Knowledge and Perceptions of Climate Change among the Science Students at the University of South Africa

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Posted Date: 18 December 2023

doi: 10.20944/preprints202312.1341.v1

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Article

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Abstract: Background:. Knowledge and positive perception of climate change are crucial for public participation in activities that contain climate change. Limited studies, particularly in South Africa have reported on the knowledge and perceptions of climate change by university students. **Study Aim**: This study aimed to assess the level of knowledge and perceptions of climate change by the science students at the University of South Africa (UNISA). **Methods:** This was a quantitative cross sectional survey, undertaken among science students using questionnaire emailed to 500 students in the School of Science through Unisa email system. Bivariate logistic regression was used to test the association between socio-demographics, level of knowledge and perceptions of climate change. **Results:** A total of 420 students participated in the study. They were predominantly male (70.3%), mostly younger than 35 years of age. Most of the respondents were in the 2nd (34.7%) and 3rd (33.8%) year of study. Majority of respondents (97.9%) knew and perceived (93.6%) that climate change was happening. Overall, 93.8% of respondents had an excellent knowledge and basic concepts of climate change. **Conclusion:** The majority of students were knowledgeable and had positive perceptions about the basic concepts of climate change. However, the year of study was not significantly associated with positive perceptions of climate change. There is need to include climate change modules in South African university curriculum.

Keywords: Climate change; knowledge; perceptions; university; students

1. Introduction

Climate change (CC) is a phenomenon that leads to the overall rise in earth surface temperature, and this warming is now known to adversely affect the environment and human health. For example, some of the public health risks attributable to climate change include, frequent flooding, extreme heat patterns and spread of communicable diseases (Nigatu *et al.*, 2014; Haines *et al.*, 2006). South Africa, being one of the under-developed countries, is susceptible to the adverse effects of climate change as it has vast agricultural activities, increasing population, informal settlements and high energy demands due to electricity generation, transport and mining.

The reality that South African cities are in the frontline of climate was demonstrated, for example, in 2017-2018 extreme drought and water restrictions in Cape Town (Curnier, 2018). High malaria cases in Limpopo province also suggest a possible expansion in malaria zones in Africa, including South Africa in the future due to proliferation of malaria vector, which has been linked to a combined influence of both temperature and rainfall (Wright *et al.*, 2015). A report on a chronological account of recent climate related events in South Africa, include the 2010-11 flooding along the Orange river, 2012 storm in Mahikeng and Mpumalanga, heavy storm in Cape Town, flood in Eastern Cape and Tornado in Kestell (Elum *et al.*, 2017). It is also evident that that agricultural sector and food security in the Southern Africa region is threatened by CC, especially in rural areas (Gbetibouo and Hassan, 2005).

Although climate change is a global phenomenon, its adverse effects need to be addressed at a local level through mass awareness as a start. The main factors that modulate awareness on climate change in developing countries include one's educational level and perception of local temperature

 doi:10.20944/preprints202312.1341.v1

change (Lee et al, 2015). Thus, improvement of basic education, public understanding and local dimensions of CC are important in engaging the residents to support CC actions.

There are few reports from developing countries and especially in Africa showing that the general population, even among educated, are unaware of the causes and impact of CC (Dana *et al.*, 2015; Kabir *et al.*, 2016; Nigatu *et al.*, 2014). There are also misconceptions and misunderstanding of climate change and its possible causes. These misconceptions seem to align to their level of education and where people live, whether rural or urban dwellings (Asekun-Olarinmoye *et al.*, 2014; Ochieng & Koske, 2013; Crona *et al.*, 2013b). In South Africa, for example, there is limited literature on peoples' level of knowledge, and perceptions on climate change and its effects on public health. Reportedly, most people have heard about climate change but the knowledge about climate change is quite modest (Alan, 2013; Nigatu *et al.*, 2014). For many lay people and the population as a whole, misconceptions and misunderstandings may cause fear about the consequences of CC (Kabir *et al.*, 2016; Haden *et al.*, 2012; Akerlof *et al.*, 2015; Crona *et al.*, 2013b). However, Ethiopian university students who knew about climate change were more likely to perceive it as a serious health threat than those who were unaware of these impacts. Thus, this study was designed to investigate the knowledge and perceptions on climate change by university students at the University of South Africa.

2. Materials and methods

2.1. Study area and design

This was a quantitative descriptive survey, conducted among the science students at the University of South Africa situated in Pretoria, South Africa. This research was carried out in the School of Science, College of Science, Engineering and Technology (CSET). The University of South Africa enrols more than 300,000 students from more than 100 countries, but most of the students were South Africans. The sample size of the school was calculated using the Cochrane's formula (for population size N>10000)

$$n = \frac{Z^2 p(1-p)}{w^2}$$

A deviation of 5%, with a confidence level of 95%.

