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Analysis of Fire Safety Preparedness and Risk in University Housing

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Abstract

In the growing field of fire safety and preparedness, university dormitories are a prime location to observe unique residential circumstances that contribute to fire risk. This study will utilize survey responses from student housing residents from four universities to analyze if and how certain factors affect fire safety preparedness. Additionally, the results will be compared to existing literature to examine any gaps in research or contributions to current data. This study seeks to confirm that university housing is a higher risk category of residential fires because of student contributions and a lack of direct intervention to improve fire safety preparedness.

Keywords: Fire Safety, Fire Risk, University Housing, Students

Introduction

Fire safety and preparedness are critical aspects of public safety. To ensure a structure or occupancy is reasonably safe there must be functional, user-friendly fire safety systems in conjunction with informed occupants. When reviewing residential fire safety, there is a unique demographic that often cannot be analyzed parallel to other occupancy types. Specifically speaking, college dormitories—dorms—pose a unique environment because of the demographic of the occupants. According to the National Fire Protection Association, dorms can range in size and structure type depending on the college but are more vulnerable than residential apartment buildings—which share a similar structure—because the residents tend to be 17-21 years of age who may lack experience with fire safety systems or behave more recklessly. Additionally, the culture of dorm-living is not comparable to adult-residencies due to a lack of responsibility/accountability for the living spaces. The demographic of college students tends to consist of young adults who are experiencing living on their own for the first time. This is an important aspect to consider because young residents likely have never needed to consider fire safety and preparedness for their living space as that aspect was likely maintained by other people such as teachers, parents/guardians, managers, etc. For this reason, many colleges have a wide array of banned items such as candles, smoking paraphernalia, grills, and space heaters as a measure to prevent fires by attempting to remove potential ignition points or human error inputs. However, many college students will still have access to an ignition point via a private or communal kitchen or bringing in banned items. Additionally, college dorms have the same risks as other occupancies from ignition points such as water heaters, faulty electrical wiring, faulty appliances, or dryer machine vents. So, universities acknowledge the student's lack of

responsibility by banning items, but ultimately if those are included in total fire risks, university housing surpasses other residential occupancy types.

Literature Review

There is a limited body of research dedicated to improving fire safety specifically within university dormitories. The readily available research stems from China, as their student population is the largest in the world and fire safety at universities is a priority. Common ground areas are: the growing urgency of research because every country is seeing an increase in college enrollment and an increased need for student housing. Additionally, as pointed out in “Research on Fire Risk Assessment and Safety Management of College Students’ Dormitory” (Yijun and Chunying, 2017), “Numerical Simulation of Dormitory Building Fire and Personnel Escape Based on Pyroism and Pathfinder” (Long et al. 2017), and “Survey and Countermeasure Discussion of College Students’ Campus Fire Safety” (Meng et al. 2016) the housing that is provided currently has been around for decades, so many fire safety systems are retrofitted or non-existent with higher risk values because of the structures’ age. There is also the common ground that students do not have the practical knowledge to mitigate fire risks or respond to a fire emergency in an effective manner.

What (Yijun and Chunying, 2017), (Long et al. 2017), and (Meng et al. 2016) all miss are the contributing factors of the student’s. None of the mentioned papers discuss specific student demographics or replicable data. Every university has semi-unique housing, with different designs, materials, and safety systems. Additionally, every university has different student demographics which furthermore vary year to year. This study will attempt to fill those gaps by examining multiple universities simultaneously to increase the chance that the findings will be replicable across more universities instead of making isolated data findings at one university.

Also, while there is no shortage of fire risk assessment studies, this specific topic is still in its preliminary stages of peer reviewed research. However, every university in the U.S. that has dormitories should (as recommended by the National Fire Protection Association [NFPA]) have an annual fire safety review where incidents and improvements are tracked and analyzed. The three main universities being surveyed all have available reports as recommended. Since the reports are published annually and there are no references to past years in the data, they are not helpful in establishing past fire incidents reliably. However, the reports do serve as evidence for what fire safety systems and resources are available at the university such as how many times a year fire drills are conducted. This information can then be contrasted with student responses to gauge reliability.

Theory

The key concepts in this research are the relationships between existing fire safety resources in university housing, the student-based contributions to fire risk, and the current recommendations for mitigating fire risk in university housing. Some research suggests that off-campus housing poses even greater risk because of the lack of supervision for a parallel living environment (NFPA, 2019). However, since so many universities require students to live on campus for 1-4 years of their academic careers, this framework approaches an unavoidable circumstance. Additionally, the target demographic, unlike off-campus housing, has possible routes of intervention within the scope of university policy and procedural action. The problem, at its core, is that students living in university housing are often experiencing their first time living with their peers, without parental/guardian supervision, and without ownership of the residency. This, according to the literature above, creates an environment void of responsibility and lays the foundation for high-risk activity. This high-risk activity may not even be intentional,

but rather, without supervision, students are less likely to learn or adhere to proper fire safety. Regular activities such as cooking or doing the laundry may be experienced for the first time for many students, but avoidable errors and preventable accidents in those activities may not be prevented because students may not be informed. Furthermore, they may not ask questions if something goes awry. In this critical stage of development for many students, starting a fire or being affected by a fire may have negative impacts on their academic enrollment or academic success. Also, a fire on university property has widespread financial impacts for students and the university itself. So, determining trends in replicable factors, or fire risks, are can help determine strong recommendations.

Data and Methods

The primary method will be a short survey consisting of three distinct sections. The first section will ask basic demographic information: age, sex, language considerations, duration of campus residency, and university of attendance. It will not gather any personal/identifiable information from students to encourage honest answers. The second section of questions will determine what the student's current understanding of existing fire safety resources in their dormitory is. These questions and the next set will be loosely based on the NFPA campus fire checklist (NFPA, 2019). The third section will determine what the student contribution, or lack thereof, to fire risk is. The data findings should show clear trends such as a decrease in fire risk contributions as age increases.

The survey will be distributed to the following four universities in Nebraska: University of Nebraska-Lincoln (UNL), University of Nebraska-Omaha (UNO), Creighton University, and Bellevue University. However, responses from other universities are expected and the survey

allows for that distinction. The survey also allows for exceptions in the age range, so graduate students are also potential data points. Finally, the target of the survey is students who previously or currently live in university housing. The survey will automatically end for students without that experience. For reference, the survey is viewable in appendix A and the response data visualizations are viewable in appendix B.

Results and Analysis

The survey was active for a total of five days and accumulated 100 respondents. It was shared via three strategies: social media, in-person, and university newsletters. The demographic results revealed some limitations to the survey analysis. 66.27% of respondents were from the University of Nebraska-Omaha so the overall results don't show trends that are necessarily applicable to other universities like initially intended. 82.47% of respondents were between the age of 19 and 22, which is reflective of the average university housing age demographics. Only 32.67% of respondents were male, which may have had an effect on the overall trends.

