**Association of health knowledge with adoption of heart healthy behaviours: a cross-cohort analysis using data from the PURE Study**

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**ABSTRACT**

**Aims:** This study aims to assessaspects of health knowledge: i) awareness of health effect of tobacco smoking and ii) awareness of preventive actions for heart disease and stroke, and their relationships with adoption of heart healthy behaviours (smoking cessation and utilisation of antihypertensive treatment).

**Methods:** In this multi-cohort study, we recruited adults aged 35 to 70 years from 21 countries. Data on health effects of tobacco smoking (10 questions) and health actions to prevent heart disease or stroke (11 questions) were collected at baseline. Logistic regression analyses were used to examine the relationship with the outcomes of smoking cessation and use of antihypertensive treatment adjusting for adjusting for possible confounders.

**Results:** Of the 12,962 included in the descriptive analysis, 50.0% were female, 42.9% had no or primary education, and 53.3 % were residing in low or lower middle-income country. Among current and former smokers, having knowledge of health effect of tobacco smoking on heart disease [Adjusted Odds Ratio (aOR): 1.70, 95% CI: 1.19, 2.43)], stroke (1.41, 1.08,1.86), and on heart disease in non-smokers exposed to others smoking (1.40, 1.06,1.86) were significantly and positively associated with smoking cessation compared to those who were not aware of health effects. Knowledge of the importance of reducing dietary salt aOR 1.62 (1.23,2.13), dietary fat aOR 1.56 (1.17,2.08) and exercising more aOR 1.48 (1.22,1.80) to prevent heart disease or stroke were positively associated with taking anti-hypertensive medication compared to those who were not aware of preventative actions.

**Conclusion:** Better health knowledge is associated with greater adoption of heart healthy behaviours such as smoking cessation and taking anti-hypertensive treatment even after accounting for baseline education and wealth.

**Lay Summary:**

Health knowledge is an important determinant of heart healthy behaviours regardless of patient’s background education and socio-economic status.

* Knowledge of health effect of smoking on heart disease, stroke, and on heart disease among secondhand smokers were associated with smoking cessation in PURE Study.
* Knowledge of the importance of reducing dietary salt, dietary fat and exercising more to prevent heart disease or stroke were associated with taking hypertensive medication in PURE Study.

**Keywords:** health knowledge, hypertension, medication, prevention

**1 INTRODUCTION**

Health inequalities are driven largely by the conditions in which people live but knowledge about health and disease also plays a role. This includes health knowledge in general, or the ability to find, understand, and use information and services to inform health-related decisions (health literacy), and specific knowledge about one or more conditions. The association between these two types of knowledge is inconsistent, perhaps reflecting differences in the impact of the particular condition on one’s life (1, 2) but there is some evidence that disease-specific knowledge is a mediator between health literacy and health outcomes.(3)

Most research has focused on health literacy which, when low, is associated with greater cardiovascular disease mortality,(4) with higher body mass index (BMI), physical inactivity, smoking, and increased anxiety and depression,(5) and with higher prevalence of ultrasound-detected carotid artery plaques, similar to that for smoking.(6) Evidence on the association with medication adherence is, however, inconsistent,(7, 8) although patients at emergency departments with low levels of health literacy were three times as likely to return within 90 days.(9) Other research finds an association between lower health literacy and greater utilization and costs.(10-13) There is some evidence on the mechanisms involved. Patients with low health literacy were more likely to misinterpret warning levels on prescription medications, increasing sub-optimal compliance and adverse events.(14) They were less responsive to prevention messages, less able to manage their health conditions,(10) and follow advice on medication use. (12, 13)

Research on disease-specific knowledge has largely focused on chronic conditions. There is an incentive for those affected to invest in obtaining information, although they are not always better informed than those without the condition, as seen with cardiovascular disease in one German study.(15) However, greater knowledge has been linked to better outcomes for several conditions, including chronic airways disease,(16) irritable bowel disease,(16, 17) and rheumatoid arthritis.(18)

This research is, however, almost exclusively from high-income countries, as are many of the initiatives to enhance disease knowledge, such as those from the American Heart Association (19) and American Medical Association.(20) Yet nearly three-quarters of the 17 million cardiovascular disease (CVD) deaths worldwide occur in low-and middle-income countries.(21, 22) Health knowledge is also closely linked with other determinants of health such as socioeconomic position (23, 24); such that individuals from lower socio-economic background are less likely to acquire health knowledge, and develop health literacy (19, 23, 25). Thus, if measures are to be adopted that improve knowledge of health and disease then it will be important to have information on how this varies with markers of socio-economic status such as education or household wealth in different settings, and how it correlates with cardiovascular health behaviours.