With Z=0.196 (95% C.I), a proportion p=0.5 and w=0.05

$$n = \frac{1.96^2 0.5X0.5}{0.05^2} = 384.16.$$

To make up for the low or non-response rate of the participants, the sample size was increased to 500.

2.2. Data collection

Data was collected from the participants using a standard questionnaire adapted from similar studies with validated tools (Alan, 2013; Nigatu *et al.*, 2014 ; Ochieng &Koske 2013). The questionnnaire tool was formatted into Google form, whose link was then sent to prospective student participants. Bulk emails were sent to all students from undergraduate, postgraduate and service students in the School of Science (Chemistry, Mathematics, Physics and Statistics) through UNISA ICT.

Only when the participants consented to participate in the study and clicked on the link that took them to the google form, and only then, could they start filling in the form.

2.3. Data analysis

The Google spreadsheet was converted into excel, coded, and imported into Stata 13.0 (Statacorp, USA) for further analysis. Descriptive summary statistics such as frequency distribution mean and percentage calculation were used for most of the variables. Data was summarised and presented in form of tables. Inferential statistics were performed on desirable variables. Bivariate and multivariate logistic regression were used to determine the strength of association between

 doi:10.20944/preprints202312.1341.v1

demographic variables and perceptions towards climate change; academic level and perceptions; and academic level and knowledge. Variables with p-value less than 0.05 were considered statistically significant.

2.4. Ethical considerations

Ethical clearance to conduct the study was obtained from Sefako Makgatho Health Science University Research Ethics Committee (SMUREC) reference Number SMUREC/H/109/2017:PG). Additionally, ethical clearance was also obtained from the UNISA School of Science Ethics Review Committee, (ERC Reference Number 2018/SSR-ERC/024). Also, the ethical clearance was obtained from Research Permission Subcommittee of the University of South Africa, Research Permission Sub-Committee (RPSC) of the Senate Research, Innovation, Postgraduate Degrees And Commercialisation Committee (SRIPCC) (Ref #: 2018_RPSC_055).

The content of the email, which served to explain the purpose of the study to the participants and that they were under no obligation to complete the survey and they could withdraw from the study at any time prior to submitting. Informed consent was then obtained thereafter.

3. Results

3.1. Sociodemographic characteristics of participants

This study aimed to investigate the level of knowledge of sciences students at a university in Gauteng on climate change. Emails were sent to all 500 students in the study sample. The results were drawn from 420 students, who completed, and submitted the online questionnaire, giving a sample response rate of 84%. The respondents were predominantly male (70.2%). The participants age ranged from 18 to 72 years, with mean age of 30.6 (SD=8.0). Most of the respondents were in the 18-29-year category (53.2%).

Out of the 420 respondents, 34.8% were in 2nd year, 33.8% in 3rd year, while only 8.3% were in 4th (Honours) year of study. More than two thirds of respondents were Black (70.2%), while the rest comprised other races (White, Coloured and Indian). Majority of respondents were enrolled for science modules (33.6%), followed by mathematics (33.3%), physics (10.2%), and the least from statistics (10.2%).

The bulk of respondents lived in South Africa (95.7%), while the rest lived in Africa outside South Africa (3.1%) and Europe (0.5%). The analysis shows that 81.9% of respondents resided in urban areas, and 18.1% lived in rural areas. Table 1 presents the demographic characteristics of the study respondents.

Table 1. Demographic characteristics of participants (n=420).

Variable	Description	Freqency	%
Gender	Female	125	29.8
	Male	295	70.2
Age (in years)	age<25	101	24.1
	25-29	122	29.1
	30-34	91	21.7
	age>=35	106	25.2
Year of study	1st year	97	23.1
	2nd year	146	34.8
	3rd year	142	33.8
	4th year	35	8.3
Race	Black	295	70,2
	White	93	22,1

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	Coloured	20	4,8
	Indian	12	2,9
Enrolled qualification	Mathematics	140	33.3
	Chemistry	33	7.9
	Physics	63	15.0
	Statistics	43	10.2
	Other	141	33.8
Part of the world where respondents live	Outside of South Africa	18	3.1
	South Africa	402	95.7
Urban/Rural	Rural Area	76	18.1
	Urban Area	344	81.9

3.3. Participants' level of knowledge on climate change

When asked about their knowledge on climate change, more than 95% of respondents had heard about it (97.9%) while the rest had never heard or were not sure. Most of them (93.6%) also believed that climate change was happening, while the rest did not or were not sure.