Ultimately, there appeared to be very few trends when results were filtered for demographics, meaning that responses varied equally regardless of age, sex, native language, university, or duration of residency. In contrast to the hypothesis that college students contribute significantly to fire risk, the responses show that most students only engage in 3-6 general risk behaviors in their dormitories out of the 10 available risk categories. When asked what fire safety systems or resources were available in their dormitories there appeared to be no clear trend at all. The phrasing of the question may have caused error in this response, the students may not have been correct in their assertions, or the students may not have been familiar or able to identify what the system or resource was and may have answered incorrectly. Whatever the cause, there is a known error because there should have been trends when results were filtered by university,

making these results inconsequential. Another area where a trend was anticipated but not received, was the amount of trust students had in each other and the fire safety systems available. Areas that confirmed the hypothesis were students' dependency on university housing for academic enrollment and the near consensus that students believe their given university could do more to reduce fire risks and inform students.

After lengthy review of the data, it is possible that the survey was either not structured properly or the sample size was too small. If the survey was structured to include more detailed demographic information such as background knowledge, specific housing—all the surveyed universities have multiple types of housing available—or even estimated value of belongings within a student's dormitory, there may have been clearer trends. Additionally, had the survey been open for more than five days to allow for more responses, existing trends may have been further confirmed and areas that showed no apparent trends initially may have either started to form trend or, in contrast, further confirm that students equally vary.

Summary

Public safety is the responsibility of every person and agency, including universities and their students. Fire safety is a topic that is becoming central to the quickly growing category of higher education. This research attempted to determine the factors that lead to higher fire risks in university housing. However, with a limited sample size and inadequate sample diversity, many of the data is inconsequential. Yet, there is consensus that universities could do more to reduce fire risk and inform students on fire safety and preparedness resources. As a result, the only recommendations that this research can support are more assertive risk reduction information on behalf of universities. This could be in the form of mandatory fire drills, floor meetings to discuss fire safety systems or evacuation procedures, hiring dedicated fire safety professionals to

manage these aspects of campus living, etc. Attending college is slowly becoming a benchmark of most professional fields and many students rely on safe housing to complete their degree programs. When that housing is provided by the university, it becomes their responsibility to adequately inform students and maintain fire safety systems.

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Appendix A

Start of Block: Block 1

Demographics What is your current age?

25+

18 19 20 21 22 23 24 25

Current Age ()	
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Demographics Which of the following best describes you?

- Male (1)
 - Female (2)
 - Non-binary / third gender (3)
 - Prefer not to say (4)
-

Demographics Which of the following best describes you?

- I only speak English (1)
- I am bilingual, English IS my first language (2)
- I am bilingual, English is NOT my first language (3)

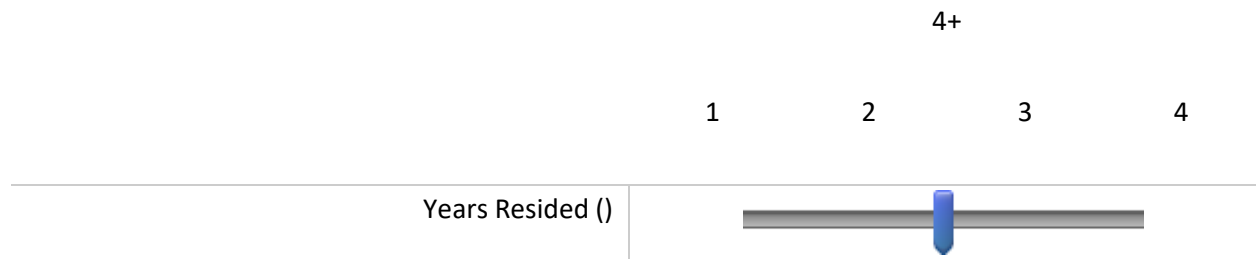
Demographics Do you currently reside in university provided housing or dormitories?

- Yes (1)
- No (2)

Demographics What University do you currently attend?

- University of Nebraska Omaha (1)
- University of Nebraska Lincoln (2)
- Bellevue University (3)
- Creighton University (4)
- None of the above (5)

Demographics How many years have you lived in University housing?



Fire Preparedness Have you ever participated in a fire evacuation drill provided at your university?

- No, the university did not provide them (1)
- No, but the university did provide drills (2)
- Yes, but only once (3)
- Yes, multiple times (4)

Fire Preparedness The following questions are on fire safety systems or emergency preparedness resources. Choose the option that best fits your university housing.

	My dorm doesn't have this (1)	My dorm has this (2)	I'm not sure (3)
Evacuation Procedures (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pull Alarms (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fire Extinguishers (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
First Aid Kit (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AED (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Fire Preparedness Are any of the following present in your university housing?

	Unsure (1)	Yes (2)	No (3)
Smoke Detector (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Carbon Monoxide Detector (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fire Sprinkler (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fire Alarm (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

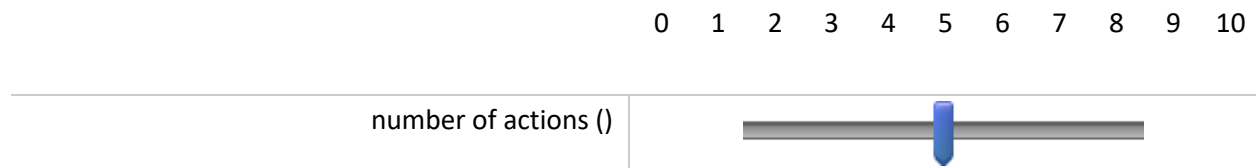
Fire Preparedness With your current knowledge, what is the proper way to use a fire extinguisher?

- I don't know (1)
- Pull the pin, aim at the base of the fire, squeeze handle, sweep side to side (2)
- Pull the pin, aim around fire, squeeze handle, sweep up and down (3)
- Pull the pin, aim above fire, squeeze handle, hold steady and straight (4)

Fire Risk Move the slider to the number corresponding to how many things you have done inside a dormitory. Responses are anonymous.

- 1) Cooked food using a microwave
- 2) Cooked food using a stove/oven
- 3) Lit a candle
- 4) Smoked a cigarette or marijuana
- 5) Used a grill indoors

- 6) Disabled the smoke alarm
- 7) Did not remove the lint from the drying machine after use
- 8) Tampered with or removed a safety resource i.e. fire extinguisher, first aid kit, etc.
- 9) Consumed alcohol or controlled substances
- 10) Used every outlet in a room simultaneously OR used every slot on a power strip simultaneously



Fire Preparedness Using your current knowledge, what is the correct way to extinguish a grease fire?

