APPLICATION OF DISCRETE-TIME, RIGHT CENSORED SURVIVAL AND UNBALANCED THREE-STAGE HIERARCHICAL DESIGNS IN MODELING CHRONIC DISEASES AMONG THE UNIVERSITY STUDENTS: KENYA

Abstract

The percentage of university students currently nursing chronic diseases including but not limited to depression, HIV/AIDs, asthma, stroke and chronic kidney diseases, is alarming, and for a long time, these students are ever thought to be healthy. However, research shows otherwise with up to 30% of the students nursing the diseases. Previous research worldwide shows that up to 30% of university students can be infected at a given time. This research aimed to investigate the issues concerning the chronic diseases among the university students in Kenya. The specific objectives included estimation of percentage of students currently suffering from the diseases, determining their effects and factors associated with them. The mixed-study design was applied. Random sampling was done among students in two selected universities in Kenya and a questionnaire was used in data collection. 739 students responded to the research questions. Minitab, SPSS and R software were involved in data management for comparison purposes especially for statistically significant results. From the analysis, currently, there are approximately 14.6% of the students who are suffering from chronic diseases, and this proportion is significant (p-value<0.0001). Among the infected, 60.19% were females and the rest were males. Among the sick, only 43.52% have let the university clinics know about their conditions while more than 50% have concealed the vital information. The factors 'family history', 'involvement in drugs', 'adopted life-styles' and 'extreme poverty' were found to be significantly associated with the chronic diseases among the students. On the effects, the diseases were found to be negatively affecting the aspects of life of the infected students. Survival of the students was found to be having a mean and median survival times of 29.9472 and 30.27 years respectively. It is concluded that, there is need for intervention among the university students as 14.6% is not a number to be ignored. It is recommended that the stakeholders to come together and arrest the situation before things slip out of hands.

Key words: University students, Chronic diseases, Survival analysis, Hierarchical designs.

Introduction

[1] and [2] define chronic maladies as those diseases that take long time before the patient recovers, with some being manageable while others are not. The diseases can be hidden within the00 host as [3] have noted. Chronic diseases are increasing in number and complexities as time goes by, causing more sufferings among the people and casting unbearable burdens on their shoulders [2]. According to [4] and [2], the proportion of students at university level that is nursing chronic diseases is frightening, although for a long time, these students are imagined to be healthy. Furthermore, [5] have discovered that, in a given university, up to 30 percent of the students can be suffering from chronic diseases. This cannot be ignored as it can really affect the quality of life, kill students' morale and lowering the performance of an individual, in addition to loss of life. It needs health care systems to pay keen attention on this group since it is the next immediate workforce that awaits to be absorbed into the industries, factories, companies and production centres for goods and services. Unfortunately, this field of chronic maladies among campus students has remained under-investigated [5] although it should be given the necessary attention. [6] have realized that the university students' health is worse compared to their agemates in the societies. The most vulnerable group has been found to be that of females [7, 8] due to more health challenges that affect them psychologically and physically.

When it comes to STDs, they can be defined as a variety of syndromes that are caused by pathogens and acquired through sexual intercourse [9]. So far, more than 30 pathogens (viral, bacterial and parasitic) are known to be transmitted through sexual contacts. STDs can cause chronic infections, acute diseases, death, infertility among other complications on top of facilitating the HIV spreading. In places like Ethiopia, the highest proportions of the STDs are among the individuals in 15 to 24 years age bracket, the age of majority of university students. Young people like university students are ever at higher risk of contracting the STDs due to lifestyles adopted. It is believed that controlling STDs' spread is an effective way of managing the spread of HIV/AIDs. Furthermore, in Ethiopia, more than 50% of HIV/AIDs infected people and about 60 percent of the new infections are in the age bracket of 15 to 24 years. Therefore, university students are at very high risk of finding themselves in the snare of chronic diseases that are thought to be of old people. In Nigeria, the national STDs rates are about 11.5% on average [10]. [10] have noted that the information and data available for most of the diseases like the STDs are due to stigmatization that may result if the patients visit the health centres or disclose their status.