The primary research question of this study is to examine the relationship between two aspects of health knowledge: i) awareness of health of effect of tobacco smoking among current and former smokers and ii) awareness of preventive actions for heart disease and stroke among those diagnosed with hypertension and their relationship with adoption of heart healthy behaviours such as smoking cessation and utilisation of antihypertensive treatment using a large cross-cohort study that has collected consistent data from low and middle-income countries.

**2 METHODS**

**2.1 Study design and participants**

We analysed data on individuals included in the PURE study, which recruited adults aged between 35 years and 70 years from 367 urban and 302 rural communities in 21 countries. We combined these individual data with information on the communities in which each lived, derived from the EPOCH2 (Environmental Proﬁle of a Community’s Health) survey (n=14,028) from PURE study, which captures knowledge and perception about cardiovascular health and their surrounding from a sample of PURE participants living in that community. The design, methods, and participant characteristics have been published elsewhere. (25-28) We categorized countries according to the 2006 World Bank income classification. Men and women within the target age range, expected to remain in their community for at least 4 years, were eligible for recruitment, with a 72% response rate. Differences between characteristics of the PURE household population and national data have been shown to be unlikely to impact significantly exposure-disease associations derived from the study, with demographics and mortality rates generally comparable to national statistics.(29) The protocol was approved by ethics committees at each centre and all participants provided written informed consent.

**2.2 Procedures**

**2.2.1 Individual PURE data**

We administered two questionnaires on families and households. The first collected sociodemographic characteristics of all household members and the second information about household structure and amenities. Cardiovascular risk factors, such as tobacco use, hypertension history, diabetes, and physical measurements, were assessed with standardized questions in a third questionnaire. The physical examination included blood pressure, anthropometric measurements, and an electrocardiogram. Participants who consented also provided a fasting blood sample. We standardized protocols, with centralized training, and rigorous quality control.

We measured socioeconomic status by education and a household wealth index. We categorized education levels as: no or primary school education only (lowest), secondary school education (intermediate), or higher education, including completion of trade school, college, or university (highest). The household wealth index was based on asset ownership and housing characteristics. We designed this to cover countries at all levels of development and validated it in the study countries. Taking anti-hypertensive medication is defined as those who responded taking anti-hypertensive medication in baseline.

**2.2.2 Health knowledge questions in EPOCH2**

We took knowledge of health effect of smoking (10 questions) and health actions to prevent heart attack or stroke (11 questions) from the Environmental Profile of a Community's Health survey. These were used to calculate the i) health knowledge of smoking and ii) health action scores.(30) Participants were asked to respond ‘yes’, ‘no’, or ‘unsure’ as to whether smoking is responsible for ten diseases (lung disease, heart disease, diabetes, stroke, arthritis, lung cancer, mouth/throat cancer, environmental tobacco exposure, premature birth, low birth weight). Likewise, participants were asked to respond whether changes in these behaviours (exercise, eat more fruit, green vegetables intake, less meat, less caffeine, dairy products, eat more fish, quit smoking, reduce fat intake, reduce salt intake, lose weight) that could prevent heart attack or stroke.

**2.3 Statistical analyses**

*2.3.1 Regression analysis*

We undertook two sets of analyses limited to those with hypertension or CVD at baseline, where smoking cessation and blood pressure management is crucial for overall disease management and prevention of complications. First, examined smoking cessation among current and former smokers. The second, examined adherence to antihypertensive medicines among those with hypertension or CVD at baseline. The flow diagram for analysis is shown in eSupplementary Figure 1.