- I don't know (1)
- Pour water on the fire (2)
- Push air into the fire by waving a towel (3)
- Cover the fire (4)
- Add more grease to the fire (5)

Fire Risk Rate the following statements on your housing environment.

	Not at all (1)	Sometimes (2)	Usually (3)	Always (4)
I trust my peers will not start a fire (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I trust that the fire safety systems are functional (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Fire Risk How prepared do you feel about fire safety issues?

- Very prepared (1)
 - Somewhat prepared (2)
 - Not at all prepared (3)
-

Fire Risk Do you feel that your university could do more to reduce fire risks or inform students?

- No (1)
 - Yes (2)
-

Fire Risk Have you ever, accidentally or intentionally, started a fire in your dormitory?

Responses are anonymous

Yes (1)

No (2)

Fire Risk Answer the following questions.

'1' meaning least likely or least important.

'3' meaning neutral.

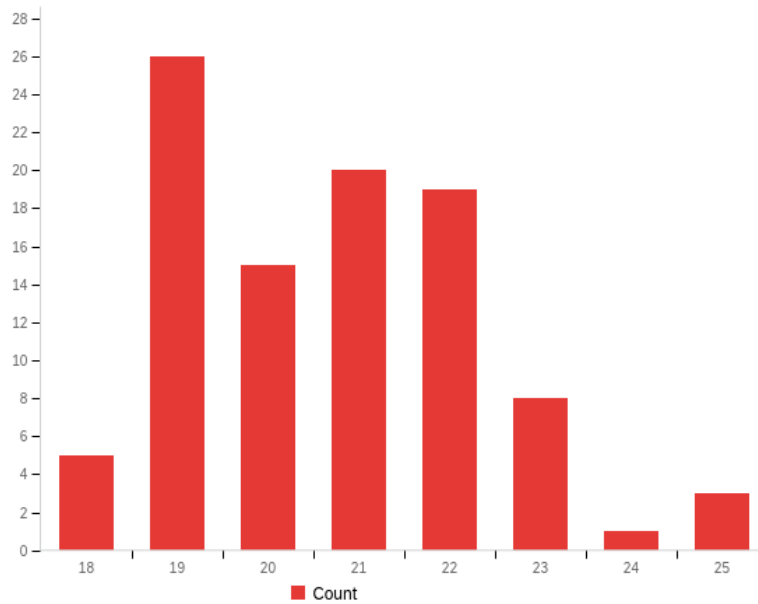
'5' meaning most likely or most important.

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
How important is fire safety to you? (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How important is university housing to your academic enrollment? (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
What is the likelihood that you would stay enrolled in university if you were displaced by a fire incident? (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

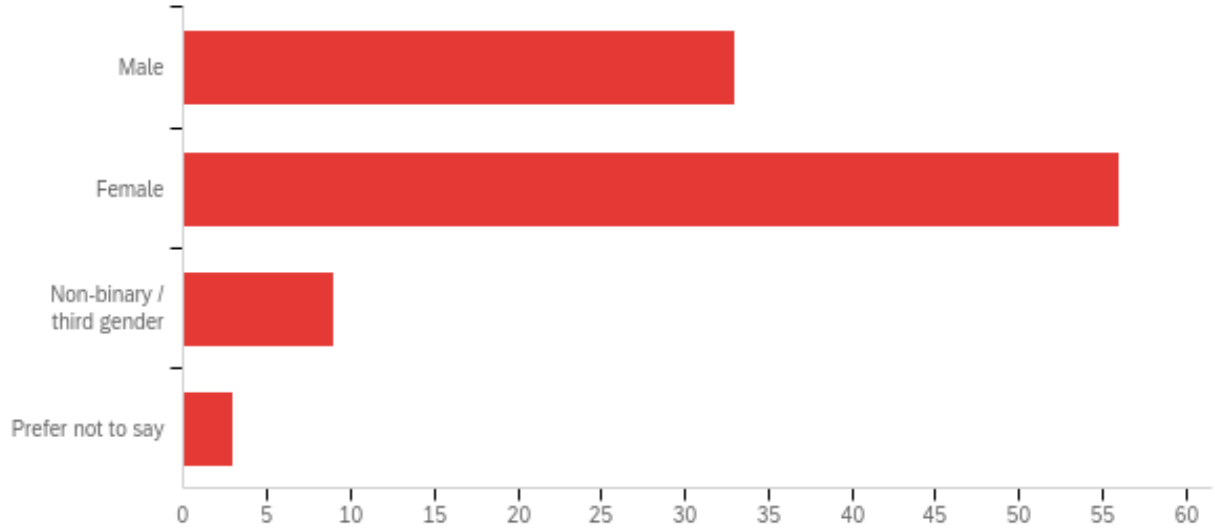
Appendix B- Survey Responses

Demographics - What is your current age?

#	Answer	%	Count
18	18	5.15%	5
19	19	26.80%	26
20	20	15.46%	15
21	21	20.62%	20
22	22	19.59%	19
23	23	8.25%	8
24	24	1.03%	1
25	25	3.09%	3
	Total	100%	97

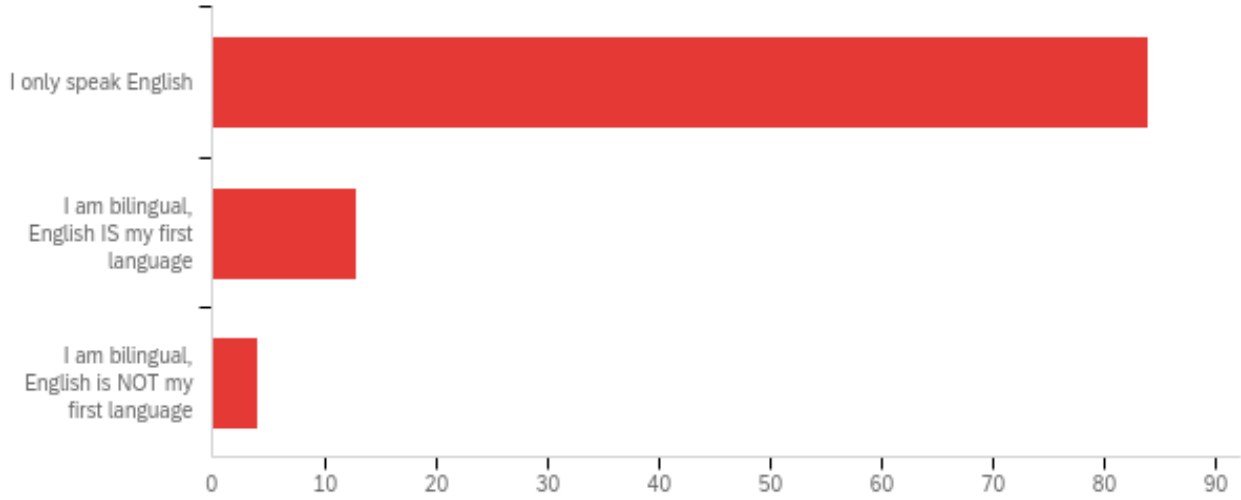


Demographics - Which of the following best describes you?