When asked why climate change was happening, majority of respondents (87.6%) believed that it was because of human daily activities, and natural changes in the environment (60.0%). Most of them perceived that deforestation (85.2%), use of fossil fuels, (83.5%), rapid population growth, (76.9%), bush burning, (71.2%), and urbanisation (64.5%) were the main causes of climate change. However, less than half of the respondents believed that agricultural expansion, 43.3%, road construction 162 (38.6%), change in rainfall 36.4%, tobacco smoke 139 (33.1%), natural causes or act of God 32.6%, supernatural reasons 13.8% worsened climate change. Most of the respondents' responses on the major outcomes of climate change were long heat waves (94.3%), drought (92.4%), and storms/ floods (86.2%). However, a great majority of students (86.4%) wrongly believed that earthquake, pollution and hail were the effects of climate change. When asked, about the regions of South Africa that they thought would be more vulnerable to the effects of climate change, more than 60% of respondents believed that coastal towns (67.6%), inland province (61.0%), and areas near river and dams (62.9%) were vulnerable.

On the response to what climate change outcomes would affect South Africa most, a great majority of respondents thought that drought (91.7%), flooding (83.8%), coastal erosion (66.4%), and rising temperatures (93.8%) were the most responsible. Also, most respondents (81%) thought that people could slow down the impact of climate change (Table 2).

Table 2. Participants' knowledge of climate change.

Basic concepts of climate change	Not sure	No	Yes
	N(%)	N(%)	N(%)
Difference between weather and climate	43(10.2)	10(2.4)	367(87.4)
Have you heard about climate change	3(0.8)	6(1.4)	411(97.9)
Surety that climate change is happening	30(7.1)	142(33.8)	248(59.1)
Causes of climate change			
Human activities	18(4.3)	34(8.1)	368(87.6)
Natural changes in the environment	45(10.7)	123(29.3)	252(60.0)
Main causes of climate change			

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Natural causes or act of God	52(12.4)	231(55.0)	137(32.7)
Use of fossil fuels	31(7.4)	38(9.1)	351(83.6)
Supernatural reasons	55(13.1)	307(73.1)	58(13.8)
Change in rain fall	42(10.0)	225(53.6)	153(36.4)
Smoke coming from tobacco	64(15.2)	217(51.7)	139(33.1)
Bush burning	33(7.9)	88(21.0)	299(71.2)
Deforestation	34(8.1)	28(6.7)	358(85.2)
Rapid population growth	37(8.8)	60(14.3)	323(77.0)
Agricultural expansion	73(17.4)	165(39.3)	182(43.3)
Road construction	82(19.5)	176(41.9)	162(38.6)
Urbanisation	67(16.0)	82(19.5)	271(64.5)
Effects of climate change			
Storm, Flood	29(6.9)	29(6.9)	362(86.2)
Drought	19(4.5)	13(3.1)	388(92.4)
Long heat waves	12(2.9)	12(2.9)	396(94.3)
Health epidemics	73(17.4)	63(15.0)	284(67.6)
Rising sea level	-	57(13.6)	363(86.4)
Earthquake, pollution, hail	56(13.3)	62(14.8)	302(71.9)
Does climate change affect human health conditions?	34(8.1)	11(2.6)	375(89.3)
Are floods after rains becoming common in your region?	29(6.9)	204(48.6)	187(44.5)
Do you observe drought in your region?	21(5.0)	99(23.6)	300(71.4)
Desertification	113(27.0)	38(9.1)	269(64.1)
Part of South Africa more vulnerable to the effects of climate change			
Coastal towns	75(17.9)	61(14.5)	284(67.6)
Inland provinces	96(22.9)	68(16.2)	256(61.0)
Areas near river and dams	79(18.8)	77(18.3)	264(62.9)
All regions of South Africa	84(20.0)	81(19.3)	255(60.7)
What will affect South Africa because of climate change			
Sea level rise	85(20.2)	64(15.2)	271(64.5)
Drought	19(4.5)	16(3.8)	385(91.7)
Flooding	40(9.5)	28(6.7)	352(83.8)
Coastal erosion	96(22.9)	45(10.7)	279(66.4)
Rising temperatures	17(4.1)	9(2.1)	394(93.8)
Desertification	113(26.9)	38(9.1)	269(64.1)
Increasing intensity and frequency of extreme weather events	31(7.4)	11(2.6)	378(90.0)

 doi:10.20944/preprints202312.1341.v1

The three major sources of information for the first time information about climate change included TV news and radio (40%), school/university education (38.6%), and internet or social media (12.1%).