For both analyses, we developed three sets of regression models. First, we performed unadjusted logistic regression analysis for each of the knowledge variables accounting for clustering at country level. Second, we ran a multivariable adjusted model which included possible confounders in Table 1. Third, we fitted three sequential regression models. The fitted model 1 includes health knowledge scores (3 categories) adjusting for possible confounders in Table 1. Subsequently, model 2 includes variables in model 1 plus education. Similarly, model 3 includes variables in model 2 plus wealth index. For these models (e.g., models 1 or 2 compared with model 3), −log likelihood (−logL) was used to calculate the deviance (−2 × difference in logL values) and test the statistical significance of inclusion of the additional factor. To calculate the quitting ratios (Pr (yij=1), for former smoker vs current smokers), we used a multilevel regression framework for each individual i in community j assuming a binomial distribution, accounting for clustering at the community j. For all analysis, we used the worst-off group (e.g., wealth index) as a reference category to ensure consistency. Depending on the clustering of individuals (e.g., community, country), random effects were specified for analysis involving taking anti-hypertensive medication and smoking cessation.

*2.3.2 Construction of knowledge scores and the association with health behaviours*

We calculated two scores: first using health effect of smoking (10 questions), which we termed “health knowledge score”. Second, we collated knowledge of captured health actions to prevent heart disease or stroke (11 questions) which we termed “health actions score”.

The scoring method has been defined and used previously.(30-32) Such methods are widely used for assessing the association of cumulative knowledge scores of knowledge questions or risk factors.(30-32)  Following previous practices, each question in our analysis contributed equally to the overall score. For each individual, we created a categorical knowledge score variable (3 categories: high, medium, low health knowledge) based on tertiles of scores; each tertile contributing to a third of the population.  We presented the percentages of correct responses for each questions capturing health effect of smoking and health actions by country and income regions (Figure 1).

*2.3.3 Stratified and sensitivity analysis*

Previous evidence showed that higher knowledge of cardiovascular risk factors is associated with education and socio-economic background (33, 34) so we stratified each sample by education and household wealth. Further, following previous practices we conducted two sets of sensitivity analysis using regression weighted knowledge scores to confirm the robustness of main findings. (33, 34) All analysis were conducted from March 2023 to January 2024 using the PURE EPOCH datasets in SAS 9.4 and visualization was done in Python version 3.9.5 (Delaware, USA). All statistical tests were 2-tailed, and P< 0.05 was considered statistically significant.

**3 RESULTS**

*3.1 Descriptive characteristics*

Of the 12,962 individuals included in the analysis, nearly half were female, 42.9% had no or primary education, and 53.3 % were residing in low or lower middle-income country (eSupple Figure 1). Overall, most participants had knowledge of three health effects of smoking, namely: chronic lung disease (95.1%), lung cancer (93.7%), and mouth and throat cancer (88.2%). There is a wide difference in knowledge among income regions. Only 80.3% of those in low-income countries (LIC) gave correct answers about the effects of smoking against 98.1% in high income countries (HIC). Differences were even wider for specific questions on lung cancer (79.9% vs 98.4%) and mouth-throat cancer (75% vs 98.5%) between LIC and HIC (Figure 1, Supple Figure 2).

On knowledge of health actions to prevent CVD, the top three responses were quitting smoking (95.3%), eating more green vegetables (92.0%), and eating more fruit (90%). Again, this differed widely by income region. For example, in LIC only 69.4% gave correct responses on knowledge of smoking cessation to prevent CVD compared to 95.5% in HIC. Again, differences were wider for some specific questions, eating more green vegetables (72.5% vs 93.5%) and eating more fruit (68.8% vs 90.2%) (Figure 1, Supple Figure 2).

*3.2 Regression analysis*

As described above, Figure 2 shows the association of two sets of health knowledge questions and two health behaviours (smoking cessation and taking anti-hypertensive medication) in appropriate sub-samples. Using the first set of questions, we found that knowledge of the health effect of tobacco smoking on heart disease aOR 1.70 (95% CI: 1.19, 2.43), stroke 1.41 (1.08,1.86), heart disease in non-smokers exposed to others smoking aOR 1.40 (1.06,1.86) were significantly and positively associated with smoking cessation among current and former smokers.

Second, the knowledge of health actions questions like reducing salt in meals aOR 1.62 (1.23,2.13), reducing fat in meals aOR 1.56 (1.17,2.08) and doing more exercise aOR 1.48 (1.22,1.80) for prevention of heart disease or stroke were positively associated with higher likelihood of taking anti-hypertensive treatment among those who had been diagnosed with hypertension or CVD at baseline. (see Table 2, Figure 2).