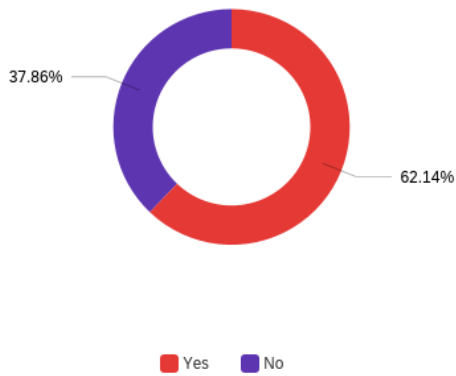
#	Answer	%	Count
1	Male	32.67%	33
2	Female	55.45%	56
3	Non-binary / third gender	8.91%	9
4	Prefer not to say	2.97%	3
	Total	100%	101

Demographics - Which of the following best describes you?

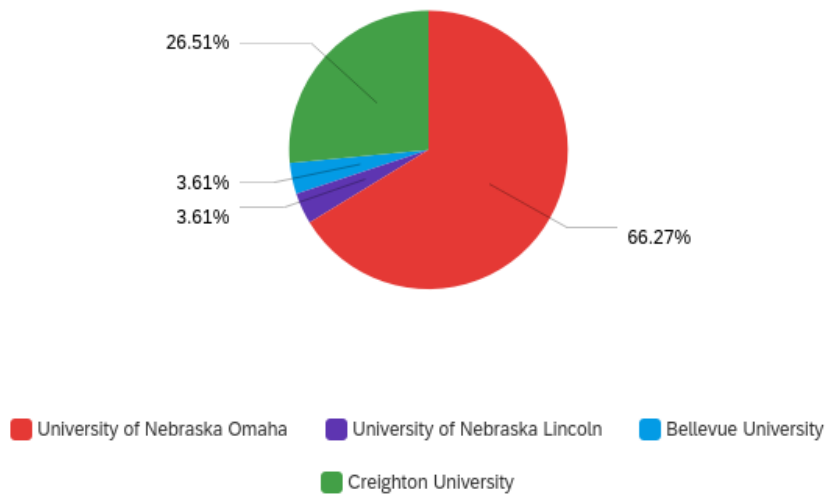


#	Answer	%	Count
1	I only speak English	83.17%	84
2	I am bilingual, English IS my first language	12.87%	13
3	I am bilingual, English is NOT my first language	3.96%	4
	Total	100%	101

Demographics - Do you currently reside in university provided housing or dormitories?



Demographics - What University do you currently attend?

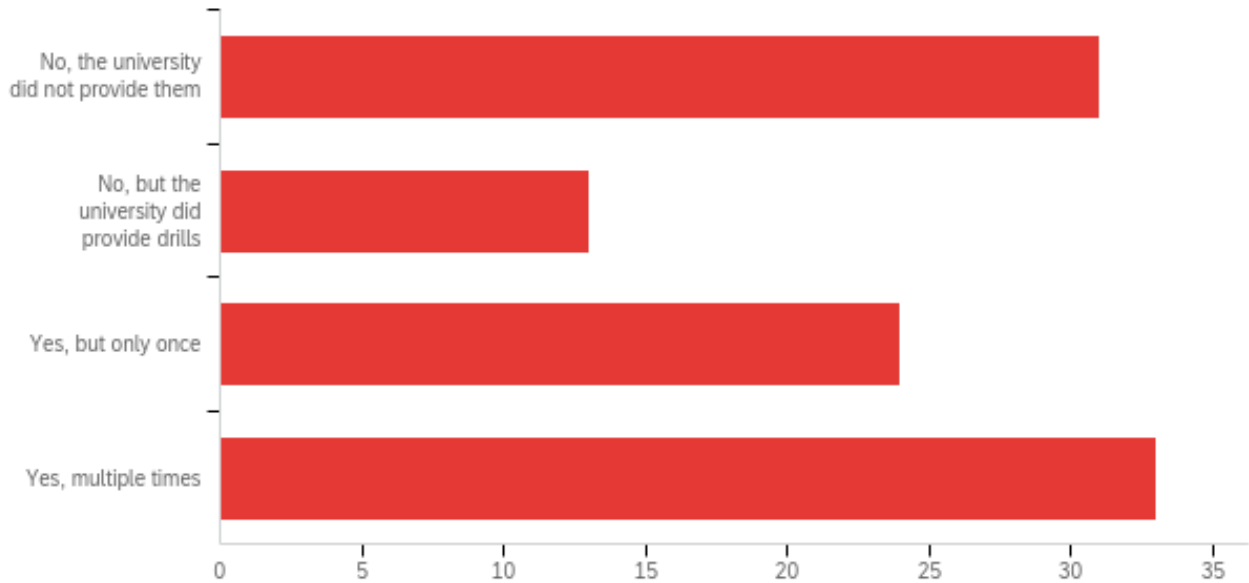


#	Answer	%	Count
1	University of Nebraska Omaha	66.27%	55
2	University of Nebraska Lincoln	3.61%	3
4	Creighton University	26.51%	22
3	Bellevue University	3.61%	3
	Total	100%	83

Demographics - How many years have you lived in University housing?

#	Answer	%	Count
1	1	35.23%	31
2	2	36.36%	32
3	3	14.77%	13
4	4	13.64%	12
	Total	100%	88

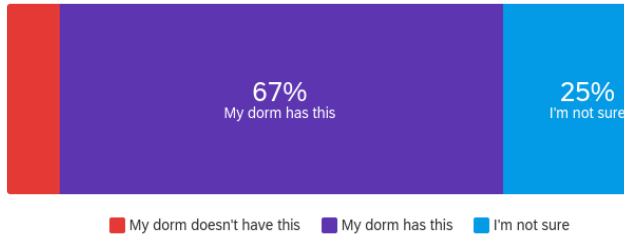
Fire Preparedness - Have you ever participated in a fire evacuation drill provided at your university?



