Influence of Subject Characteristics on Adoption of Multiple Preventive Health Behaviours against Noncommunicable Diseases: A survey of Female Students at Makerere University

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Abstract

Many researchers worldwide report that health behaviours tend to be highly clustered, and can be addressed simultaneously. Yet, more remains unknown than known about how to optimize multiple preventive health behaviour change to mitigate health risks associated with noncommunicable diseases, which currently presents major public health concerns, and represents the greatest global health security threats in the future. There are emerging shifts in epidemiology of these chronic diseases, not only by gender, socio-economic status, disability, ethnicity, but most recently by age- albeit subject characteristics, as they are increasingly causing premature deaths. Nevertheless, the problem remains a neglected public health issue in Uganda, and at Makerere University in particular.

A cross-sectional sample of 381 undergraduate female students completed the self-administered questionnaire, whose results were subjected to binary logistic regression modeling to determine extents to which subject characteristics influenced adoption of preventive health behaviours.

Multivariate regression models suggest that course of study significantly (p=.013) influenced physician visits, with adjusted odds ratio of 0.32. Pentecostal (p=.018) and Anglican (p=.002) affiliations significantly influenced screening behaviour, with corresponding odd ratios of 0.37 and 0.34. Pentecostal (p= .021), like Science course (p=.030) significantly influenced physical activity, with corresponding odds ratios of 0.34 and 0.44. With respect to multiple preventive health behaviours, only course of study showed significant (p=.036) influence on adoption of all three desired behaviours, with adjusted odds ratio of 3.15.

The study contributes to body of knowledge on multiple health behavioral change and the healthy Universities concept. Future health promotions should consider issues around equitable access to essential information, and take advantage of religious places of worship and leaders to channel messaging.

Keywords: Noncommunicable diseases, subject characteristics, multiple preventive health behavior.

Background

Scientific evidence from studies around the world suggest that lifestyle behaviours of sick, healthy, and at-risk populations tend to be highly clustered due to external social influence. These findings were upheld by Meader et al. (2016) in their systematic review on the clustering and co-occurrence of multiple health risk behaviours and their predictors. Moreover, empirical studies continue to report similar results, for instance, the research by Champion et al. (2018) and de Souza Dantas et al. (2018) among Australian and Brazilian youths respectively. Consequently, literature reveals that behavioral researchers hold the consensus that health risk behaviours co-occur and most people display more than one behaviour.

The implication of these findings is that if clustered aka bundled health risk behaviours and their drivers are known, they can be addressed simultaneously (Spring, Moller & Coons, 2012) rather than one at a time sequentially, and so allow public health to enjoy the benefits associated with economies of scope- and thus presents a possible strategy for reducing the bottlenecks that constrain efforts on elimination of major noncommunicable diseases (NCDs). Yet according to Spring et al. (2012), more

remains unknown than known about how to optimize multiple preventive health behaviour change at the individual or the population level, which calls for further research- towards addressing the scourge of NCDs.

Noncommunicable diseases like cancer, diabetes, cardiovascular disease, and chronic respiratory diseases currently present a major public health concern globally, and represent the greatest threats to global health security in the future (Jamison et al., 2013). Their prevalence continues to persist, and to surge globally, and yet disproportionately among low- and middle-income countries, as well as within populations in any single country. An estimated 71% of all deaths in 2012 (WHO, 2014) were attributed to NCDs alone, which represents increase of about 5.7% in just a period of two years (Lozano et al., 2010).

The four major NCDs were responsible for about 82% of all the case mortalities in 2012 (WHO, 2014). Moreover, these chronic diseases are no longer a problem of the rich nor of the elderly only. At least some 42% of all deaths due to these diseases- globally occurred before the age of seventy years, of which 82% were in low- and middle-income countries, according to the 2014 World Health Organization's status report on NCDs. Moreover, the role of gender inequality in perpetuating the menace of these preventable lifestyle diseases is not questionable (Marmot et al., 2008; WHO, 2009). These trends depict an emerging shift in occurrence and distribution of these chronic diseases that are posing increased public health risks to younger people and poorer populations worldwide.

In Uganda, the probability of premature death between the age of thirty and seventy years reduced only slightly from 21.3% in 2010 to 21.2% (WHO, 2014) yet it remains comparatively higher than for her neighboring States like Kenya, Rwanda and South Sudan. And, though premature death rates were significantly higher in males than females for most countries worldwide, there was only a small marginal difference of about 5.5% in Uganda (p.160)- implying that as nearly as many women (64.0%) as men (69.5%) die prematurely from these preventable lifestyle diseases.

These new paradigms call for an urgent need to re-focus socio-behavioral health research, and generate empirical evidence that can be used to communicate and influence policy and decisions in favor of younger people and women so as to be able to mitigate the associated health risks, and prevent individuals from developing these lifestyle conditions. Unfortunately, until now, it appears to be a neglected public health issue in Uganda, and in particular at Makerere University, despite the institution being a regional research hub and an academic destination for several thousands of young people across the country and the region. Our most recent research (accepted for publishing) only documented public health concerns and risk perceptions of the undergraduate female students, from a qualitative viewpoint, yet it provides insights for the current study (Asaku, Kiguli & Agaba, 2019). There is evidence that NCDs continue to receive less political attention than emerging infectious diseases (Saha & Alleyne, 2018), which in turn tends to hinder progress on prevention and elimination efforts, hence the need to strengthen the knowledge evidence base.