*Construction of knowledge scores and the association with health behaviours*

As the score for knowledge of the heath effect of smoking increased, the percentage of smokers increased from 38.6% to 50.7% when moving from low to high knowledge. Similarly, as the knowledge of health actions score increased, the percentage of taking anti-hypertensive medication increased from 10.4% to 19.4% when moving from low to high health knowledge.

We present the relationship between health knowledge tertiles and health behaviour variables in the two groups in Table 3 and 4. Among current and former smokers, those with high health knowledge of tobacco smoking were significantly and positively associated with odds of smoking cessation (quit ratios: 1.30, 95% CI: 1.01,1.68) in model 1, although this did not reach statistical significance after accounting for education and household wealth in model 3 (Table 3). Similarly, in those with hypertension or CVD, high health knowledge of actions to prevent CVD was significantly and positively associated with taking antihypertensive medication (aOR 2.58, 95% CI: 1.57,4.22) in model 1; the effect size only decreased marginally after adjusting for education and household wealth in model 3 (Table 4). -2logLikelihood showed that the model with health literacy, education, household wealth (model 3) adjusting for all possible confounders provided the best model fit in the multivariable analysis.

*3.3 Stratified and sensitivity analysis*

We conducted two sets of sensitivity analysis as follows: knowledge of health effects of smoking and smoking cessation (tertiles), and the relationship of health actions to prevent CVD or stroke (tertiles) and taking antihypertensive medication, using regression weighted knowledge scores (eSupple Table 1-2). Additionally, we showed the cross stratified relationship of health knowledge tertiles with smoking cessation and taking hypertensive medication, using both household wealth and education. Our main findings remained robust even after accounting for regression-based weights for each individual knowledge questions in Table 1. We found a notable effect of increasing health knowledge on odds of smoking cessation by educational attainment and wealth (eSupple 2-3). Among people in trade, college or university education, the odds of smoking cessation were nearly 2.3 times higher if they had higher knowledge of the health effect of tobacco smoking. Similarly, a statistically significant, and positive effect of increasing knowledge of both health effects of smoking and health actions to prevent CVD was present among people regardless of educational attainment and wealth status (eSupple Table 1-4).

**4 DISCUSSION**

This cross-sectional study examined the relationship between two aspects of health knowledge: awareness of health effects of tobacco smoking and of actions to prevent heart disease and stroke on adoption of heart healthy behaviours across over six hundred communities in low and middle-income countries. We found a positive relationship between health knowledge and adoption of heart healthy behaviours such as smoking cessation and taking anti-hypertensive treatment in the relevant subgroups even after accounting for individual’s baseline education and wealth. However, given the cross-sectional design, we cannot claim to have established causality.

Our findings are consistent with previous studies which showed effect of health knowledge on health behaviours on both short (high blood pressure, hyperglycaemia) and long term health outcomes (hospitalization, mortality) (35-38) and health-related quality of life.(39) For example, Isa et al suggested that health literacy has a notable effect on blood pressure outcomes, with consistently poorer control among people with lower health literacy.(38) Nevertheless, Du et al suggested that the evidence regarding the influence of health literacy on clinical and behavioural outcomes, such as self-care and self-efficacy, is insufficient, underscoring need for future studies.(40) Aligning with this idea, we quantified the association as well as the shape of the relationship with two aspects of heart health behaviours: smoking cessation and taking anti-hypertensive treatment in appropriate subgroups. We also quantified whether health knowledge is independently associated with these outcomes after considering education and wealth. Our analysis further confirmed that those with lower health knowledge, lower educational attainment and lower household wealth were less unlikely to stop smoking and or take anti-hypertensive medication. Our findings support the statement of the American Heart Association which highlights lack of knowledge as a barrier to improving cardiovascular health.(19) This is consistent with other social determinants of health; those with lower educational attainment and wealth status were least likely to adopt healthy behaviours. (41) Further studies are needed to assess the broader effect of health knowledge and literacy on both short- and long-term health outcomes and health system costs for diseases including and not limited to cardiovascular diseases.