4.4. Respondents' overall knowledge on climate change (n=420)

The different components on the matrix were aggregated into a composite attitudinal score, which was then re-grouped into "know" or "do not know". An indifferent response as "I am not sure" was scored zero, correctly scoring correct answers as either "Yes" or "No" were scored as +1, while wrongly scoring a correct answer as either "Yes" or "No" were scored as 0. The mean composite score of these responses were calculated and then converted into percentage. Scores below 49% were "Low", while scores between 50 and 70% were regarded as "Good", and scores above 70% were regarded as "Excellent".

The analysis showed that respondents have an excellent (64.3%) and good (31.2%) overall knowledge of climate change. Based on the respondents' responses, more than half of respondents (51.9%) had an excellent overall knowledge and 38.1% had a good knowledge of basic concepts, of climate change. Slightly more males (94.2%) had excellent knowledge of basic knowledge of climate change than the female respondents (92.8%). Over 95% of the respondents in the 30-year old and above categories had both excellent and good knowledge on the basic concepts of climate change. The scoring for basic knowledge is summarised in Table 3.

Table 3. A 3-point Likert-scale of overall knowledge of basic concepts of climate change according to gender (N=420).

Variable		Low N(%)	Good N(%)	Excellent N(%)
Overall understanding of climate change		19(4.6)	131(31.2)	270(64.3)
Overall knowledge of causes of climate change		42(10)	169(38.1)	218(51.9)
Overall knowledge of basic concepts of climate change according to gender and age				
Gender	**Female**	6(4.8)	3(2.4)	116(92.8)
	Male	7(2.4)	10(3.4)	278(94.2)
Age Category	**age<25**	6(5.9)	4(4)	91(90.1)
	25-29	5(4.1)	4(3.3)	113(92.6)
	30-34	1(1.1)	3(3.3)	87(95.6)
	age>=35	1(0.9)	2(1.9)	103(97.2)

4.4. Respondents' perceptions of climate change

When asked about their perceptions of climate change, most of the respondents (88.8%), perceived that the earth's temperature was getting higher. Also majority (90.5%) perceived that the pattern of weather was changing in their region, and that climate change was happening in their region (90.2%). Just over three quarters of respondents (77.1%) thought that climate change was reducing crop production in their region. Most of the respondents (86.4%) perceived that climate change was affecting the economy of their country, and that climate change was affecting their way of life. However, less than half of respondents (47.9%) perceived that their families believed that climate change was a serious problem.

With respect to where climate change would harm most, respondents ranked people in developing countries (38.3%) industrialised countries (19.8%) and Africa (19.3%). Only 5.5% perceived that climate change would harm South Africa, and the minority were not sure which part

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of the world would be most harmed by climate change (17.1%). Detailed information on the respondents on perceptions of climate change in depicted in Table 4.

Table 4. *Perceptions of climate change and its impacts.*

Perceptions of climate change and its impacts	Not sure N(%)	No N(%)	Yes N(%)
Believe climate change is happening	16(3.8)	11(2.6)	393(93.6)
Difference between weather and climate	43(10.2)	10(2.4)	367(87.4)
Do you think temperature getting warmer in your region?	26(6.2)	21(5)	373(88.8)
Do you think the pattern of weather is changing in your region?	21(5)	19(4.5)	380(90.5)
Do you think climate change is happening in your region?	25(6)	16(3.8)	379(90.2)
Do you think climate change is a real problem in your region?	62(14.8)	48(11.4)	310(73.8)
Do you think climate change reduces crop production in your region?	59(14.1)	37(8.8)	324(77.1)
Do you think climate change affects the economy of your country?	34(8.1)	23(5.5)	363(86.4)
Climate change affects our way of life.	21(5)	34(8.1)	365(86.9)
Do you think your family believes that climate change is a serious problem?	117(27.9)	102(24.3)	201(47.9)
Belief climate change is happening	16(3.8)	11(2.6)	393(93.6)
When and where climate change will harm people the most?			
People in industrialised countries right now	100(23.8)	71(16.9)	249(59.3)
People in South Africa right now	81(19.3)	51(12.1)	288(68.6)
People in developed countries right now	93(22.1)	81(19.3)	246(58.6)
People in industrialised countries in few years	78(18.6)	48(11.4)	294(70)
People in South Africa in few years	74(17.6)	36(8.6)	310(73.8)