Anyhow, there appears to be a unique window of opportunity that public health must exploit. Studies have revealed that adopting as few as only three preventative health behaviours (PHBs), without any other interventions, is capable of reducing health risks associated with any given NCD by up to 68% to 71% (Harrington et al., 2010). Throughout this article, we use health risk behaviour clustering and bundling interchangeably, as well as to infer multiple- though we recognize that these terms could differ epidemiologically. So, by multiple PHBs, we restrict the context of the current study to the adoption of three bundled health behaviours; screening behaviour, physician visit and physical activity routine.

But what are preventive health behaviours? They are actions undertaken voluntarily by apparently healthy persons, for the purpose of preventing disease or detecting illness at the earliest possible asymptomatic stage (Kasl & Cobb, 1966). This differs from the illness behaviour and sick-role behaviour described by the same authors, but have received more consideration from researchers over the past couple of decades.

Further to that, Marmot and Bell (2019) in one of their most recent articles, emphasize the need to adopt integrated preventive approaches, which in turn are in line with the aim of multiple PHBs- to address bundled unhealthy behaviours simultaneously. The current study sought to investigate the extent to which individual characteristics- specifically the respondents' hall of residence, age, religious

affiliation, educational level, course of study, programme of study, and the year of study were likely to influence the probability of adoption of multiple PHBs by the undergraduate female students.

Moreover, Arah (2008) argues that the concept of individual health must emphasize the role of the persons' circumstances in health maintenance or even in disease causation, and maintains that the health of a population is more than just the sum of the parts (Arah, 2008; Reidpath, 2005). The link between individual behaviours and the individual's health, and that of the health of the population (Arah, 2008) - is no longer a question of doubt, since most of the health choices that people make in life are shaped by their societies. Besides, Marmot et al. (2008) maintain that drivers for health inequality are rooted in social stratifications among which subject characteristics like gender, ethnicity, education level, age, religion etc., are key. These observations underline the importance of subject characteristics as social determinants of health - thus underpins the relevance of the current study.

It was hoped that results from the current study would harness multiple behavioral change deign and interventions as applauded by Amato, Park and Nigg (2016) among other behavioral change researchers. In short, understanding how these subject characteristics influence adoption of multiple PHBs as primary prevention measures- is an essential step towards achieving a healthy university, universal health, global health security agenda, and the corresponding Sustainable Development Goals (SDGs).

Methods

This was a cross-sectional study aimed at describing the extents of associations between subject characteristics and adoption of bundled multiple PHBs among undergraduate female students at Makerere University. The institution had a total enrolment of an estimated 36,000 undergraduate students, of which at least 45% were females. There were three on-compass halls of residence for the undergraduate female students. We considered each of these halls as a stratum, with assumed high between stratum heterogeneity and low within stratum homogeneity, and so applied the stratified random sampling method. We adopted stratified sampling because it permits a fair representation of views of respondents across all subgroups unlike cluster sampling that concentrates a study in only a few subgroups (Amin, 2005). None resident students were excluded from the study because they would not be accessed readily.

The study sample size (n= 384, at 95% confidence level) was calculated using the formula adopted from Mugenda and Mugenda (2003), and Charan and Biswas (2013) for cross-sectional studies, and on the assumption that 50% of the target population exhibits the desired behaviours- we assumed the maximum because there was no reliable yardstick data on adoption of multiple PHBs by young people in Uganda, and in particular the context of current study. The method of proportional sample size allocation, whose results have been included on **Table** - was adopted to allocate the study sample across the three strata.

Table 1. Sample size allocation by halls of residence

Female Hall of residence	Stratum size	Number of rooms	Students-Room ratio	Sample Size	Number of rooms sampled
Africa Hall	N_1= 498	198	2.515	n_1= 121	61
Mary Stuart Hall	N_2= 556	298	1.866	n_2= 135	68
Complex Hall	N_3= 530	252	2.103	n_3= 128	64
Total	**N= 1,584**	**748**	**2.117**	**n= 384**	**193**

Source: Makerere University Planning and Development Department (2016).

The three female halls of residence constituted the sampling units for the current study, while the dwellers were the sampling elements that make up the sampling frame drawn from the list of room numbers. All undergraduate female students residing in those halls in the 2018/2019 academic year, irrespective of their year, course or time of study were eligible to participate. Undergraduate, as used in this study refers to students pursing various Bachelor degree, Diploma and Certificate courses- irrespective of year of study.

The simple random lottery sampling method was used to select survey respondents from within each stratum. There were just above two dwellers per room on average. The questionnaire was administered to either (not both) of the students in the sampled rooms. Paper-based structured questionnaire with a set of pre-coded closed-ended fixed alternative questions (FAQs) was used, and were self-administered. The research assistants delivered the questionnaires to the target respondents, and returned the following day to collect completed questionnaires. Some extra five questionnaires were provided per stratum to cater for lost to follow-ups and those that would be deemed invalid. The questionnaire was pre-tested and adjusted for validity and reliability. We obtained an adjusted mean content validity index (CVI) of .97, and reliability of .79 and internal consistency aka Cronbach's coefficient alpha (α=.92), which were generally above the recommended thresholds for epidemiological surveys.

The current study operationalized and measured PHBs in terms of three dimensions: 1) often/very often voluntary physician visit or contact with health facility in last six month- as was measured by a 4-point unbalanced Likert scale; 2) voluntary screening for at least one NCD (breast cancer, cervical cancer, other cancer types, obesity and/or high blood pressure) in last six month prior to the study- measured by the yes/no dichotomous scale; and 3) often/very often engaging in at least one physical activity (PA), also measured by a 4-point unbalanced Likert scale. Respondents were characterized into Doers and Non-Doers.