Our study has several strengths. Firstly, we have incorporated a unique and geographically diverse sample from countries at different levels of economic development. Secondly, we employed a standardized and systematic approach to collect data. Lastly, we utilized both wealth and education as indicators of socioeconomic status, both of which serve as proxies for the ability of individuals to make choices. However, there are certain limitations to our study. We grouped countries based on their economic status (low-income or high-income), but each is culturally, socially, and economically diverse. Unfortunately, our study, like many others of its kind, did not gather data on quality of education and attainment. Therefore, grouping education into a single variable based on time spend lacks granularity. Although the participants in our study generally resemble the populations of the respective countries, it is possible that the impact of education and wealth on health could vary depending on each country’s welfare policies or ethnic or religious diversity, which may be linked to belief systems, social networks, or marginalisation that we could not identify. Further, there are limitations on use of health knowledge questions which were self-reported and might not represent the diversity of health knowledge that is captured typically by a health literacy instrument. Despite having ten questions that assessed the health knowledge and eleven questions that assessed the knowledge-actions, they may not encompass those specifically indicative of self-care or self-efficacy, which are the crucial pillars in the development of health literacy. (19) For these various reasons, the estimated ORs could be overestimated compared to any typical analysis involving much nuanced health literacy instruments.

Despite the limitations, we provide a comprehensive evaluation of two aspects of health knowledge and their associated effects on two health behaviours namely smoking cessation and taking anti-hypertensive medication. Further studies are needed to quantify the effect on both short- and long-term health outcomes and the extent to which are findings are influenced by the structural constraints that people face.

**5 CONCLUSION**

Cardiovascular health knowledge is associated with adoption of health behaviours even after accounting for individual’s baseline education and wealth. The findings of this study underscore the critical role of cardiovascular health knowledge in fostering heart healthy behaviours, which in turn can lead to better cardiovascular outcomes.

**DATA AVAILABILITY**

Data is available from the PURE collaborative group upon reasonable request. The data analysis was done from March 2023 to January 2024 using the PURE EPOCH dataset in SAS 9.4.

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\*National Coordinator

# Deceased

**ABBREVIATIONS**

BMI: body mass index, HIC: high income country, LIC: low-income country, LMIC: low -middle-income country, UMIC: upper middle-income country,