Examples of the chronic diseases are the chronic obstructive pulmonary disease (COPD) [11], arthritis [12], chronic kidney disease (CKD) [13], human immunodeficiency virus (HIV) [14, 15], hypertension or high blood pressure [16], stroke or cerebrovascular accident (CVA) [17, 18, 19], diabetes [20, 21], congestive heart failure [22, 23], hepatitis [24], dementia [25], autism spectrum disorder (ASD) [26], hyperlipidemia [27], arrhythmia [28], asthma [29, 30], coronary artery disease (CAD) or coronary heart disease (CHD) [31], cancers [32, 33, 34], depression [35, 36], Alzheimer's disease (AD) [37, 38], osteoporosis disease or 'silent disease' [39, 12] and schizophrenia disease [40, 41]. The Corona-Virus disease, a pandemic, [42, 43, 44, 45, 46, 47] can be a chronic disease depending on the immune system of an individual with some recovering as soon as they contract the disease and others suffering for a long period of time. The most susceptible persons are those with underlying health conditions such as those suffering from any other chronic disease. The disease has hindered not only the prevention of other chronic diseases but also disrupted the management of the chronic diseases. More details on these maladies as well as their burdens on health systems, families, individuals and nations together with their invasion on university students can be found in [2].

Hierarchical/Nested designs

Nested designs [48, 49], also called hierarchical designs, are designs in which the experimental levels of a given factor, say factor B, are not identical but similar for the different experimental levels of another factor, say factor A, those of another factor, say C, are not identical but similar for levels of factor B, and so on. One says that, the levels of factor C are nested under those of B while factor levels of B are nested under those of A. There could be another factor whose levels are nested under C in a similar manner like in the previous narrative. In the end, a large number of factors, whose levels are similar but unidentical, could be nested under each other in a chain form. The designs are widely used in industries and often involve one or many random factors [48, 49] as well as fixed factors. Nested designs can also be said to be those designs involving nested factors [50]. The hierarchical design involving only two factors, say A and B, is called a two-stage hierarchical design with levels of factor B being nested under those of A. The factor levels of B must be unidentical but similar for the levels of A. The design having only three factors, say A, B and C, is a three-stage hierarchical design in which levels of factor C are nested under those of B and those of B are in turn nested under those of factor A. Generally, an m-stage hierarchical design involves m ($m = 2,3,4,5...$) factors with levels of one factor nested in the levels of the other factor, and the other factor has its levels in turn nested in another factor's levels, and so on. Whenever one finds that the levels of the involved factors can be arbitrarily renumbered/renamed, then the factors are nested and not factorial. In factorial designs, one factor's levels must have each level paired with every experimental level of the other factor, this is not

the case with nested designs. Hierarchical designs are very useful in identifying the sources of variability in the response(s)/output.

As an example, consider courses pursued at a given learning institution. Each course has units under it. Suppose a sample of marks from the units is collected for investigation. In this scenario, the marks are said to be nested under the units and in turn, the units are nested under the courses. The 'sample' as a factor is nested in 'units' as another factor, and the factor 'units' is nested in the 'courses' as another factor.

As such, hierarchical designs are applied in production centres and laboratories where nested factors are widely encountered/ involved. They can also be applied if procedures in experiments or cost restrictions [50] are required in such a way that some treatment combinations are fixed while varying those that have other factors involved. While crossed factors occur when every factor level combines with each level of all the other factors in an experiment like in a factorial experiment, nested/hierarchical factors have treatments that are different within a single factor or many factors in a given experiment.

Survival analysis

Survival analysis [51, 52, 53, 54] is simply the analysis of time-to-event(s). In the case where some subjects do not experience the event of interest within the study period, then the survival time is right-censored. In right-censored survival time, the time of survival is greater than the set-end-time of study for those without the event of interest by the end of the study. Time can be continuous or discrete depending on the interval specified. Censoring in survival analysis refers to a case of missing data problem/drawback [53, 55, 51, 52] or more precisely, it is a problem involving incomplete data in a study. In this scenario, the time of the event is not recorded on some subjects of interest due to some reasons like losing subjects under study before the study terminates (could be due to some reasons like lack of interest in the study and hence quitting from the study) and termination of the study prior to all the subjects under the follow-up experiencing the event of interest. A subject under investigation is said to be censored if it does not experience the event of interest- if is lost to study before the expiring time or if the study ends before the subject experiences the event [54]. Whenever data on events of interest can be classified/collected in intervals or time is discrete, the data are classified as interval-censored and discrete-time hazard models [54, 52] are the most appropriate ones. The survival time T_i for i^{th} subject takes values $T_i = 1, 2, 3, \ldots$ that denote the points of events or censoring. A common model that applies the log-odds of event's occurrence as the dependent/response variable at time t is the logit model (discrete-time logit model that gives the log-odds of occurrence of the event) [52].