By way of definition, Doers (the YES category) refers to those respondents who exhibited all the three desired PHBs in the previous six calendar months prior to the study- precisely: 1) screened for at least one of the listed target NCDs; 2) had at least one physician contact; and 3) often/very often spent their leisure time outside class on at least one of the listed physical activities. Respondents who had none or less than three of these desired bundled behaviours were categorized as Non-Doers (the NO category respondents).

Raw data was entered in EpiData, edited, and some variables transformed before it was exported to StataSE. Frequencies and percentages were used to describe subject characteristics. Then, the binary logistic regression model was employed to predict adoption of a single desired PHB. Regressors whose p- values were less than .20 in bivariate analysis, were considered for multivariate analysis, to determine the extents to which they influenced adoption of the desired multiple PHBs. The odds ratios were used as the measure of association and the p-values of less than .05 at 95% confidence level- suggested statistical significance. The assumptions of linearity and multicollinearity[1] were tested in the regression model building, and so was interaction and confounding of factors. The regression models were also assessed for goodness of fit of data, and the model was considered fit when the p-value was high (p >.05).

Results

Participants

First, three questionnaires were excluded from statistical analysis because they were incomplete. The results presented hereafter, therefore, are based on 381 respondents, which translates in an overall valid response rate of 99.2%. Among the valid questionnaires, Africa hall was less the target by only 0.3%, Marry Stuart was less by 1.6%, while Complex hall exceeded by 1.9%. All the descriptive statistics were based on actual number of valid responses to corresponding items. The demographic characteristics for survey respondents are summarized on **Table** .

Table 2a. Demographic characteristics of respondents

Characteristic		Frequency	Percentage
Hall of Residence	Africa	119	31.2
	Complex	134	35.2
	Mary Stuart	128	33.6
Age Group	18-24	349	91.6
	25yrs+	30	7.9

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[1] Variables that are strongly correlated. Tested in the model using vif (variance inflating factor) and tolerance (1/vif). If vif<10 and 1/vif>0.1, then there is no multicollinearity

	Not specified	2	0.5
Religious Affiliation	Roman Catholic	112	29.4
	Pentecostal	53	13.9
	Anglican	129	33.9
	Moslem	39	10.2
	Seventh-day Adventist	7	1.8
	Others**	41	10.8
**Orthodox, Baptist, Traditional, not specified Source: Primary Data			

It was evident from the table above, that majority of respondents (91.6%) were of the age 18 to 24 years. And, since only a few respondents were older than 25 years, those age brackets were collapsed. This was an expected normal distribution since participants are undergraduate students. The proportion of Anglicans was highest (33.9%), above the Roman Catholic by 4.5%. Nonetheless, the distribution of religious affiliations was not too far from the normal Uganda demographic profile[2].

Table 2b. Demographic characteristics of respondents

Characteristic		Frequency	Percentage
Education Level	Undergraduate Degree	368	96.6
	Undergraduate Diploma	12	3.2
	Undergraduate Certificate	1	0.2
Course Category	Arts	277	72.7
	Sciences	104	27.3
Programme of Study	Day	188	49.3
	Evening	187	49.1
	Weekend	6	1.6
Year of Study	New Entrants (year1)	163	42.8
	Continuing students	43	11.3
	Final year students	175	45.9

Further, just above 3% of all respondents were not undergraduate Degree students. This was not unexpected result because the University was gradually phasing out Diploma and Certificate courses. Yet, the proportion of respondents pursuing the Arts courses (72.7%) was about thrice greater than their Science counterparts. Furthermore, about equal proportions of respondents were Day (49.3%) or Evening (49.1%) scholars. Finally, students in their final year of study constituted 45.9% of total respondents, followed by new entrants (42.8%), while the proportion of continuing students (those not in their first or final year) was unexpectedly lower (11.3%) - possibly because most continuing students prefer to reside in private hostels.

Preventive health behaviours

Preferred choice of first contact

Respondents were asked to indicate their LIKELY **(Table a)** preferred choice of first contact, and ACTUAL **(Table b)** first contact preferences, if they needed health related help. These results were suggestive of the levels of trust that respondents had in their social networks and institutions.

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[2] https://www.indexmundi.com/uganda/demographics_profile.html

Table 3a. Likely preferred choice of first contacts for health-related help

	Percentage of Respondents			
	Very Unlikely	**Unlikely**	**Likely**	**Very Likely**
Close friend (n=336)	8.63	9.82	41.96	39.59
Close nuclear family member (n=315)	13.65	15.24	26.35	44.76
Close extended family member (n=301)	33.55	29.90	23.92	12.63
Private Clinic (n=310)	12.90	20.32	39.68	27.10
Private Pharmacy (n=311)	14.79	19.29	39.87	26.05
Private Hospital (n=295)	11.18	17.63	36.95	34.24
Government Hospital (n=298)	33.23	23.15	29.19	14.43
Makerere University Hospital (n=309)	30.42	22.66	30.74	16.18
Traditional Herbalist (n=293)	77.82	13.31	4.43	4.44
Spiritual/religious leader (n=309)	40.13	16.18	25.24	18.45

Table 3b. Actual preferred choices of first contacts for health-related help

	Percentage of Respondents			
	Never	**Rarely**	**Often**	**Very Often**
Close friend (n=331)	12.69	20.24	30.51	36.56
Close nuclear family member (n=310)	14.84	19.03	28.06	38.07
Close extended family member (n=298)	42.95	32.21	16.11	8.73
Private Clinic (n=300)	21.00	32.33	30.33	16.34
Private Pharmacy (n=292)	21.58	31.85	33.56	13.01
Private Hospital (n=293)	23.21	35.15	26.62	15.02
Government Hospital (n=289)	47.06	33.22	14.19	5.53
Makerere University Hospital (n=302)	55.96	27.48	10.60	5.96
Traditional Herbalist (n=295)	85.76	11.53	1.69	1.02
Spiritual/religious leader (n=303)	55.12	21.12	13.20	10.56