4.5. Association between socio-demographic and perceptions of respondents on climate change

Bivariate logistic regression were used to test the strength of association between socio-demographics and perceptions of climate change by the respondents. There was statistically significant association between age, subject major and the variable "climate change is happening in your region". The respondents over 25 years old more positively perceived that climate change was happening in their region than those who were younger that 25 years would (OR=1.54, 95% CI: 1.13-2.11, p=0.007). This category of participants also perceived more positively that floods after rains were becoming common in their region (OR=1.29, 95% CI: 1.08-1.53, p=0.005). The analysis also showed that students who had maths as their subject major had a more positive perception that climate change was happening in their region (OR =0.80, 95%CI: 0.67-0.95, p=0.009), that people could slow down the impact of climate change (OR=0.86, 95%CI: 0.76-0.98, p=0.025), that patterns of weather were changing in their area (OR= 0.85, 95%CI: 0.73-0.98, p=0.030), than than those who had other subject majors. Participants in the rural area perceived more positively that climate change reduced crop production in their region (OR: 0.29, 95% CI: 0.13-0.66, p=0.003) than those living in the urban

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area. The black race participants perceived more positively that floods after rains were becoming common in their region (OR=0.71, 95% CI: 0.54-0.94, p=0.016) than the other category of races. The rest of the variables, such as gender, and year of study, did not show any statistical significant association with perceptions of climate change. Table 5 gives the details of the respondents' responses.

Table 5. Association between socio-demographics and perceptions of respondents on climate change.

Variable	Details	OR	95%CI	p-value
Climate change is happening in your region				
Age	Age<25	Ref	-	-
	>age25	1.54	1.13-2.11	0.007
Gender	Female	Ref		
	Male	0.85	0.41-1.76	0.660
Subject Major	Maths	Ref		
	Others	0.80	0.67-0.95	0.009
Year of study	1	Ref	-	-
	2-4	1.03	0.73-1.48	0.842
Lived area	Rural	Ref	-	-
	Urban	0.76	0.31-1.87	0.546
Race	Black	Ref	-	-
	Others	0.74	0.51-1.06	0.098
Floods after rains are becoming common in your region.				
Age	<25 years	Ref	-	-
	>25 years	1.29	1.08-1.53	0.005
Gender	Female	Ref	-	-
	Male	0.90	0.59-1.37	0.615
Subject major	Maths	Ref	-	-
	Others	0.97	0.87-1.08	0.539
Year of study	1	Ref	-	-
	2-4	1.21	0.98-1.50	0.075
Lived area	Rural	Ref	-	-
	Urban	1.28	0.78-2.14	0.328
Race	Black	Ref	-	-
	Others	0.71	0.54-0.94	0.016
Climate change affects human health				
Age	<25 years	Ref	-	-
	>25 years	1.17	0.88-1.55	0.279
Gender	Female	Ref	-	-
	Male	1.20	0.62-2.32	0.580
Subject major	Maths	Ref	-	-
	Others	0.89	0.77-1.02	0.091

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Year of study	1	Ref	-	-
	2-4	1.26	0.89-1.79	0.185
Lived area	Rural	Ref	-	-
	Urban	0.67	0.27-1.65	0.383
Race	Black	Ref	-	-
	Others	0.64	0.46-0.89	0.008
Patterns of weather changing in your area				
Age	<25 years	Ref	-	-
	>25 years	1.26	0.93-1.70	0.128
Gender	Female	Ref	-	-
	Male	0.86	0.43-1.83	0.742
Subject major	Maths	Ref	-	-
	Others	0.85	0.73-0.98	0.030
Year of study	1	Ref	-	-
	2-4	0.99	0.69-1.42	0.958
Lived area	Rural	Ref	-	-
	Urban	0.78	0.32-1.93	0.594
Race	Black	Ref	-	-
	Others	0.70	0.49-0.998	0.049
Climate change reduces crop production in your region				
Age	<25 years	Ref	-	-
	>25 years	1.12	0.91-1.37	0.288
Gender	Female	Ref	-	-
	Male	0.69	0.41-1.16	0.685
Subject major	Maths	Ref	-	-
	Others	0.93	0.83-1.04	0.205
Year of study	1	Ref	-	-
	2-4	1.02	0.80-1.32	0.827
Lived area	Rural	Ref	-	-
	Urban	0.29	0.13-0.66	0.003
Race	Black	Ref	-	-
	Others	0.76	0.58-1.01	0.057
People can slow down the impact of climate change				
Age	<25 years	Ref	-	-
	>25 years	1.10	0.88-1.37	0.404
Gender	Female	Ref	-	-
	Male	1.35	0.81-2.26	0.256
Subject major	Maths	Ref	-	-
	Others	0.86	0.76-0.98	0.025
Year of study	1	Ref	-	-

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	2-4	0.89	0.68-1.16	0.370
Lived area	Rural	Ref	-	-
	Urban	0.76	0.39-1.49	0.425
Race	Black	Ref	-	-
	Others	1.02	0.74-1.41	0.907

5. Discussion

5.1. Socio-demographics of the respondents

The study assessed the level of knowledge and perceptions of climate change by the science students registered at the University of South Africa. Most students were younger than 35 years old of age and lived in urban areas. Similar age distribution has been reported in other similar African studies (Gemeda, 2015; Nigatu *et al.*, 2014) except for students who mostly resided in the rural areas rather than in the urban areas as observed in our study. This is in accordance with the demographic of South Africa (World Bank, 2017), where most black families reportedly reside in the urban areas. The respondents were predominantly male, which is consistent with the demography of the enrolled respondents. This differs from characteristic reported in similar studies (Alan, 2013; Nigatu *et al.*, 2014), where female students were slightly more that male students.