Statement of the problem

The increased diseases of all calibre among people have left them not only unhealthy, restless and without peace but also made their lives miserable, unproductive, too costly to bear and shortened lifetime. The day-to-day escalating health complexities including cancers, viral diseases like Covid-19 and Ebola, tuberculosis among others are becoming unbearable burdens among humans. The diseases do not discriminate any age group including the students. Experience shows that there are many students with chronic infections but do not let the universities know. However, due to some un-openness among students, lack of enough research on students' health, lack of a single health-centre and single medical practitioner for all students, day-to-day increasing health complexities, rising number of new diseases, among other factors, there is no enough information about chronic diseases among students. It's in light to all these factors that this research aims to investigate on chronic diseases among the university students.

General objective

To study and model chronic infections among the university students based on discrete-time, right-censored survival and unbalanced three-stage hierarchical designs.

Specific objectives

1. To estimate the proportion of university students suffering from chronic diseases.
2. To determine the effects of the diseases on students' selected aspects of life.
3. To investigate the factors associated with chronic diseases among the students.
4. To perform survival analysis of students' survival based on the chronic diseases discovered.

Hypotheses

1. H_0: There are no students with chronic diseases in the universities. Versus
   H_1: There are students with chronic diseases in the universities.
2. H_0: There are no students who develop chronic diseases during various levels of study. Versus
   H_1: There are students who develop chronic diseases during various levels of study.
3. H_0: There are no factors associated with chronic diseases among university students. Versus
   H_1: There are factors associated with chronic diseases among university students.
4. H_0: There are no effects of chronic diseases on students' aspects of life. Versus
   H_1: There are effects of chronic diseases on students' aspects of life.
5. H_0: There is survival time for students before they contract chronic diseases. Versus
   H_1: There is no survival time for students before they contract chronic diseases.

Research questions

1. What is the proportion of university students suffering from chronic diseases?
2. What effects do chronic diseases have on university students' aspects of life?
3. Are there factors associable with chronic diseases among the university students?
4. What is the survival time for university students in relation to chronic diseases?

Significance of the study

The analysis on data from chronic diseases among the students shall help know those chronic diseases that are experienced by students, gauge the prevalences and incidences of the various chronic diseases among them, understand the factors that are associated with the chronic diseases among the university students as well as establishing the effects of these diseases on some of the vital aspects of students' life.

Justification of the study

There are many chronic diseases among all the ages of people and students suffer the same fate. The findings of this research can be used by the university managements in developing measures that can help the affected students live better lives at the universities such as mandatory housing for all the infected persons, fee subsidies for the concerned groups to help ease the cost burdens, among other measures. The governments (national and county levels) can use the document to identify the groups that need more funding in their studies and research, medical care and diets. The university clinics can use the document to identify the technologies and health experts they need to hire to help in treating the concerned groups. Various sponsors like NGOs can use the report as a basis for directing their resources and efforts in funding the needy students. HELB can use the report to identify those groups that need more loans for financing their education and living standards. Other researchers can use the document as a basis for further research among students not only at university level but also at other levels of education such as secondary schools.

Methodology

Mixed-study design was applied because both qualitative and quantitative data were of importance. Randomness was adhered to when sampling. Stratified sampling played a part as the students were stratified according to universities. A customized questionnaire was used.

Sample size (n):

739 university students were sampled and this sample size was determined using the Cochran's formula [56, 57].

$$n = \frac{n_0}{1 + (n_0 - 1)/N}, \quad where \quad n_0 = \frac{z^2_{\alpha/2} * p * q}{d^2}$$

where α = 5% is the level of significance, p = proportion of university students suffering from chronic diseases, q = 1- p = proportion of university students free from chronic diseases, Z is the value from standard normal distribution statistical table that corresponds to the specified α- value, d = the margin error, N is the population size (total number of university students) and n is the sample size or the number of the university students sampled. The value of p is hereby taken to be 0.3, and the value of q is 0.7 [5] as this has been the highest proportion discovered so far as the proportion of university students suffering from chronic diseases. The d value is fixed to be 0.03 = 3% in order to control sample size to a manageable figure and ensure the estimates are as close to the actual parameter as possible. The formulae yield:

$$n_0 = \frac{z^2_{\alpha/2} * p * q}{d^2} = \frac{1.96^2 * 0.3 * 0.7}{0.03^2} = 896.3733, \quad and$$

$$n = \frac{n_0}{1 + (n_0 - 1)/N} = \frac{896.3733}{1 + (896.3733 - 1)/42000} = 738.8601 \cong 739$$

Study area

Moi University and the University of Eldoret (UoE). Convenience sampling method was applied in choosing the two institutions.

