70567>
- [7] Habara, A. and Steinberg, M.H. (2016) Minireview: Genetic Basis of Heterogeneity and Severity in Sickle Cell Disease. *Experimental Biology and Medicine*, **241**, 689-696. <https://doi.org/10.1177/1535370216636726>
- [8] Rees, D.C., Brousse, V.A.M. and Brewin, J.N. (2022) Determinants of Severity in Sickle Cell Disease. *Blood Reviews*, **56**, 100983. <https://doi.org/10.1016/j.blre.2022.100983>
- [9] Igbineweka, N.E. and van Loon, J.J.W.A. (2024) Gene-Environmental Influence of Space and Microgravity on Red Blood Cells with Sickle Cell Disease. *npj Genomic Medicine*, **9**, Article No. 44. <https://doi.org/10.1038/s41525-024-00427-7>
- [10] Tukker, A.M., Royal, C.D., Bowman, A.B. and McAllister, K.A. (2021) The Impact of Environmental Factors on Monogenic Mendelian Diseases. *Toxicological Sciences*, **181**, 3-12. <https://doi.org/10.1093/toxsci/kfab022>
- [11] Kolber, P. and Krüger, R. (2019) Gene-Environment Interaction and Mendelian Randomisation. *Revue Neurologique*, **175**, 597-603. <https://doi.org/10.1016/j.neurol.2019.04.010>
- [12] Obeagu, E.I. and Obeagu, G.U. (2024) Implications of Climatic Change on Sickle Cell Anemia: A Review. *Medicine*, **103**, e37127. <https://doi.org/10.1097/md.00000000000037127>
- [13] Hamel-Dufour, S. (2000) What Concerns Does the Issue of Climate Change Raise? *Vertigo*. <https://journals.openedition.org/vertigo/4046>
- [14] Godard, O. (2006) Le principe de précaution. *Revue Projet*, **293**, 39-47. <https://doi.org/10.3917/pro.293.0039>
- [15] Oluwole, E.O., Okoye, C.D., Ogunyemi, A.O., Olowoselu, O.F. and Oyediji, O.A. (2022) Knowledge, Attitude and Premarital Screening Practices for Sickle Cell Disease among Young Unmarried Adults in an Urban Community in Lagos, Nigeria. *Pan African Medical Journal*, **42**, Article 8. <https://doi.org/10.11604/pamj.2022.42.8.27705>
- [16] Bila-Isia, I. (2023) Questions of Purpose and Attachment to Life in Time of Biodiversity Erosion and Global Climate Change. *Congo-Afrique*, No. 579, 1001-1012.
- [17] Oludare, G.O. and Ogili, M.C. (2013) Knowledge, Attitude and Practice of Premarital Counseling for Sickle Cell Disease among Youth in Yaba, Nigeria. *African Journal of Reproductive Health*, **17**, 175-182.

- [18] Olakunle, O.S., Kenneth, E., Olakekan, A.W. and Adenike, O. (2013) Knowledge and Attitude of Secondary School Students in Jos, Nigeria on Sickle Cell Disease. *Pan African Medical Journal*, **15**, Article 127. <https://doi.org/10.11604/pamj.2013.15.127.2712>
- [19] National Center for Atmospheric Science (2023) Why Is Climate Important? NCAS Fairbairn House 71-75 Clarendon Road Leeds LS2 9PH. <https://ncas.ac.uk/learn/why-is-climate-important/>
- [20] CLIMAT.BE (2019) Climate Change. Consequences. <https://climat.be/changements-climatiques/consequences/sante#:~:text=Selon%20l'OMS%2C%20les%20changements,et%20des%20vagues%20de%20heat>
- [21] Ebi, K.L., Vanos, J., Baldwin, J.W., Bell, J.E., Hondula, D.M., Errett, N.A., *et al.* (2021) Extreme Weather and Climate Change: Population Health and Health System Implications. *Annual Review of Public Health*, **42**, 293-315. <https://doi.org/10.1146/annurev-publhealth-012420-105026>
- [22] Segal, T.R. and Giudice, L.C. (2022) Systematic Review of Climate Change Effects on Reproductive Health. *Fertility and Sterility*, **118**, 215-223. <https://doi.org/10.1016/j.fertnstert.2022.06.005>
- [23] Giudice, L.C., Llamas-Clark, E.F., DeNicola, N., Pandipati, S., Zlatnik, M.G., Decena, D.C.D., *et al.* (2021) Climate Change, Women's Health, and the Role of Obstetricians and Gynecologists in Leadership. *International Journal of Gynecology & Obstetrics*, **155**, 345-356. <https://doi.org/10.1002/ijgo.13958>
- [24] Jee, S.H., Friedman, E., Etzel, R.A., Nguyen, V.T., Sack, T.L. and Kemper, K.J. (2023) Climate Change Imperils Pediatric Health: Child Advocacy through Fossil Fuel Divestment. *The Yale Journal of Biology and Medicine*, **96**, 233-239. <https://doi.org/10.59249/zodd9375>
- [25] Zandalinas, S.I., Fritschi, F.B. and Mittler, R. (2021) Global Warming, Climate Change, and Environmental Pollution: Recipe for a Multifactorial Stress Combination Disaster. *Trends in Plant Science*, **26**, 588-599. <https://doi.org/10.1016/j.tplants.2021.02.011>
- [26] Marten, R., Yangchen, S., Campbell-Lendrum, D., Prats, E.V., Neira, M.P. and Ghaffar, A. (2020) Climate Change: An Urgent Priority for Health Policy and Systems Research. *Health Policy and Planning*, **36**, 218-220. <https://doi.org/10.1093/heapol/czaa165>
- [27] Mayo-Gamble, T.L., Middlestadt, S.E., Lin, H., Cunningham-Erves, J., Barnes, P. and Jackson, P.B. (2018) Identifying Factors Underlying the Decision for Sickle Cell Carrier Screening among African Americans within Middle Reproductive Age. *Journal of Genetic Counseling*, **27**, 1302-1311. <https://doi.org/10.1007/s10897-018-0255-3>
- [28] WHO (2024) Heat and Health. <https://www.who.int/en/news-room/fact-sheets/detail/climate-change-heat-and-health#:~:text=Heat%20stress%20is%20the%20transmission%20of%20some%20infectious%20diseases>
- [29] Ettinger, J., Walton, P., Painter, J., Flocke, S.A. and Otto, F.E.L. (2023) Extreme Weather Events as Teachable Moments: Catalyzing Climate Change Learning and Action through Conversation. *Environmental Communication*, **17**, 828-843. <https://doi.org/10.1080/17524032.2023.2259623>
- [30] Sisco, M.R., Bosetti, V. and Weber, E.U. (2017) When Do Extreme Weather Events Generate Attention to Climate Change? *Climatic Change*, **143**, 227-241. <https://doi.org/10.1007/s10584-017-1984-2>

- [31] Jalin, H., Chandès, C., Congard, A. and Boudoukha, A.-H. (2024) Appréhender l'éco-anxiété: Une approche clinique et phénoménologique. *Psychologie Française*, **69**, 35-47. <https://doi.org/10.1016/j.psfr.2022.03.003>
- [32] Senn, N., Gaille, M., Del Rio Carral, M. and Holguera, G. (2022) Health and Environment: Towards a New Global Approach. RMS éditions Médecine et Hygiène.