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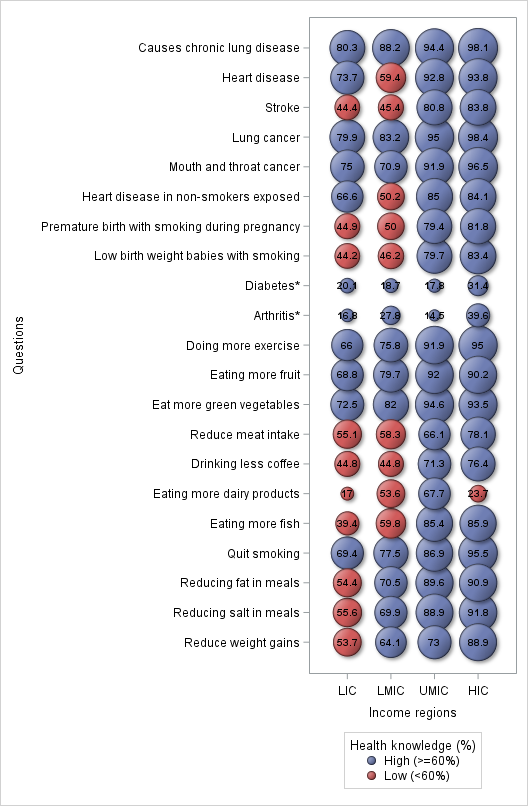
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**Table 1.** Baseline characteristics of the sample.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variables** | **Total**  **population** | **N=12,962 Hypertension treatment (row, %)** | **P value (χ2)** | **N=1,608**  **Former smoker (row, %)** | **P value (χ2)** |
| **Age**  Mean (SD)  Median (IQR) | 50.5(9.8) y  50.0(42-58) y | 57.2(8.3)  58.0(52-54) | <0.0001 | 57.4(8.4)  59.0(51.0-64.0) | <0.0001 |
| **Gender** |  |  |  |  |  |
| Female | 6473(50.0) | 840 (13.0) | 0.608 | 212 (56.1) | 0.0001 |
| Male | 6485(50.1) | 822 (12.7) |  | 522 (42.4) |  |
| **Education level** |  |  |  |  |  |
| None, Primary, or Unknown | 5550(42.9) | 692 (12.5) | 0.0001 | 240 (39.4) | 0.0001 |
| Secondary/Higher secondary | 4478(34.6) | 509 (11.4) |  | 220 (39.5) |  |
| Trade or College/University | 2902(22.4) | 459 (15.8) |  | 274 (62.3) |  |
| **Urban and rural setting** |  |  |  |  |  |
| Urban | 6662(51.4) | 974 (12.1) | 0.0001 | 477 (51.1) | 0.0001 |
| Rural | 6296(48.6) | 1022 (15.3) |  | 257 (38.1) |  |
| **Country classification** |  |  |  |  |  |
| HIC | 2400(18.5) | 535 (22.3) | 0.0001 | 342 (70.7) | 0.0001 |
| UMIC | 3531(27.3) | 595 (16.9) |  | 263 (45.7) |  |
| LMIC | 4398(33.9) | 431 (9.80) |  | 102 (24.9) |  |
| LIC | 2629(20.3) | 101 (3.84) |  | 27 (19.3) |  |
| **Previous coronary heart disease** |  |  |  |  |  |
| No | 12380(95.7) | 1404 (11.3) | 0.0001 | 649 (44.2) | 0.0001 |
| Yes | 555(4.3) | 257 (46.3) |  | 84 (61.8) |  |
| **Previous stroke** |  |  |  |  |  |
| No | 12732(98.5) | 1575 (12.4) | 0.0001 | 711 (45.5) | 0.376 |
| Yes | 197(1.2) | 84 (42.6) |  | 22 (52.4) |  |
| **Hypertension** |  |  |  |  |  |
| No | 7587(60.7) | 154 (2.03) | 0.0001 | 57 (27.7) | 0.0001 |
| Yes | 4916(39.3) | 1480 (30.1) |  | 665 (49.4) |  |
| **Diabetes** |  |  |  |  |  |
| No | 11908(92.1) | 1313 (11.0) | 0.0001 | 620 (43.8) | 0.0001 |
| Yes | 1027(7.9) | 348 (33.9) |  | 114 (60.0) |  |
| **BMI**  Mean (SD) Kg/m2  Median (IQR) Kg/m2 | 26.1(5.4)  25.6(22.5-29.0) | 29.5(5.8)  28.5(25.6-32.3) | <0.0001 | 29.4(5.4)  28.6(26.0-32.0) | <0.0001 |
| **Obesity** |  |  |  |  |  |
| <30 kg/m2 | 10021(80.1) | 996 (9.94) | 0.0001 | 453 (41.6) | 0.0001 |
| ≥30 kg/m2 | 2489(19.9) | 636 (25.6) |  | 268 (57.5) |  |

**Figure 1.** Distribution of health knowledge variables shown by bubble plot by countries in PURE Study. The number inside the bubble are percentages (%). We used an arbitrary cut off 60% for visualisation of regions with high (≥60%) vs low health knowledge (<60%). \*Diabetes and arthritis are not considered as health effects of smoking; therefore, not highlighted in red color. Abbreviations: LIC: low-income country, LMIC: lower middle-income country, UMIC: upper middle-income country, HIC: high income country.



**Knowledge on ‘health actions to prevent heart attack or stroke’ (11 questions)**

**Knowledge on ‘health effects of smoking cigarettes’ (10 questions)**

**Table 2.** Individual associations of health effects of smoking (10 questions) and health actions to prevent CVD (11 questions) with smoking cessation and taking anti-hypertensive medication adjusting for baseline covariates.