Procedures and data analysis

A well-structured and carefully-designed questionnaire was issued randomly to 74 participants in MMUST during the pilot survey. The data from the pilot survey was analysed and necessary adjustments made on the questionnaire as was identified from the sampled students and other stakeholders. Using the revised questionnaire, a sample of 739 individuals (students) from Moi University and UoE was obtained and data collected from them (this is the actual survey). Each participant was guided by the data collecting team to ensure full coverage of all the questions. Data coding, entry and cleaning in Ms-Excel followed the data collection exercise. Analysis was then done in R statistical software, Minitab, SPSS and STATA and this was followed by interpretation, inferences and reporting.

Theoretical framework

Figures 1 gives the diagrammatic representation of the ideas that are discussed in this work. It represents ideas of chronic infections and how they affect university students' life.

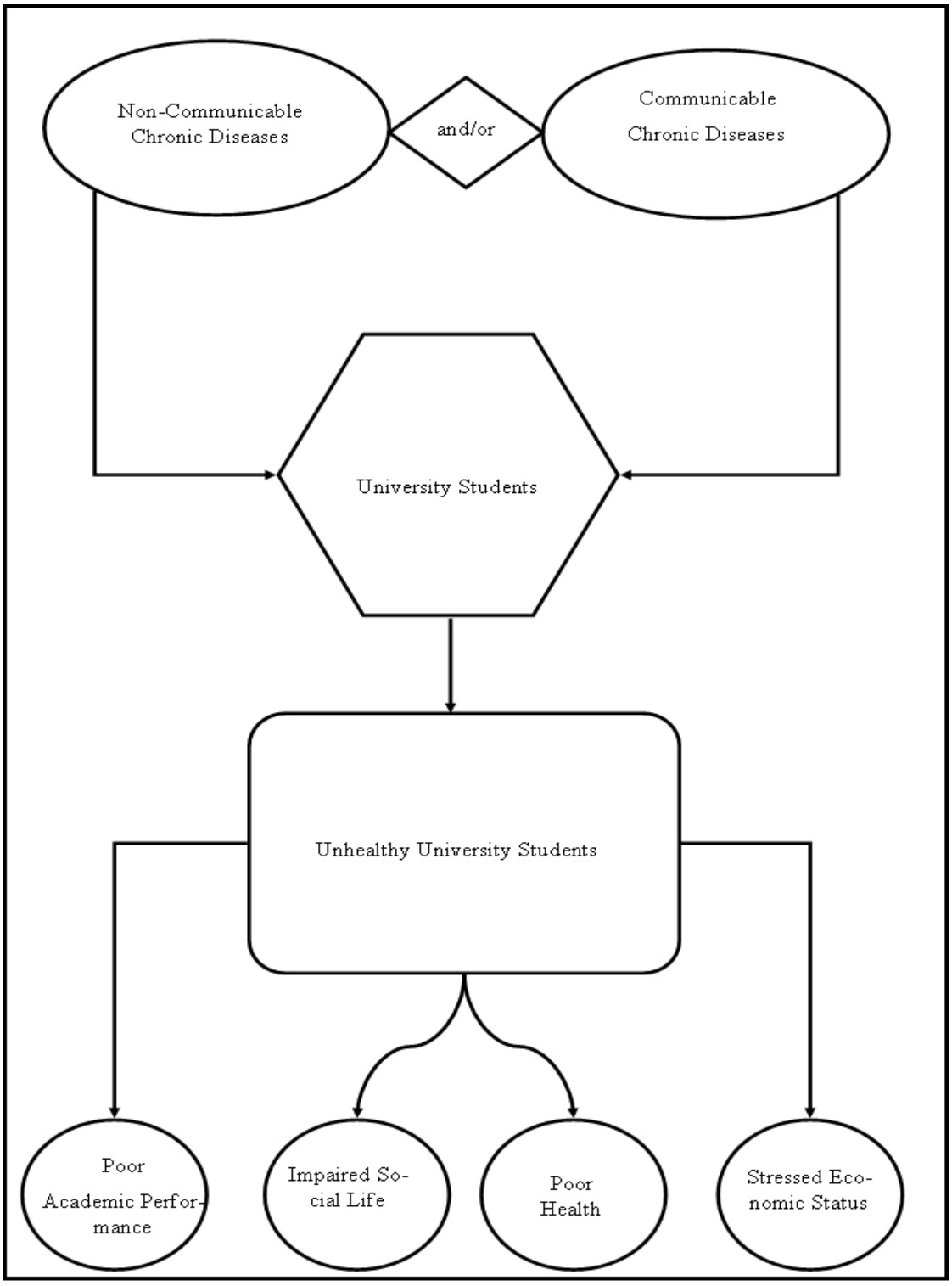


Figure 1: Theoretical framework diagram on chronic infections among students.