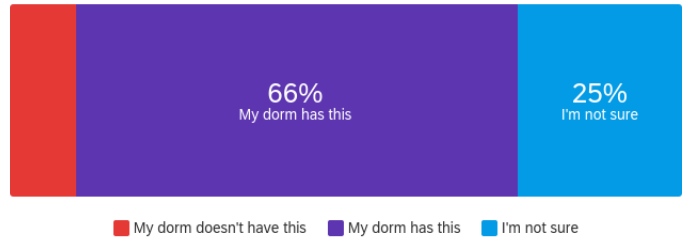
#	Answer	%	Count
1	No, the university did not provide them	30.69%	31
2	No, but the university did provide drills	12.87%	13
3	Yes, but only once	23.76%	24
4	Yes, multiple times	32.67%	33
	Total	100%	101

Fire Preparedness - The following questions are on fire safety systems or emergency preparedness resources. Choose the option that best fits your university housing.

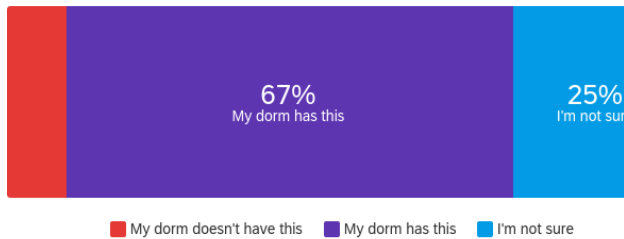
Evacuation Procedures



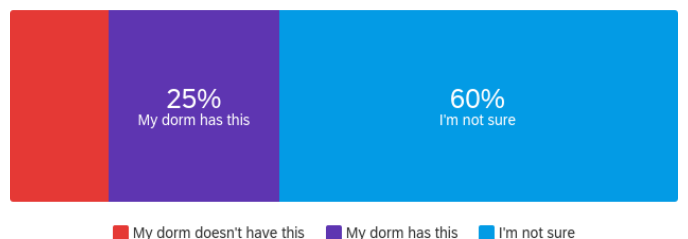
Fire Extinguishers



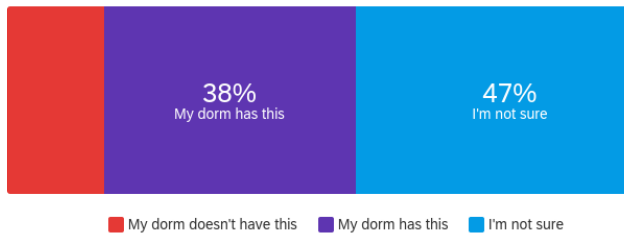
Pull Alarms



AED

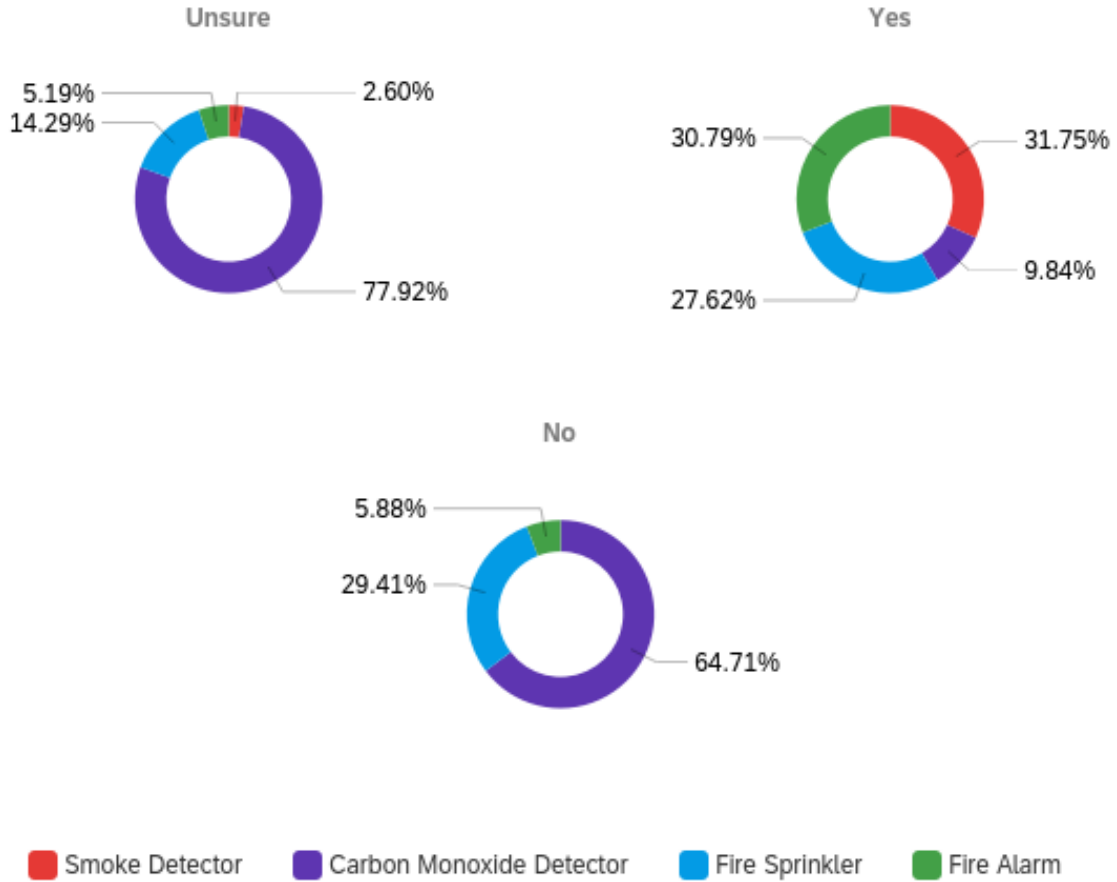


First Aid Kit



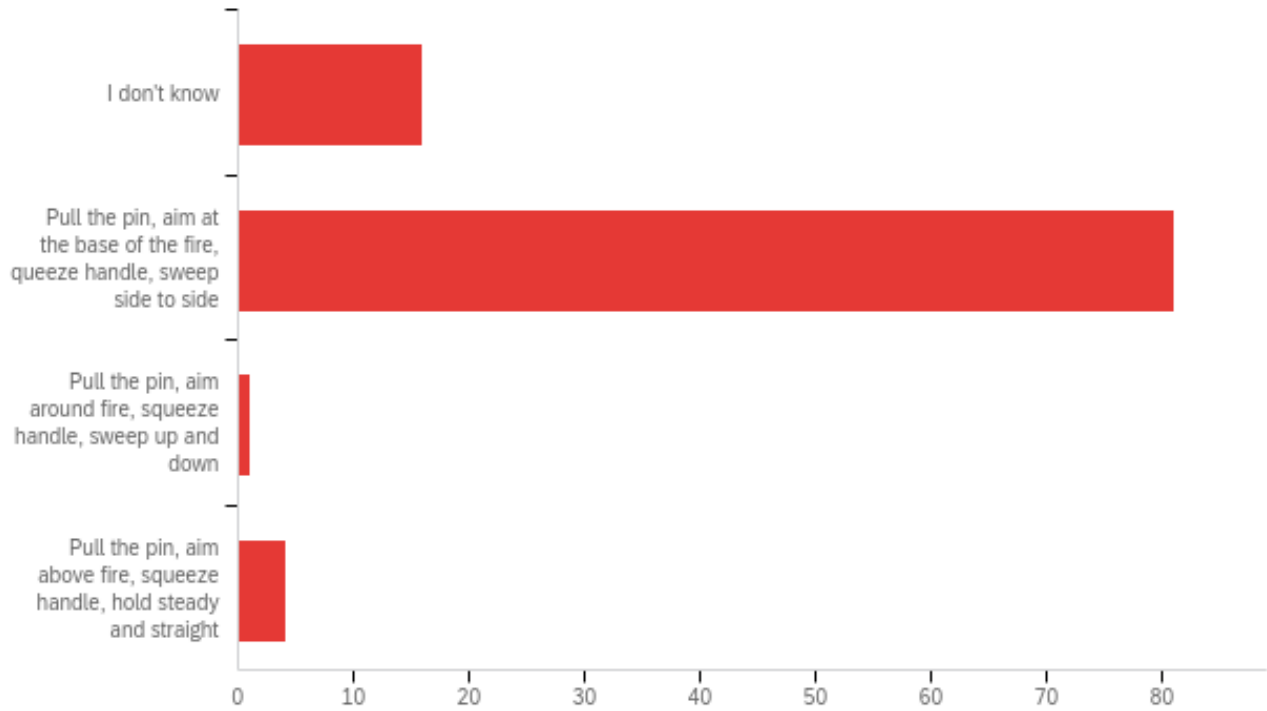