Overall, consistency was evident in the trend of responses between corresponding matched items on the tables shown above, though actual contacts were generally lower than corresponding preferred likely contacts. This may suggest that whilst the wish and will were there, taking the desired action still remains challenging. It was evident from the tables that close friend, and close nuclear family member were most preferred choices of first contact for health-related help. For instance, over 81% of respondents were likely/very likely to contact a close friend, and at least 71% contacted them often/very often, in the last six months. It was also evident that private health facilities were preferred to public ones. Just above 16% of total respondents often/very often visited the Makerere University hospital, yet it is closest to them. This could be translating in underutilization of services available at the University hospital. Lastly, smaller proportion of respondents were likely/very likely (8.9%) to contact, or actually contacted (2.7%) traditional herbalists, while spiritual leaders recorded slightly higher contacts.

Physical activity routines

Again, respondents were asked to indicate how LIKELY **(Table a)** they would spend their leisure time outside class, and how they ACTUALLY **(Table b)** spent their leisure time in the last six months. The response options comprised array of sedentary and physical activities as shown on tables below.

Table 4a. Likelihood of spending leisure time outside class

	Percentage of Respondents			
	Very unlikely	Unlikely	Likely	Very likely
Cooking (n=317)	16.09	17.98	40.38	25.55
Walking to visit a friend (n=316)	11.08	22.78	42.41	23.73
Shopping in supermarkets (n=301)	12.29	27.24	39.20	21.27
Sleeping (n=314)	6.05	14.01	32.17	47.77
Watching television (n=308)	13.31	15.26	27.60	43.83
Playing video games (n=302)	45.36	21.19	20.20	13.25
Playing board games (n=301)	41.86	28.24	15.61	14.29
Browsing internet (n=303)	7.27	6.27	35.31	51.15
Reading novels, news, magazines etc., (n=310)	12.25	15.81	33.23	38.71
Charting with friends on social media (n=307)	3.91	6.51	31.92	57.66
Jogging, running or aerobic activity (n=299)	30.10	30.43	27.42	12.05
Swimming (n=299)	35.45	24.75	21.74	18.06
Other physical games (n=293)	28.67	21.50	32.76	17.07

Table 4b. How respondents spent their leisure time

	Percentage of Respondents			
	Never	Rarely	Often	Very Often
Cooking (n=340)	16.18	30.88	30.88	22.06
Walking to visit a friend (n=344)	9.01	38.08	32.56	20.35
Shopping in supermarkets (n=330)	13.64	42.12	30.91	13.33
Sleeping (n=338)	3.55	15.98	31.95	48.52
Watching television (n=338)	9.76	23.96	26.04	40.24
Playing video games (n=325)	48.31	25.23	14.46	12.00
Playing board games (n=327)	50.15	28.44	11.01	10.40
Browsing internet (n=327)	7.34	13.15	30.58	48.93
Reading novels, news, magazines etc., (n=331)	13.90	29.31	26.88	29.91
Charting with friends on social media (n=328)	4.57	11.28	26.52	57.63
Jogging, running or aerobic activity (n=338)	38.74	33.63	18.32	9.31
Swimming (n=311)	48.94	26.44	13.07	11.55
Other physical games (n=311)	39.87	29.90	15.44	14.79

With exception of playing video games or board games, higher proportions of respondents were likely/very likely to spend their leisure time, and actually did spend their leisure time on sedentary activities, as opposed to physical activities (PA). Video games and board games are considered mannish games.

For instance, a combined 80.5% expressed that they were likely/very likely to spend their leisure time on sleeping, as compared to jogging, running, aerobics, swimming and other PAs, which had much lower proportions of respondents in favor of them. This presents increased risks for obesity and associated chronic conditions.

Voluntary screening behaviour

Table 5. How likely are you to undertake screening tests for NCDs below in the next six months?

	Percentage of Respondents			
	Very unlikely	Unlikely	Likely	Very likely
Breast Cancer (n=343)	29.45	15.45	35.86	19.24
Cervical Cancer (n=329)	32.52	19.76	26.44	21.28
Other Cancer types (n=319)	36.99	23.82	23.82	15.37
Weight/Obesity (n=317)	28.08	17.03	27.44	27.45
Pressure (n=323)	31.89	20.43	28.48	19.20
Diabetes (n=316)	34.81	22.15	25.63	17.41
Others (n=304)	28.62	18.42	28.95	24.01