A very high percentage of the respondents were black, this is in line with the demographics of the country where Blacks are the majority in the country. This is reflected in other countries with similar demographic profile (Nigatu *et al.*, 2014; Gemeda, 2015). Most of the participants in this study had mathematics as their subject major, and this is because a very high percentage of students in science faculty register for mathematics modules which are compulsory for their degree.

5.2. Knowledge of climate change of respondents

This study findings showed that more than 90% of students had an excellent or a good knowledge of climate change. The analysis showed that almost all respondents had heard about climate change, thought that climate change was happening and knew the difference between climate and weather. This percentage is much high than 77.5% reported in a similar Ethiopian study (Nigatu *et al.*, 2014). Less than 40% of respondents had TV news, radio programs as source of information for climate change, only 39% from school/university and 12% from internet and social media. Internet and social media were the least sources of information on climate possibly because of reduced access to the internet in the mostly informal urban and rural settlements where most students lived. This is contrary to the results found in similar studies (McCright, 2010; Irlam et al 2023), which showed that the social media, internet and main stream media coverage have a positive impact on informing the community about climate change. The discrepancy between our study and the Ethiopian study may be due to their increased access to internet social media and mainstream media coverage since 2014.

This study also found that the knowledge of basic concepts of climate change varies with age. For example, the basic knowledge of climate change was high among older than younger students. Similar findings were reported in a similar study in Ethiopia (Nigatu *et al.*, 2014). The fact that these perceptions were not associated with the year of study, could mean that older people have seen more of the changes in the climates lived through more floods than young people.

Based on the 420 participants, a high number of respondents were in 2nd year and 3rd year. These results are similar to those reported in Ethiopia in terms of participants response rate per year of study (Gemeda, 2015). We did not further investigate the reason for this trend in response frequencies, but it is possible that being in a higher year of study led to more knowledge of the subject and therefore a greater enthusiasm to take part in the subject debate. This may also be observed as a divergence from average adults in terms of knowledge on climate change, as being in a science class appears to also reinforce their perceptions on the risks that climate change pose to the public (Rodríguez et al, 2022). However, other studies may suggest that ideology, worldviews (informed

 doi:10.20944/preprints202312.1341.v1

through, television and radio, social media, internet,), are more responsible in shaping individual's beliefs perceptions than the scientific knowledge on climate change (Kahan et al, 2012).

Climate change is best understood if the individuals possess both an understanding of climate change science and be able to reason from evidence that is presented through observation of earthly events and related phenomena. In this study, the great majority of respondents (over 85%) correctly indicated that climate change was happening because of human activities, while less than two thirds (60%) wrongly thought that climate change was happening because of natural changes in the environment. Similar results were reported in one study where high school students from Philippines had alternative perceptions or causes of climate change (Pitpitunge, 2013) and also by South African university students (Irlam et al, 2023).

Many respondents identified deforestation, use of fossil fuels, and rapid population growth as the top three main causes of climate change, followed by bush burning, and urbanisation. Some of these factors maybe inappropriately associated with climate change as reported elsewhere (Pitpitunge, 2013). However, the respondents did not perceive that agriculture, road construction, change in rainfall, smoke coming from tobacco and natural causes or act of God were causing climate change. These findings are inconsistent with the studies in Ethiopia (Nigatu *et al.*, 2014) and Nigeria (Asekun-Olarinmoye *et al.*, 2014), where supernatural reasons were prominent among respondents as causes of climate change. The inconsistency could have arisen due differences in cultural beliefs between the two countries and South Africa.

Long heat waves were ranked as top impact of climate change, followed by drought, and human activities. This is probably due to the hot weather and drought that South Africa has experienced in recent years. Respondents gave least consideration for flood after rains, this is inconsistent with findings in Ethiopia (Asekun-Olarinmoye *et al.*, 2014; Nigatu *et al.*, 2014), mainly because of local conditions in the respective countries where the studies were conducted.