#	Question	My dorm doesn't have this		My dorm has this		I'm not sure		Total
1	Evacuation Procedures	7.84%	8	66.67%	68	25.49%	26	102
2	Pull Alarms	8.82%	9	66.67%	68	24.51%	25	102
3	Fire Extinguishers	9.80%	10	65.69%	67	24.51%	25	102
4	First Aid Kit	14.71%	15	38.24%	39	47.06%	48	102
5	AED	14.71%	15	25.49%	26	59.80%	61	102

Fire Preparedness - Are any of the following present in your university housing?



#	Question	Unsure		Yes		No		Total
1	Smoke Detector	1.96%	2	98.04%	100	0.00%	0	102
2	Carbon Monoxide Detector	58.82%	60	30.39%	31	10.78%	11	102
3	Fire Sprinkler	10.68%	11	84.47%	87	4.85%	5	103
4	Fire Alarm	3.92%	4	95.10%	97	0.98%	1	102

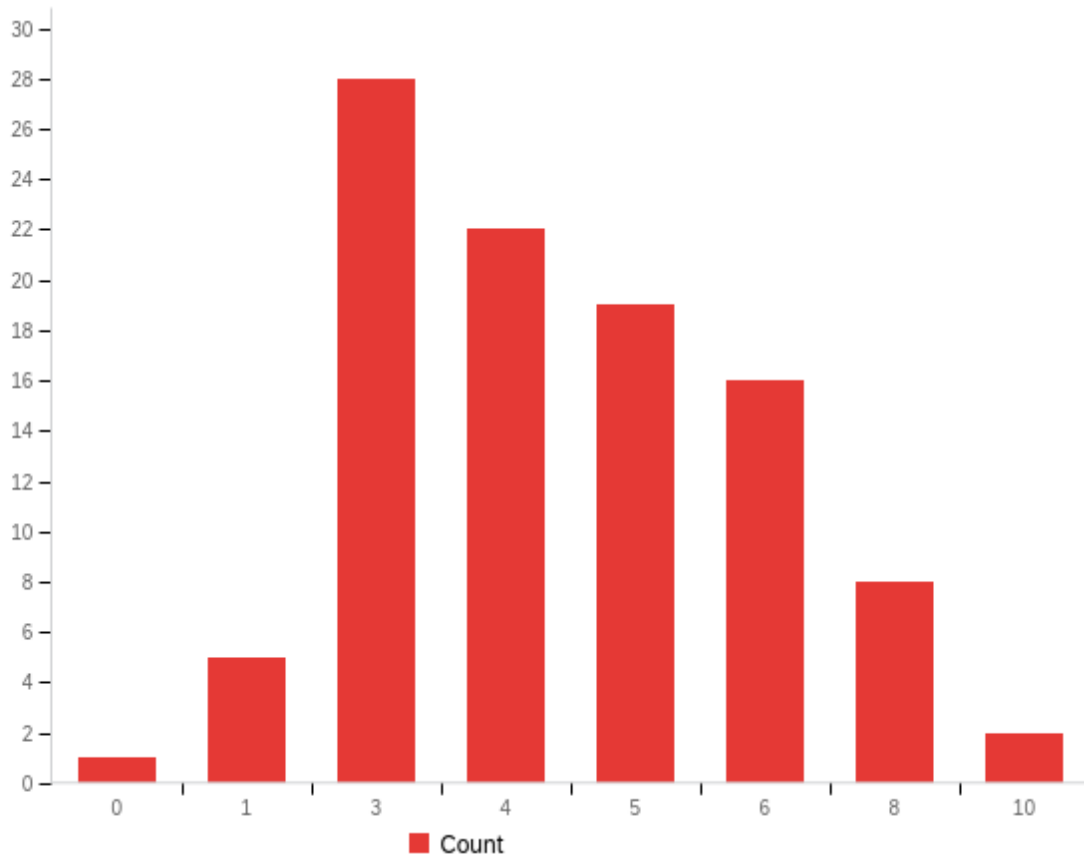
Fire Preparedness - With your current knowledge, what is the proper way to use a fire extinguisher?