The table above reveals that at least over 52% of total respondents expressed that they were very unlikely/unlikely to screen for cervical cancer (52.3%), pressure (52.3%), diabetes (57.0%), and other cancer types (60.8%) in the following six months. Corresponding proportions for obesity and breast cancer were even less than 50%. **Figure** shows proportions of respondents who screened (YES or NO) for the same NCDs in the previous six months.
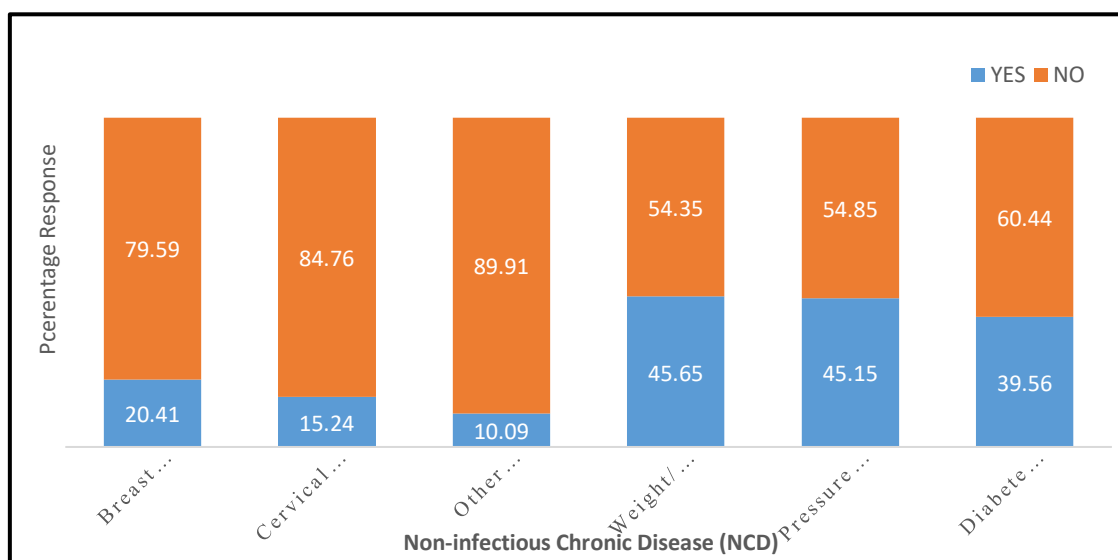
Figure 1. Shows proportions of respondents who voluntarily screened for NCDs in the last six months

Higher proportions of respondents did not screen for the listed NCDs. For instance, about 80% did not screen for breast cancer and cervical cancer in the last six months. The question as to why uptake of voluntary screening for NCDs remains low requires to be investigated further.

Subject characteristics and adoption of preventive health behaviours

We present here results from the two-step sequential binary logistic regression models, beginning with the associations between each of subject characteristic (predictor or regressor) and adoption of a single desired PHBs, then results for adoption of the bundled PHBs. We have combined bivariate and multivariate results on same tables. We did not look at gender as a subject characteristic because the study focuses on only female. Among the 381 survey respondents, up to 82.8% were categorized as Non-Doers, compared to only 17.2% Doers.

Table 6. Subject characteristic and adoption of physician visit

Characteristic		Bivariate			Multivariate		
		OR	95%CI	P-value	AOR	95%CI	P-value
Hall of Residence	Africa	Ref*					
	Complex	1.39	0.50- 3.88	0.527			
	Mary Stuart	1.61	0.55- 4.69	0.383			
Age Group	18-24	Ref*					
	25year+	0.91	0.20- 4.10	0.898			
Religious Affiliation	Roman Catholic	Ref*					
	Pentecostal	0.47	0.11- 1.96	0.297			
	Anglican	0.45	0.13- 1.48	0.189			
Course of Study	Others	0.77	0.19- 3.17	0.714			
	Arts	Ref*			Ref*		
	Sciences	0.32	0.13-0.79	0.013	0.32	0.13-0.79	**0.013**
Education Level	Undergraduate Degree	Ref*					
	Undergraduate Diploma	0.21	0.02- 2.15	0.190			
Programme of Study	Day	Ref*					
	Evening/Weekend	1.13	0.47- 2.70	0.783			
Year of Study	New Entrants	Ref*					
	Continuing Students	1.67	0.20- 13.68	0.632			
	Final Year Students	1.91	0.76- 4.81	0.172			

*Reference Variable

Source: Primary Data

The multivariate regression model, whose results are presented on **Table** above suggests that the course of study significantly (p=.013) influenced the frequency of physician visits with an adjusted odds ratio of 0.32. The result suggests that female students offering the Arts courses were over thrice more likely to visit a health facility and make contact with a health worker or physician, than their Science counterparts.

Table 7. Subject characteristic and adoption of voluntary screening behaviour

Characteristic		Bivariate			Multivariate		
		OR	95%CI	P-value	AOR	95%CI	P-value
Hall of Residence	Africa	Ref*					
	Complex	1.30	0.73- 2.33	0.373			
	Mary Stuart	1.29	0.72- 2.32	0.398			
Age Group	18-24	Ref*					
Religious Affiliation	25year+	0.73	0.32- 1.69	0.466			
	Roman Catholic	Ref*			Ref*		
	Pentecostal	0.39	0.17- 0.88	0.023	0.37	0.16-0.84	**0.018**
	Anglican	0.36	0.19- 0.69	0.002	0.34	0.18-0.67	**0.002**

	Moslem	0.55	0.20-0.70	0.090	0.35	0.19-0.68	0.065
	Others	0.53	0.25- 1.10	0.089	0.49	0.23- 1.04	0.064
Course of Study	Arts	Ref*					
	Sciences	0.93	0.49- 1.77	0.828			
Education Level	Undergraduate Degree	Ref*					
	Undergraduate Diploma	0.36	0.05- 2.62	0.315			
Programme of Study	Day	Ref*			Ref*		
	Evening/Weekend	0.59	0.36-0.96	0.033	0.61	0.37- 1.01	0.054
Year of Study	New Entrants	Ref*					
	Continuing Students	1.96	0.54- 7.09	0.304			
	Final Year Students	0.88	0.53- 1.45	0.606			

The multivariate logistic regression model, whose results are presented on **Table** above suggests that the Pentecostal (p=.018) and Anglican (p=.002) religious affiliations significantly influenced adoption of voluntary screening behaviour of the respondents, with adjusted odd ratios of 0.37 and 0.34 respectively. The results suggest that Catholic affiliated respondents were 2.7 times more likely than their Pentecostal counterparts, and 2.9 times more likely than Anglicans, to adopt a voluntary screening behaviour. The other subject characteristics tested in the model had to significant influence on screening behaviour of the female students. However, evening/weekend programmes of study (p=.054) was quite close to being significant with an adjusted odds ratio of 0.61, which suggests that students offering day programme were about 1.6 times more likely to adopt voluntary screening than their evening/weekend counterparts. This result could be explained by the fact that most day programmes were science courses, and students offering sciences courses are most likely to be better informed on the benefits of screening than their Arts counterparts.