Choice of university students

This is the next immediate work-force group in the country, most productive group due to skills acquired in institutions of higher learning and are part of youths. If the group is maimed by chronic infections, the work-force is marred. The group is a representative of the entire nation since the students are admitted from all the parts of the country. Therefore, all the communities and the entire nation are represented at university level. There is also the idea of ease of access to students since they are clustered in one institution. The reluctance of the students to disclose their health status to avoid discrimination and stigmatization that comes with these diseases has dealt a heavy blow in studying their health. The field remains understudied, data remains limited and the real picture remains unclear. Among the university students, the research shall investigate the chronic diseases, estimate the prevalences and incidences, study their effects, factors linked to them and the survival chances for the students.

Ethical considerations/issues

1. The data collected from the students shall be used for the purpose of this research only.
2. The identity of the subjects shall never be disclosed under whatever circumstances and therefore, total confidentiality was guaranteed to the subjects.
3. Permit from the National Commission for Science, Technology and Innovation (NACOSTI) was sought first before collecting data from subjects.

Results and discussions

Students composed: 56.56% females, 44.44% males. 21.2%, 21.9%, 24.2%, 24.0%, 6.5% and 2.2% were in years 1, 2, 3, 4, 5 and 6 respectively. 76% were single while 24% were married. 9.6% had ever been employed and 8.5 percent have ever given birth to at least one child. About 62.5% feel their health is good, 13.5% feel it's poor. Currently there are approximately 14.6% of the students who are suffering from chronic diseases. Overall, about 18.0% of the students have ever suffered from the infections in their life-time. No student was found to have suffered from more than three diseases. Among the infected, 60.19% were females. Gender-wise, the infection is at 15.55% and 13.40% among females and males respectively. Overall infection was at 8.79% and 5.82% for females and males respectively. Among the sick, only 43.52% have let the university clinics know about their conditions. For the case of those who haven't informed the universities about their illnesses, 29.51% do not trust the level of the universities' confidentiality, 34.43% have no faith in their services while 36.07% seek medication elsewhere hence they have alternatives. About 18.8% don't know how they contracted the diseases, 18.8% were due to the adopted life-styles, 3.0% were infected by their 'sponsors', 23.3% were due to family history, 21.8% were involved in drugs-abuse, 3.0% from polluted environment, 3.8% from unfavourable climatic conditions, 5.3% were 'hustling' while 2.3% contracted from their partners. All the sick students acknowledged the fact that the infections had affected their normal performance/operations in life negatively: socially, economically, health-wise and academically. Note that, all tests were done at 5% level of significance.

Table 1 gives the test of significance results for the number of cases for each disease currently affecting the students. The first 5 diseases individually have significant number of cases among the students while last 9 diseases have insignificant number of cases individually, at 5% level of significance.

Table 1: Significance of the diseases' current number of cases.

Chronic Disease	Frequency	Chi-Square value	df	p-value
Depression	30	28.03	1	<0.0001
Hypertension	19	17.05	1	<0.0001
HIV/AIDs	17	15.06	1	0.0001
Hepatitis	11	9.09	1	0.0026
Diabetes	9	7.11	1	0.0077
Arthritis	5	3.20	1	0.0736
Osteoporosis	3	1.33	1	0.2482
Asthma	3	1.33	1	0.2482
Stroke	3	1.33	1	0.2482
Cancers	3	1.33	1	0.2482
Chronic Obstructive Pulmonary Disease (COPD)	2	0.20	1	0.4795
Chronic Kidney Disease (CKD)	1	0.00	1	1.0000
Hyperlipidemia	1	0.00	1	1.0000
Congestive Heart Failure	1	0.00	1	1.0000

Table 2 gives the results for the test of significance for the various number of students who developed diseases at different levels of their study. From the table, all the p-values indicate that the number of students currently suffering is significant together with those who have currently and previously developed the diseases at the three levels of study, at 5% level of significance.

Table 2: Significance of number of infected students.

		Frequency	Chi-Square value	df	p-value
Currently sick	Students with chronic diseases	108	106.01	1	<0.0001
	Students who developed chronic diseases in primary schools	23	21.04	1	<0.0001
	Students who developed chronic diseases in secondary schools	44	42.02	1	<0.0001
	Students who developed chronic diseases in universities	41	39.02	1	<0.0001

	Students who developed chronic diseases in primary schools	13	11.08	1	0.0009
Previously sick (recovered)	Students who developed chronic diseases in secondary schools	23	21.04	1	<0.0001
	Students who developed chronic diseases in universities	16	14.06	1	0.0002

The research has shown that there are 8 factors that are associated with the chronic diseases. Table 3 shows the 8 factors, the frequencies and the test of significance results. From the table, the first 4 factors are individually significant while the rest are not at 5% level of significance.