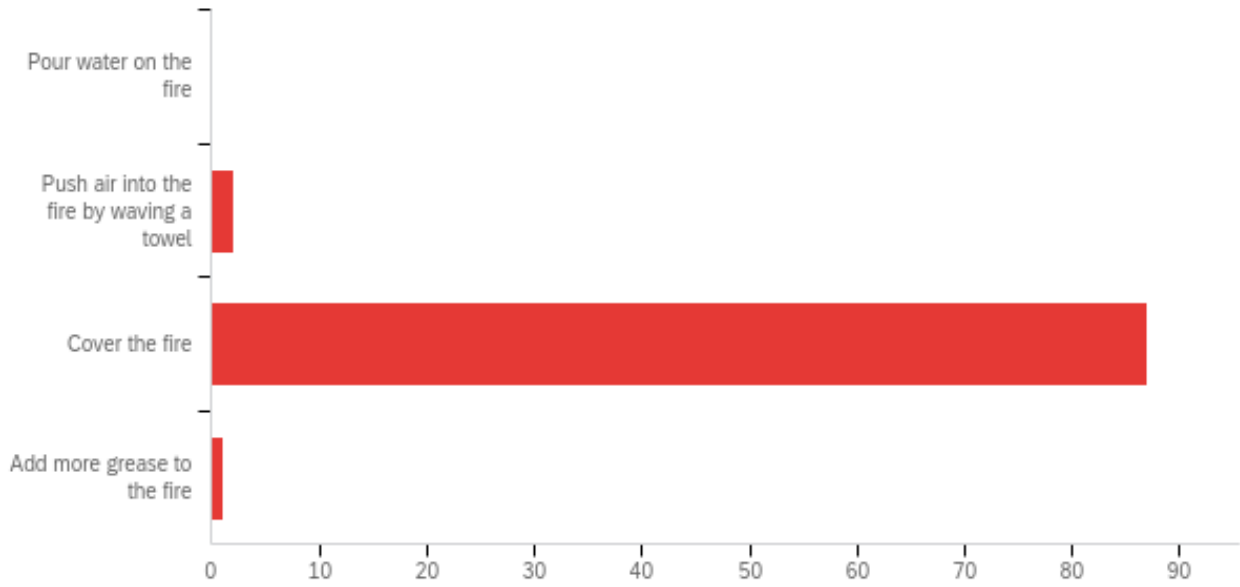
#	Answer	%	Count
1	I don't know	15.69%	16
2	Pull the pin, aim at the base of the fire, squeeze handle, sweep side to side	79.41%	81
3	Pull the pin, aim around fire, squeeze handle, sweep up and down	0.98%	1
4	Pull the pin, aim above fire, squeeze handle, hold steady and straight	3.92%	4
	Total	100%	102

Fire Risk - Move the slider to the number corresponding to how many things you have done inside a dormitory. Responses are anonymous. 1) Cooked food using a microwave 2) Cooked food using a stove/oven 3) Lit a candle 4) Smoked a cigarette or marijuana 5) Used a grill indoors 6) Disabled the smoke alarm 7) Did not remove the lint from the drying machine after use 8) Tampered with or removed a safety resource i.e. fire extinguisher, first aid kit, etc. 9) Consumed alcohol or controlled substances 10) Used every outlet in a room simultaneously OR used every slot on a power strip simultaneously

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	number of actions	0.00	10.00	4.48	1.86	3.46	101



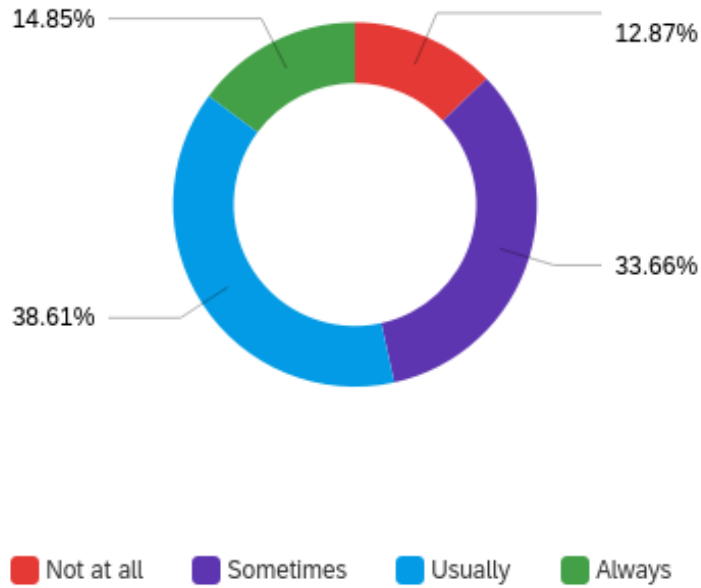
Fire Preparedness - Using your current knowledge, what is the correct way to extinguish a grease fire?



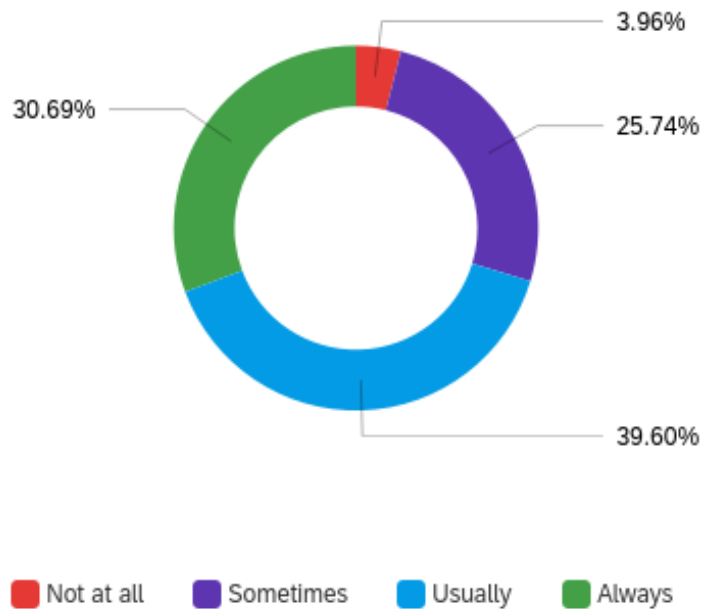
#	Answer	%	Count
2	Pour water on the fire	0.00%	0
3	Push air into the fire by waving a towel	2.22%	2
4	Cover the fire	96.67%	87
5	Add more grease to the fire	1.11%	1
	Total	100%	90

Fire Risk - Rate the following statements on your housing environment.