Table 8. Subject characteristic and adoption of physical activity routine

		Bivariate			Multivariate		
Characteristic		**OR**	**95%CI**	**P-value**	**AOR**	**95%CI**	**P-value**
Hall of Residence	Africa	Ref*					
	Complex	0.75	0.418- 1.340	0.329			
	Mary Stuart	0.69	0.374- 1.234	0.204			
Age Group	18-24	Ref*					
	25year+	0.58	0.208- 1.648	0.311			
Religious Affiliation	Roman Catholic	Ref*			Ref*		
	Pentecostal	0.33	0.138- 0.817	0.016	0.34	0.14- 0.85	**0.021**
	Anglican	0.58	0.318- 1.061	0.077	0.66	0.34- 1.26	0.205
	Moslem	0.89	0.450- 1.671	0.651	0.89	0.33-1.28	0.982

		OR	95%CI	P-value	AOR	95%CI	P-value
	Others	0.84	0.432-1.631	0.605	0.99	0.48-2.03	0.971
Course of Study	Arts	Ref*			Ref*		
	Sciences	0.45	0.22- 0.94	0.033	0.44	0.21-0.92	**0.030**
Education Level	Undergraduate Degree	Ref*					
	Undergraduate Diploma	0.65	0.066-6.293	0.707			
Programme of Study	Day	Ref*					
	Evening/Weekend	1.23	0.761-2.006	0.393			
Year of Study	New Entrants	Ref*					
	Continuing Students	1.04	0.37- 2.93	0.940			
	Final Year Students	1.41	0.84- 2.37	0.193			

The multivariate regression model, whose results are presented on **Table** above suggests that Pentecostal religious affiliation (p= .021) and Science course of study (p=.030) significantly influenced the respondents' adoption of PA routines, with corresponding adjusted odds ratios of 0.34 and 0.44 respectively. These ratios imply that Catholic religious affiliated respondents were 2.9 times more likely to adopt physical leisure activities than their Pentecostal counterparts, and that respondents offering Arts courses were about 2.3 times more likely to adopt the behaviour than their Science counterparts. This result may be explained in terms of time barrier since over 69% of None-Doers agree/strongly agree that their course of study would not allow time for them to try something else for themselves, majority of whom are anticipated to be Science students. Science courses at the University are generally considered to be more time demanding than Arts. The other subject characteristics investigated in the model had no statistically significant influence on adoption of this desired health behaviour.

Table 9. Subject characteristics and adoption of multiple PHBs

		Bivariate			Multivariate		
Characteristic		OR	95%CI	P-value	AOR	95%CI	P-value
Hall of Residence	Africa	Ref*					
	Complex	0.90	0.47-1.70	0.735			
	Mary Stuart	0.66	0.33-1.31	0.238			
Age Group	18-24	Ref*					
	25year+	0.32	0.74-1.38	0.127	0.37	0.08-1.64	0.191
Religious Affiliation	Roman Catholic	Ref*			Ref*		
	Pentecostal	0.41	0.14-1.14	0.087	0.47	0.16-1.37	0.167
	Anglican	0.67	0.35-1.32	0.254	0.87	0.43-1.81	0.740
	Moslem	0.90	0.49-1.87	0.850	0.99	0.48-2.10	0.888
	Others	0.93	0.48-1.91	0.853	1.06	0.48-2.31	0.781

Course of Study	Arts	Ref *			Ref *		
	Sciences	0.31	0.11-0.90	0.037	3.15	1.07-9.26	**0.036**
Education Level	Undergraduate Degree	Ref *					
	Undergraduate Diploma	1.60	0.16-15.70	0.684			
Programme of Study	Day	Ref *					
	Evening/Weekend	0.72	0.42-1.25	0.241			
Year of Study	New Entrants	Ref *					
	Continuing Students	0.89	0.51-1.55	0.687			
	Final Year Students	2.98	0.94-4.75	0.427			

*reference variable

Source: primary Data

The multivariate regression model whose results are presented on **Table** above suggests that the Science course of study (p=.036) significantly influenced adoption of a combination of the three desired behaviours that were associated with being a Doer. The adjusted odds ratio to that respect was 3.15, which implies that Science students were over thrice more likely to adopt multiple PHBs than their Arts counterparts. This result differs from earlier results in which Arts students were more likely to adopt a single desired PHB. The difference may be due to differences in level of knowledge on benefits associated with adopting multiple PHBs, the fact that higher proportions of Doers were Science students.

Discussion

Direct influence of subject characteristics was examined on the selected PHBs. The most noted and statistically significant findings were that; 1) undergraduate female students offering Arts courses were more likely to make contact with physicians or formal health facility, as well as adopt PA routines than their science counterparts; 2) Catholic religion affiliated undergraduate female students were more likely to adopt voluntary screening behaviour, as well as PA routines than their counterparts; 3) undergraduate female students offering Science courses were more likely to adopt voluntary screening behaviour than their Arts counterparts; and 4) undergraduate female students offering Science courses were more likely to adopt the desired multiple PHBs than their Arts counterparts.