Table 3: Significance of the factors associated with chronic infections.

	Frequency	Chi-Square value	df	p-value
Family history (inheritance)	31	29.03	1	<0.0001
Involvement in drugs	29	27.03	1	<0.0001
Adopted life-styles	25	23.04	1	<0.0001
Hustling (Extreme poverty)	7	5.14	1	0.0233
Unfavourable climatic conditions	5	3.2	1	0.0736
Sponsors	4	2.25	1	0.1336
Polluted environment	4	2.25	1	0.1336
Partners	3	1.33	1	0.2482

Using t-tests, Table 4 shows the results for the selected aspects of life of the students for the overall group and the currently sick students- before and after illnesses.

Table 4: The t-test results for the students' aspects of life before and after illnesses.

Group	Life aspect	df	t-value	p-value
Overall students	Spending	738	-9.6303	<0.0001
	Friends	738	6.5345	<0.0001
	Hospital visits	738	-10.509	<0.0001
	Social gatherings	738	6.7316	<0.0001
	Academic performance	738	6.241	<0.0001
Currently sick	Spending	107	-60.204	<0.0001
	Friends	107	30.853	<0.0001

Hospital visits	107	-43.256	<0.0001
Social gatherings	107	47.286	<0.0001
Academic performance	107	36.479	<0.0001

The tests consider the life aspects before and after getting illnesses when all the students are considered together and when only the currently sick are considered. From the table, all the p-values are less than the 5% level of significance and therefore, the averages for the selected life aspects before illnesses are not the same as averages after getting ill. The averages before illnesses are far much less than those obtained during illnesses. This means that, the diseases, increased the spending (money spent) and the number of hospital visits while decreasing the number of friends, social gatherings and academic performance. Therefore, on the effects of the chronic diseases on the selected aspects of life, the effects are negative and significant.

Since the effects of the chronic diseases on students' aspects of life have been found to be significant, the next thing is to identify the source of these variations using unbalanced three-stage hierarchical designs.

Table 5: ANOVA and variance components for the case of currently sick students.

Life's aspect	Source of variation	df	SS	MSS	F-value	p-value	Variance components
Spending	Schools	13	1468502956	112961766	0.88	0.5810	
	Students (Schools)	94	12131723871	129060892	0.03	1.0000	0.0000
	Chronic diseases (Schools, Students)	108	4.86E+11	4498284826	26.43	<0.0001	1.44E+09
	Error	432	73531179133	170211063			1.70E+08
Friends	Schools	13	288.4	22.18	0.92	0.5310	
	Students (Schools)	94	2255.6	24	0.09	1.0000	0.0000
	Chronic diseases (Schools, Students)	108	30383	281.33	10.52	<0.0001	84.8585
	Error	432	11556	26.75			26.75
Hospital visits	Schools	13	74.27	5.713	1.34	0.2050	
	Students (Schools)	94	401.35	4.27	0.06	1.0000	0.0000

	Chronic diseases (Schools, Students)	108	7249.67	67.127	13.69	<0.0001	20.7407
	Error	432	2118.67	4.904			4.90432
Social gatherings	Schools	13	73.5	5.654	0.47	0.9350	
	Students (Schools)	94	1124.6	11.964	0.05	1.0000	0.0000
	Chronic diseases (Schools, Students)	108	26484.5	245.227	17.81	<0.0001	77.1538
	Error	432	5946.7	13.765			13.7654
Academic performance	Schools	13	589.5	45.35	0.76	0.7000	
	Students (Schools)	94	5613.1	59.71	0.09	1.0000	0.0000
	Chronic diseases (Schools, Students)	108	69406.7	642.65	13.55	<0.0001	198.406
	Error	432	20492	47.44			47.4352

Table 5 gives the analysis of variance and the variance components for the factor 'chronic diseases' nested in the factor 'students' that is in turn nested in the factor 'schools'. The analysis is based on the selected aspects of life. The factor 'schools' is fixed while factors students and chronic diseases are random. From Table 5, the p-values corresponding to schools and students nested in schools are greater than the level of significance, 0.05. This means that, the means across the schools are the same and the variance components corresponding to students nested in schools are zero (insignificant) for all aspects of life. On the other hand, the p-values corresponding to the chronic diseases nested in students are very small compared to 0.05 level of significance. This implies that the variance components for chronic diseases nested in students are significantly different from zero, and hence the variation in aspects of life for the currently sick students and before their sicknesses is due to chronic diseases. In all aspects of life, the differences arise due to the diseases and neither due to students themselves nor schools.