5.3. Perceptions towards climate change

Majority of the respondents in this study perceived that temperature was getting warmer, pattern of weather was changing, and that climate change was really happening. These findings are consistent with those reported in an Ethiopian study (Nigatu *et al.*, 2014). Majority of respondents thought that climate change was reducing crop production and thus affecting the economy of their country. About 90% of respondents were somewhat or very worried that climate change was affecting their way of life. These perceptions are shared by Taiwanese and Norwegian students, who had similar concerns on the impact of climate change in their lives (Leohartdt et al 2022; Li and Liu, 2022). However, less than half of the respondents' families believed that climate change was serious problem. A study conducted in the United States showed the importance of family discussions on influencing climate change perceptions and behaviours which this setting can draw from (Dayton *et al.*, 2022). The study respondents also perceived that climate change was a very serious threat to human health. This is in line with a German study that showed majority of its respondents to perceive climate change was equally a threat to human health (van Baal *et al.*, 2023) and more people perceive that human health is harmed by climate change (Dana *et al.*, 2015). The positive perception observed in both studies could be related to their level education, being university students.

More than two-thirds of respondents thought that people in South Africa would be harmed right now or in a few following years, and in industrialised countries in few years to come. Just over half of the respondents believe that people in industrialised and developed countries will be harmed right now. This is because of the belief that people in industrialised countries were well equipped to deal with climate change and its consequences (Caribbean Institute of Media and Communication, 2012).

The analysis also shows that there was a negative association between perceptions that reduction of crop production and respondents living in urban area. The negative perception of urban dwellers is probably because urban dwellers do not interact with crop production rather with processed food. These results corroborate the results obtained by (Nigatu *et al.*, 2014) in Ethiopia, that there was a close association between people perceptions, their educational status and where they lived. However, we did not find any association between level of education and perception of climate

change as reported by (Nigatu *et al.*, 2014). We think that this due to the high access to internet and reporting in the mainstream media on climate change.

5.4. Limitations of the study

The study was restricted to the students of the school of sciences. Therefore, the results may not be generalised to all students of University of South Africa, nor to all students in South Africa..

Because of the online survey, it is plausible that many students who have limited internet connection did not respond to the survey, therefore restricting the profile of students surveyed. This could have limited the generalisability and the comparison of this study at the national and international levels.

5.5. Conclusion

The study has demonstrated a high level of knowledge on the basics of climate change by the science students at the University of South Africa. However, that academic level of study was not positively associated with the perception of climate change being a real problem. Age and living in urban area were associated with the students' positive perceptions of climate change. There is a dire need to create more awareness of climate change in various South African communities.

Authors' Contributions: PKC, JM both contributed in the conceptualisation of the study. JM collected study data. PKC and AM both did data analysis and write-up of manuscript. TD Manuscript write-up: review and editing.

Acknowledgements: We acknowledge the willingness of students at University of South Africa to participate in this study.

Competing Interests: The authors declare no competing interest

References

Akerlof, K. L., Delamater, P. L., Boules, C. R., Upperman, C. R. and Mitchell, C. S. (2015). Vulnerable populations perceive their health as at risk from climate change. *International Journal of Environmental Research and Public Health*, 12: 15419–15433.

Alan, T. K. H. (2013). Students' perceptions on climate change and engagement in low-carbon behaviours: implications for climate change education in Hong Kong. *University of Hong Kong, Hong Kong.*

Asekun-Olarinmoye, E., Bamidele, J. O., Odu, O. O., Olugbenga-Bello, A. I., Abodunrin, O., Adebimpe, W. and Adeomi, A. A. (2014). Public perception of climate change and its impact on health and environment in rural southwestern Nigeria. *Research and Reports in Tropical Medicine*, Volume 5: 1–10.

Caribbean Institute of Media and Communication (2012). *Report on Climate Change Knowledge , Attitude and Behavioural Practice Report on Climate Change Knowledge , Attitude and Behavioural Practice*. Kingston, Jamaica.

Center for Science Education (2015). *Climate Mitigation and Adaptation | UCAR Center for Science Education* (on-line).

Crona, B., Wutich, A., Brewis, A. and Gartin, M. (2013b). Perceptions of climate change: Linking local and global perceptions through a cultural knowledge approach. *Climatic Change*, 119: 519–531.

Curnier, B. (2018). *Cape Town water crisis: the reality of cities facing climate change* (on-line). https://www.carbontrust.com/news/2018/03/cape-town-water-crisis-climate-change/. Accessed 8 March 2019.

Dana, G. P. T., Roy, S. and Haque, M. R. (2015). Adolescents Perception on Environmental Change and Health Risk in Two Divisions of Bangladesh. *Open Journal of Social Sciences*, 03: 71–79.

Dayton, L., Balaban, A., Scherkoske, M. and Latkin, C., 2023. Family communication about climate change in the United States. *Journal of Prevention*, *44*(4), pp.373-387.