We discuss these results to attempt put the current study on context of other researchers on similar topics. Specifically, to highlight areas of agreements and disagreements with the statistically significant results, enrich what is already known with what the current paper adds to the existing body of knowledge, explain potential implications of these results and suggest possible recommendations, as well as highlight potential areas of the study limitations.

There is consistent evidence that insufficient[3] PA, both in terms of frequency and duration, has emerged as the most leading factor for global mortality, causing some 3.2 million deaths every year (Lim et al, 2012; WHO, 2014). Regular PA is known to reduce health risks associated with developing Ischaemic heart disease, stroke, diabetes, breast cancer and colon cancer, and is a key determinant of energy expenditure, which is a critical role in maintaining body energy balance, weight control and prevention of obesity (WHO, 2010). While there is no valid gender disaggregated data on prevalence of insufficient PA in Uganda (WHO, 2014), globally, more women (27%) than men (20%) were not

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[3] Less than 60 minutes of PA of moderate vigorous intensity per daily or 150 minutes of moderate PA per week or 75 minutes of vigorous PA per week (WHO, 2010).

reaching the desired levels of PA (p.33). Moreover, there is substantial evidence that University study is often accompanied by decline in levels of PA (Kwan et al., 2012; Sigmundova et al., 2013; Masselli, Ward & Gobbi, 2018). Fagaras, Radu and Vanu (2015) maintain that female students are physically less active than their male counterparts, while Bray and Born (2004) earlier reported that at least one-third of active students in high school become insufficiently inactive upon joining University life. Hence, the preference for sedentary activities reported by the current studies in not new.

Notwithstanding, scientific evidence to link religious affiliation and course of study with desired levels of PA among University students remains vague. While a wealth of existing scientific literature, including a meta-analysis by McCullough, Hoyt et al. (2000) generally and consistently support that religiosity aka spirituality is associated with reduced risks of NCD mortalities, healthy behaviours, and better health outcomes across a number of populations, Schlundt et al. (2008) contends that the positive associations might be a result of failure to sufficiently control for individual differences in demographics. Moreover, we could not readily cite literature that specifically demonstrated statistically significant associations between a particular religious denomination and desired levels of PA among female University students or even in the general populations. So, further research might be required to that effect.

Nonetheless, we objectively support the arguments by researchers that religions (be it the Catholic, Anglican, Moslem etc.,) have the ability to influence the distribution of advantages and disadvantages in the social determinants of health, which in turn might influence the health of its congregation. For instance, some may host sporting events, while others do not. This school of thought becomes even clearer, if the comparison is made in the contexts of rural and urban settings- in rural areas for instance, believers often walk several distances as opposed to cities where the use of vehicles is dominant as means of transport. Lastly, scientists have proposed other mechanisms by which religion impacts positively on the health of its congregation; provision of social support to its members, regulation of stress pathways and promotion of healthy lifestyles (Levin, 1994).

Positive religious coping has been associated with reduced stress levels, leading to better physical and mental health and well-being of the individuals (Koenig, Dana &Carson, 2011). The current study therefore maintains and recommends active engagements of places of worship and religious leaders in health promotion to increase adoption of desired PHBs. Additionally, in awake of the strong desire by University female students to lose weight and keep slim, as was reported by de-Franca and Colares (2008) in Brazil, it is prudent that administrators exploit this positive will, as an opportunity to promote adoption of PA routines by providing a supportive policy environment.

In fact, the WHO (2014) recommends that, if countries are to accelerate attainment of the 10% global target on reduction in prevalence of insufficient PA, leaders must address bottlenecks in the physical and policy environments- for instance, for instance provision of walkways and non-motorized cycling initiatives, accompanied with displaying health massages on stairs and walkways, as an incentive for students to use them. Most female students at Makerere University shy away from living in Mary Stuart hall because of its stairs. In addition, the use of hostel shuttles is rampant among most female students.

We could not readily cite studies that dispute or support the observation form the current study that undergraduate female students offering Arts courses were more likely to adopt PA routines than their Science counterparts. However, we objectively think that it is related to perceived academic load differences between Arts and Science students. Indeed, some researchers elsewhere like DiDomenico and Nussbaum (2011) and Brighenti-Zogg et al. (2016) among others have demonstrated the effects of physical workload on mental workload and performance. These studies suggest that individuals who perceive themselves to have heavy mental workload are more likely to shun physical activities on perception that it negatively affects their cognitive performance. Moreover, Kelloway and Gottlieb (1998) earlier affirmed that arrangements that permit flexibility increased women's perceived control over time, and reduce a feeling of having overload. Generally, Arts students are considered to have less academic load, and are therefore more likely to have time to try something different than their Science counterparts.

In view of the above, the authors hereby suggest that the University adopts approaches to learning that increase students' confidence on control over time. Further, we suggest that linking PA to academic excellence through positive messaging like ''More physical activity each day improves your academic

performance'', placed at strategic locations within the University like in the lecture rooms, libraries, halls of residences, walkways, and other strategic locations could increase uptake and adoption of PA routines across both Arts and Science based courses of study. This is particularly important owing to the fact that off all subject characteristic variables investigated by the current study- only the course of study showed a statistically significant association with adoption of all the three desired health behaviours simultaneously, yet the proportion of respondents (17.2%) categorized as Doers (adopting all three behaviors) was small. In particular, our study suggests that students offering Science courses were more likely to adopt multiple PHBs than their Arts counterparts. We anticipate this to be an issue of knowledge differences on perceptions of risks and benefits associated with multiple PHBs.