Discrete time model involving selected covariates:

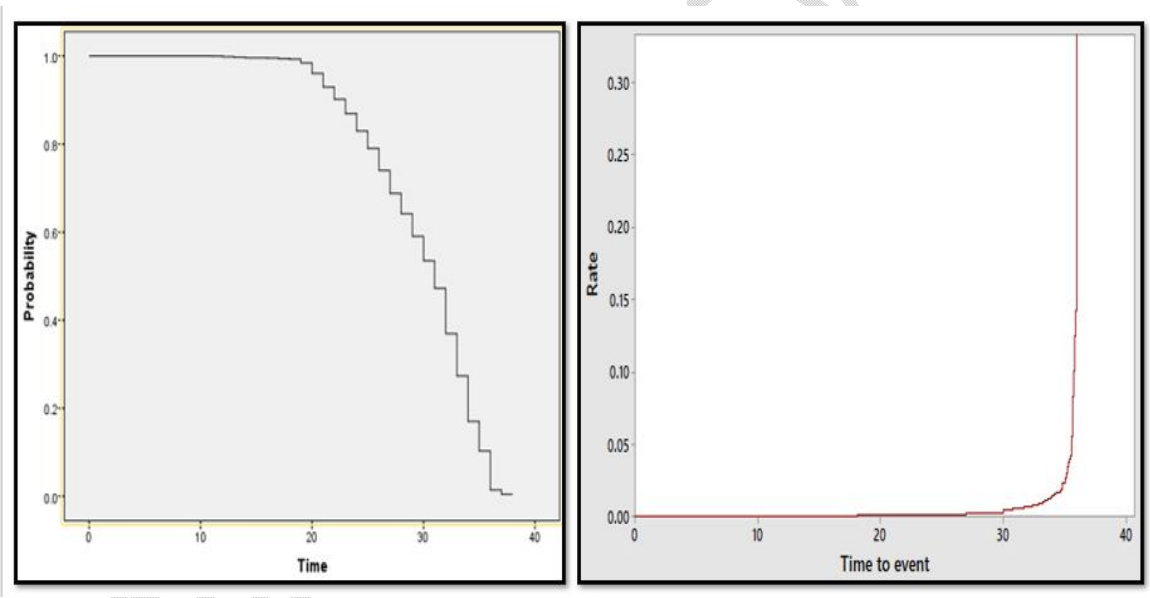
$$ln\left(\frac{\hat{P}_{it}}{1-\hat{P}_{it}}\right) = 9.3312 - 0.3585t_1 + 0.6669t_2 + 5.8958t_3 + 9.4495t_4 + 29.7501t_5 + 0.0710x_1 + 0.0203x_2 - 0.1136x_3 + 1.4455x_4 + 0.0145x_5 + 3.4855x_6 - 0.6171x_7 .$$

where P_{it} is the discrete-time hazard. The model gives the log-odds of occurring of the infection at time. Null deviance = 3821.5 on 3773 df, Residual deviance = 1098.6 on 3761 df, Chi-Square value = 2722.9 on 12 df, p-value <0.0001. The statistics show that the model is adequate.

In the model, the covariates are: Time period 1 to 5 are represented by t_1 to t_5 respectively while gender, year of study, employment, child birth, marital status, prior infection and age of students are represented by x_1, x_2, x_3, x_4, x_5, x_6 and x_7 respectively. Child birth (x_4), Prior infection (x_6), Age (x_7), Time period 2 (t_2), Time period 3 (t_3) and Time period 4 (t_4) were found to be significant in the fitted model as each had a p-value less than 0.05. The estimated odds of chronic disease occurrence multiply by exp (1.4455) = 4.24 when a student bears a child, multiply by exp (3.4855) = 32.64 when one has had a prior infection and multiply by exp (-0.6171) = 0.54 (reduce by 46%) when one grows older by one year; when all other factors are constant in each case. For the time periods 2, 3 and 4, the multiplying factors are 1.95, 363.51 and 12701.81 respectively per unit increase in time within a given time-period.

Figures 1 and 2 show the estimated survival and hazard functions for discrete-time data. The mean and median survival times are 29.9472 and 30.27 years respectively.

Figures 1 & 2: Overall survival and hazard function plots.