Elum, Z. A., Modise, D. M. and Marr, A. (2017). Farmer's perception of climate change and responsive strategies in three selected provinces of South Africa. *Climate Risk Management* (on-line), 16: 246–257.

Gbetibouo, G. A. and Hassan, R. M. (2005). Measuring the economic impact of climate change on major South African field crops: a Ricardian approach. *Global and Planetary Change*, 47: 143–152.

Gemeda, D. O. (2015). Perceptions of Climate Change among Natural Resources Management Students at Jimma University , Ethiopia. *International Journal of Sciences: Basic and Applied Research*, 23: 106–119.

Haden, V. R., Niles, M. T., Lubell, M., Perlman, J. and Jackson, L. E. (2012). Global and Local Concerns: What Attitudes and Beliefs Motivate Farmers to Mitigate and Adapt to Climate Change? *PLoS ONE*, 7.

Haines, A., Kovats, R. S., Campbell-Lendrum, D. and Corvalan, C. (2006). Climate change and human health: impacts, vulnerability and public health. *Public health* (on-line), 120: 585–596.

Irlam, J., Razzak, Z., Parker, Q.A. and Rother, H.A., 2023. Student knowledge and perceptions of climate change and environmental sustainability at the Faculty of Health Sciences, University of Cape Town, South Africa. African Journal of Health Professions Education, 15(1), pp.4-8.

Kabir, M. I., Rahman, M. B., Smith, W., Lusha, M. A. F., Azim, S. and Milton, A. H. (2016). Knowledge and perception about climate change and human health: findings from a baseline survey among vulnerable communities in Bangladesh. *BMC public health*, 16: 1–10.

Kahan, D. M., Peters, E.,Wittlin, M., Slovic, P., Ouellette, L. L., Braman, D.,&Mandel, G. (2012). The polarizing impact of science literacy and numeracy on perceived climate change risks. Nature Climate Change, 2(10), 732–735.

Lee, T.M., Markowitz, E.M., Howe, P.D., Ko,C. and Leiserowitz, A.A. (2015) Predictors ofpublic climate change awareness and risk perception around the world. Nat. Clim. Ch., 5: 1014-1020.

Leonhardt, M., Granrud, M.D., Bonsaksen, T. and Lien, L., 2022. Associations between mental health, lifestyle factors and worries about climate change in Norwegian adolescents. *International Journal of Environmental Research and Public Health*, *19*(19), p.12826.

Li YY, Liu SC. Examining Taiwanese students' views on climate change and the teaching of climate change in the context of higher education. Research in Science & Technological Education. 2022 Oct 2;40(4):515-28.

McCright, A. M. (2010). The effects of gender on climate change knowledge and concern in the American public. *Population and Environment* (on-line), 32: 66–87.

McMichael, A. J., Campbell-Lendrum, D. H., Corvalan, C. F., Ebi, K. L., Githeko, A. K., Scheraga, J. D. and Woodward, A. (2003). Climate Change and Human Health: Risks and Response. *Geneva: World Health Organization*, 23: 205.

Nayak, J., 2010. An investigation into the awareness, knowledge and attitude of student teachers towards climate change. *Gyanodaya: The Journal of Progressive Education*, *3*(1), pp.13-20.

Nigatu, A. S., Asamoah, B. O. and Kloos, H. (2014). Knowledge and perceptions about the health impact of climate change among health sciences students in Ethiopia : a cross-sectional study. *BMC Public Health*, 14: 587.

Ochieng, M. and Koske, J. (2013). The Level of Climate Change Awareness and Perception among Primary School Teachers in Kisumu Municipality, Kenya. *International Journal of Humanities and Social Science*, 3: 174–179.

Pitpitunge, A. D. (2013). Students' Perceptions about Climate Change. *Asian Journal of Biology Education*, 7.

Rodríguez Pacheco, F.L., Mejía Rodríguez, D.L. and Sánchez Buitrago, J.O., (2022). Knowledge and Perceptions of Climate Change Among University Students. Diversitas: Perspectivas en Psicología, 18(1), pp.130-145.

van Baal, K., Stiel, S. and Schulte, P., 2023. Public Perceptions of Climate Change and

Health—A Cross-Sectional Survey Study. *International Journal of Environmental Research and Public Health*, *20*(2), p.1464.

World Bank (2017). *Urban population Data* (on-line). https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?end=2017&name_desc=true&start=2015. Accessed 13 February 2019.

Wright, C. Y., Norval, M. and Albers, P. N. (2015). Climate change, public health and COP21 – a South African perspective. *South African Medical Journal* (on-line), 105: 997. http://www.samj.org.za/index.php/samj/article/view/10232. Accessed 8 March 2019.