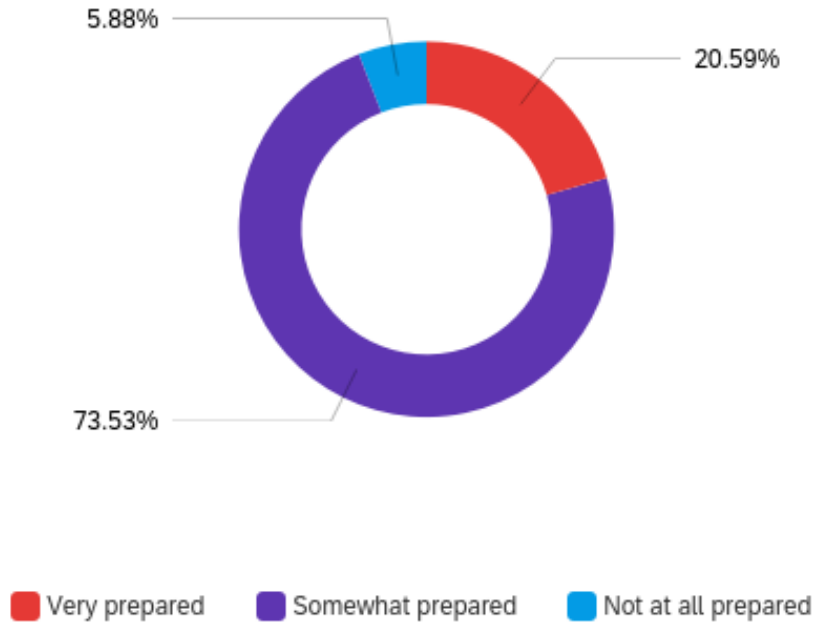
I trust my peers will not start a fire



I trust that the fire safety systems are functional

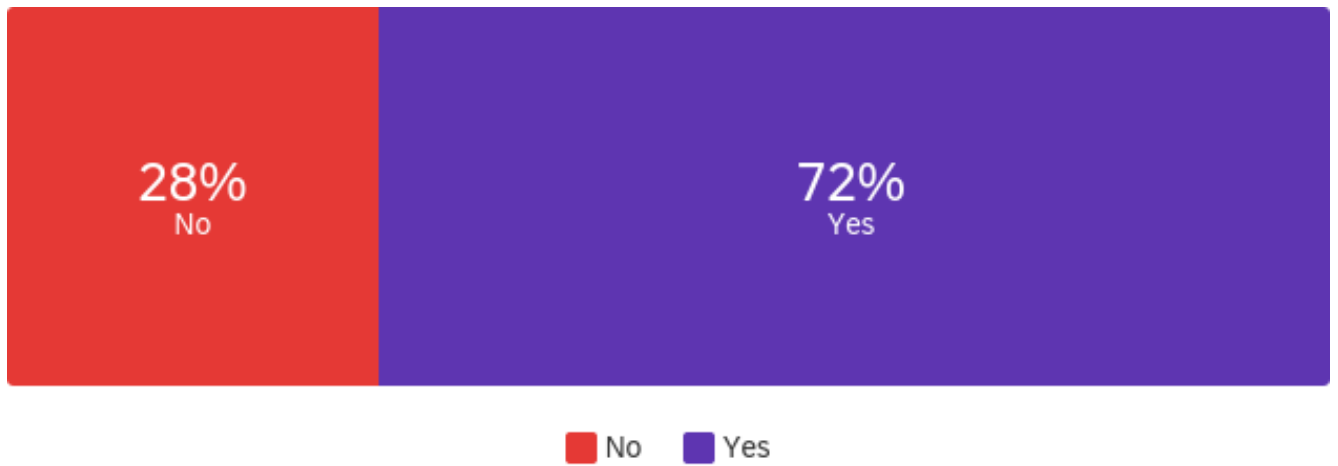


Fire Risk - How prepared do you feel about fire safety issues?

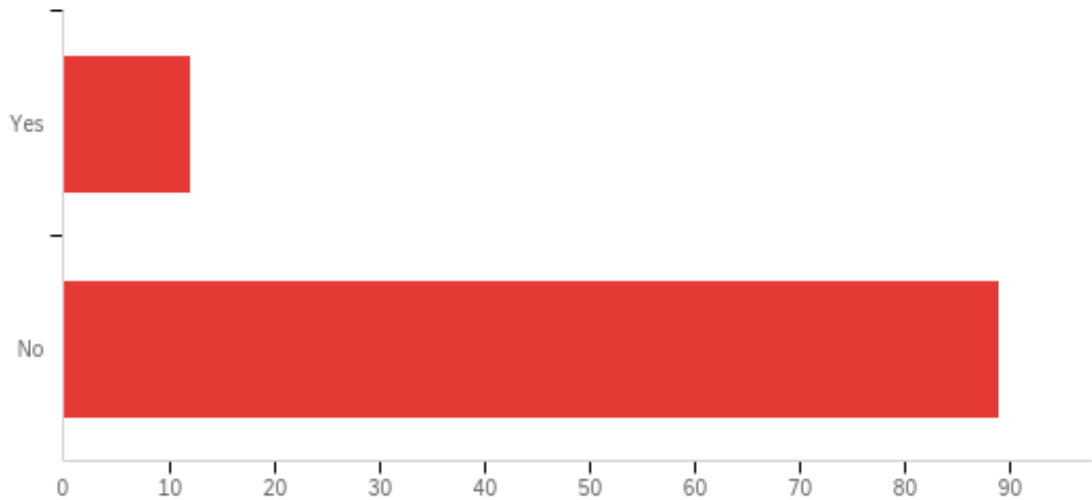


#	Answer	%	Count
1	Very prepared	20.59%	21
2	Somewhat prepared	73.53%	75
3	Not at all prepared	5.88%	6
	Total	100%	102

Fire Risk - Do you feel that your university could do more to reduce fire risks or inform students?

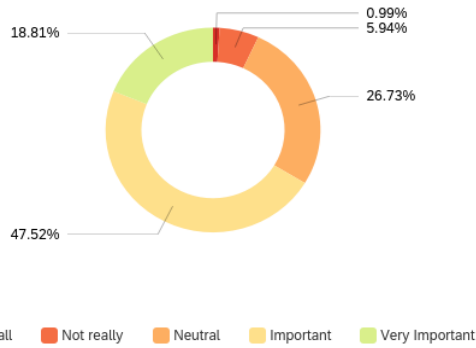


Fire Risk - Have you ever, accidentally or intentionally, started a fire in your dormitory? Responses are anonymous.

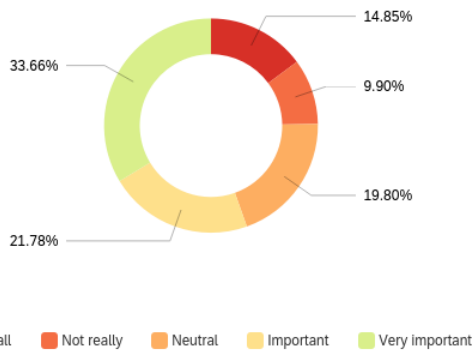


Fire Risk - Answer the following questions. '1' meaning least likely or least important. '3' meaning neutral. '5' meaning most likely or most important.

How important is fire safety to you?



How important is university housing to your academic enrollment?



What is the likelihood that you would stay enrolled in university if you were displaced by a fire incident?