A greater proportion of respondents (57.2%) in the current study were either continuing (11.3%) or final year (45.9%) students, which give an insight to explain the low probability of being a reported by the study. This argument is rooted on findings by de-Franca and Colares (2008) that students who are approaching the end of their courses are more associated with multiple unhealthy behaviours that could lead to them developing NCDs. In our view, having graduates leave a University with unhealthy behaviours would be disastrous trend to health and well-being of the wider society since they are the immediate generation of future parents- worse for females ''potential mothers'' considering their societal ascribed roles in upbringing of children. This in our viewpoint, perpetuates the cycle, hence the need to strengthen targeted awareness among new entrants in order to reduce uptake and adoption of unhealthy behaviours.

Further, descriptive results from the current study suggest that significantly higher proportions of undergraduate female students did not screen for the selected NCDs within the previous six months prior to the study, though the proportion of those who expressed willingness to screen staggered around 50%. Yet, at least two variables- religion & course of study had statistically significant influence on adoption of voluntary screening behaviour. Precisely, affiliation to Catholic religion as well as offering Science course was likely to increase uptake and adoption of voluntary screening behaviour. Although the current study did not attempt to investigate reasons neither could the authors readily cite evidence to explain the differences observed among religious affiliations and adoption of voluntary screening behaviour- because only a few studies, such as by Schiller and Levin (1988), and Levin (1994) have attempted to investigate the influence of a particular religious denomination on health and health outcomes. Unfortunately, those studies focused on only a particular denomination, making it not possible to compare differences among religious groups. A few studies that have investigated differences across religious affiliations- have for instance found significant differences in body weight (Kim et al., 2003), use of preventive healthcare (Benjamins 2004) and breast cancer survival (Van Ness et al., 2003). Considering the increasing number of emergent religious sects around the world, this could be apposable area for future research- to be able to address health holistically since it has become increasingly evident these groups play a critical role in influencing decisions and health behaviours of their followers.

However, what we found to be broadly known, accepted, and consistent in scientific literature is the belief that religion gives meaning to life and that religious beliefs affect individuals' perceptions of pain, symptoms, and beliefs about the causes of illness and its course (Walsh 1999). There is further evidence that religion serves as a source of meaning and purpose, and shapes the framework within which people interpret their lives and experiences. As such differences in terms of religious doctrines, norms, and values are expected to influence individuals' choices on health behaviours in general, including voluntary seeking behaviour in particular.

Study limitations

Although these findings give valuable insights on how subject characteristics influence adoption of PHBs, a couple of intrinsic design limitations warrant taking note off. The use of self-administered structured questionnaires limits in-depth exploration of the research problem. Further a cross-sectional design, does not in any way infer causality despite significant associations. Besides, the study targeted resident undergraduate female students, which constitute only a small proportion of the total University enrollment. This limits the extent with which the results can be generalized to the wider student population. Finally, with respect to PA routines, the current study did not investigate if respondents

who said they engaged on PA activities, met the required levels in line with the recommendations from WHO. The study only asked if respondents were engaged on the physical activities.

Conclusions

Only the course of study exerted statistically significant influence on adoption of the three desired PHBs combined- specifically, offering a Science course favors adoption of multiple PHBs. So, we recommend that measures to increase accessibility of essential knowledge about this behavioral prevention of these major NCDs should be harnessed to ensure equitable access across different sections of the University. Secondly, the results from the current study uphold the importance of religion and spirituality in promoting adoption of desired PHBs. For instance, religious affiliation had positive influence on adoption of voluntary screening behaviour, as well as PA routines. However, further studies will be required to investigate if participants were meeting sufficient levels of PA since we did not attempt to investigate that. We therefore recommend that places of worship and religious leaders should be used to disseminate behavioral change messages. Further, only the course of study had significant association with adoption of all the three desired PHBs, which suggests its potential importance in facilitating the uptake and adoption of healthy behaviours, and so we recommend the University to adopt learning approaches that builds students' confidence on control over time. We conclude that these results contribute to the body of knowledge on multiple behavioral change design, and is a positive step towards addressing public health concerns of the undergraduate female students, and achieving health equity in order to curtail the scourge of major NCDs among young people.

List of Abbreviations

NCD   Noncommunicable Disease
WHO   World Health Organization
FAQs   Fixed Alternative Questions
CVI   Content Validity Index
PHB   Preventive Health Behaviours
PA   Physical Activity
UNCST   Uganda National Council for Science and Technology

Declarations

Ethical approvals and consent

The research proposal was initially vetted by the Texila American University School of Public Health, after which it was reviewed and approved by the Makerere University College of Health Sciences Ethical Review Committee **(Ref, 2018-033)**. Further approval was obtained from the Uganda National Council of Science and Technology (UNCST) - **Ref, HS229ES**. These measures were aimed at ensuring that the study was fully compliant with the basic ethical principles of research (Beauchamp & Childress, 2013) and the Uganda National guidelines for involving human participants in social research (UNCST, 2014). Informed consent was obtained from participants, including permission to publish the data on peer reviewed open access journals. The consent form used was reviewed and approved by the research ethics committee and the UNCST as an annex to the main research protocol.

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

STA, JK and JKA contributed to study design and implementation, and data analysis. STA drafted the manuscript that was critically reviewed by JK and JKA. All authors read and approved the final version before it submitted for publishing.

Competing interests

The authors declare that they have no competing interests in the current research.

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