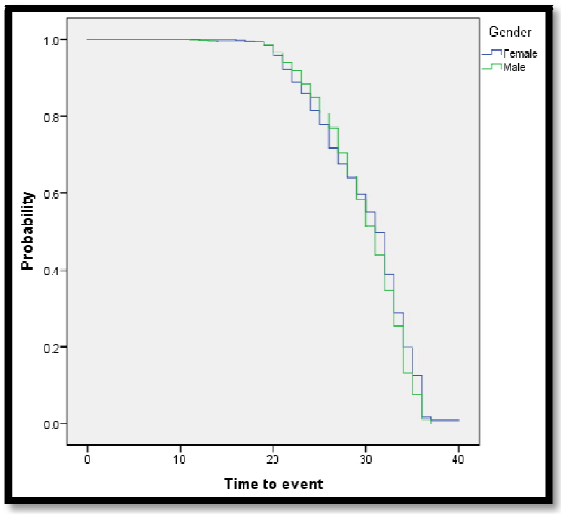


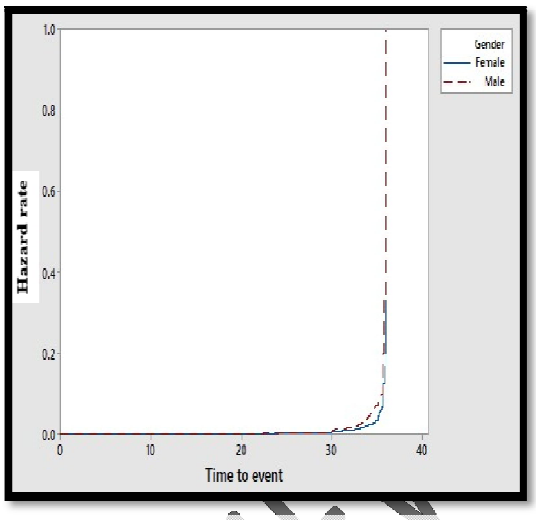
From Figure 1 (right hand side), the survivorship is almost constant from the beginning up to about 20 years and falls drastically up to the end of the study. From Figure 2 (left hand side), the hazard is constant from year 1 up to approximately 20 years before rising up to the end of the study.

Figures 3 and 4 show the survival and hazard functions across gender for discrete-time data.

The Log-rank and Wilcoxon Chi-Square values at 1 degree of freedom each are 0.5843 and 0.3000 with corresponding p-values 0.445 and 0.584 respectively. The mean and median survival time for females and males are 30.5959 and 30.53, and 29.0610 and 30.10 years respectively. For the two figures (Figures 133 and 134), the survival and hazard are the same across gender.

Figures 3 & 4: Survival and hazard functions across gender for discrete-time data.





Conclusions and recommendations

Conclusions

1. Currently, there are approximately 14.6% of the students who are suffering from chronic diseases, and this proportion is significant (p-value<0.0001).
2. Among the infected, more females (60.19%) were infected.
3. Among the sick, only 43.52% have let the university clinics know about their conditions while more than 50% have concealed the vital information.
4. The factors 'family history', 'involvement in drugs', 'adopted life-styles' and 'extreme poverty' were found to be significantly associated with the chronic diseases among the students.
5. On the effects, the diseases were found to be negatively affecting the aspects of life of the infected students.
6. Survival of the students was found to be having a mean and median survival times of 29.95 and 30.27 years respectively.
7. Female and male students experience the same survivorship and risks.
8. It is concluded that, there is need for intervention among the university students as 14.6% is not a number to be ignored.

Recommendations

1) It is recommended that the stakeholders to come together and arrest the situation before things slip out of hands.
2) Stakeholders such as university managements, governments, NGOs among others to adopt the findings from this research and develop strategies that can help improve the students' health such as ensuring the university clinics are well equipped with the right technology, machines and drugs.
3) University managements to create conducive environments that ensure healthy relationships between them and the students for a better information-sharing platform. This is because of the lack of openness among the students to the universities.
4) Students to take sound actions necessary for reducing the proportion of infected students such as getting more open about their health issues, abandoning life-styles that are unnecessary and unachievable at their level, living responsibly and seeking assistance when in need to avoid engagement in drugs and 'dying' in their problems.
5) Stakeholders such as media to strive in disseminating information appropriately among the students in order to sensitize them frequently about the environment they are living in at university level. Some students are in 'darkness' when it comes to these diseases.

6) Funding groups such as HELB in Kenya to adopt this report in order to develop measures that can help them identify infected students for more loans' allocation. This is because it has been found that the infected students spend more than the healthy ones.

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