|  |  |  |  |
| --- | --- | --- | --- |
| **Knowledge variables** | **Positive statement (%)** | **Model 1: unadjusted**  **OR (95% CI)** | **Model 2: adjusted**  **OR (95% CI)** |
| **Smoking cessation (N=1,608)** | | | |
| **Knowledge on health effects of smoking** |  |  |  |
| Chronic lung disease | 95.1 | **2.13(1.31, 3.47)** | 1.31(0.76, 2.26) |
| Heart disease | 82.5 | **2.98(2.20, 4.04)** | **1.62(1.13, 2.32)** |
| Diabetes | 24.9 | 1.06(0.87, 1.30) | 1.24(0.98, 1.57) |
| Stroke | 66.9 | **2.43(1.93, 3.06)** | **1.34(1.02, 1.77)** |
| Arthritis | 31.9 | 0.96(0.78, 1.19) | 1.25(0.97, 1.61) |
| Lung cancer | 93.7 | **2.79(1.76, 4.43)** | 1.46(0.86, 2.46) |
| Mouth and throat cancer | 88.2 | **2.24(1.57, 3.20)** | 1.22(0.81, 1.84) |
| Heart disease in non-smokers exposed | 74.4 | **1.99(1.56, 2.52)** | **1.35(1.02, 1.80)** |
| Premature birth with smoking during pregnancy | 69.6 | **1.46(1.18, 1.81)** | 1.05(0.82, 1.36) |
| Low birth weight babies with smoking | 69.0 | **1.82(1.47, 2.26)** | 1.29(1.00, 1.67) |
| **Anti hypertensive treatment (N=4,032)** | | | |
| **Knowledge on health actions to prevent CVD** |  |  |  |
| Doing more exercise | 87.8 | **1.80 (1.15,2.82)** | **1.48 (1.22,1.80)** |
| Eating more fruit | 90.0 | **1.41 (1.15,1.73)** | **1.25 (1.02,1.52)** |
| Eat more green vegetables | 92.0 | **1.54 (1.18,1.99)** | **1.19 (1.03,1.38)** |
| Reduced meat intake | 76.1 | **1.29 (1.10,1.51)** | **1.26 (1.05,1.50)** |
| Drinking less coffee | 70.5 | 1.25 (1.00,1.57) | 1.08 (0.93,1.26) |
| Eating more dairy products | 48.9 | 1.19 (0.83,1.70) | 1.22 (0.97,1.53) |
| Eating more fish | 75.5 | **1.71 (1.30,2.25)** | 1.27 (0.99,1.63) |
| Quit smoking | 95.3 | **1.42 (1.08,1.87)** | 1.09 (0.93,1.28) |
| Reducing fat in meals | 86.3 | **2.05 (1.32,3.18)** | **1.31(0.76, 2.26)** |
| Reducing salt in meals | 85.9 | **2.08 (1.42,3.05)** | **1.62(1.13, 2.32)** |

The model 1 is unadjusted. The model 2 is adjusted for a basic set of covariates in Table 1.×(%) denotes percentage of total participants with affirmative response to each knowledge questions. Reporting affirmative answer to each question (*i=1 to 21*) was compared against a reference category combining “No” and “Unsure”.

**Table 3.** Nested models for the relationship between knowledge of health effects of smoking and smoking cessation (N=1,608).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Total population** | **Model 1** | **Model 2** | **Model 3** |
| **Health effects (of smoking) score** |  |  |  |  |
| Low health knowledge | 512 (37.9) | Reference | Reference | Reference |
| Moderate health knowledge | 530 (33.0) | 1.21 (0.94,1.58) | 1.20 (0.92,1.56) | 1.16 (0.89,1.52) |
| High health knowledge | 566 (35.2) | **1.30 (1.01,1.68)** | **1.33 (1.03,1.73)** | 1.28 (0.99,1.67) |
| **Education** |  |  |  |  |
| None or primary only | 609 (37.9) | Reference | Reference | Reference |
| Secondary | 557 (34.7) | 1.06 (0.84,1.34) | 1.08 (0.86,1.37) | 1.05 (0.82,1.33) |
| **Trade, college or university** | 440 (27.4) | **1.65 (1.26,2.16)** | **1.67 (1.27,2.19)** | **1.57 (1.19,2.08)** |
| **Wealth** |  |  |  |  |
| Poorest third | 52 9(33.4) | Reference | - | Reference |
| Middle third | 519 (32.8) | 1.26 (0.99,1.59) | - | 1.21 (0.95,1.54) |
| Richest third | 536 (33.8) | **1.39 (1.08,1.79)** | **-** | 1.28 (0.99,1.66) |
| -2 Res Log Pseudo-Likelihood (smaller *is better)* |  | 9457 | 9453 | 9291 |

Model 1s are individual models of association between knowledge of health effects of smoking score, education and wealth - adjusted for a basic set of covariates in Table 1.Model 2 is adjusted for model 1 plus education. Model 3 is adjusted for model 2 plus wealth. Likelihood ratio test defined as l )bigger model) – l (smaller model) ~ c 2p. Where, l is the maximum log-likelihood, and p is the number of extra parameters in the bigger model. c 2p is chi-squared value with p degrees of freedom.

**Table 4.** Nested models for the relationship between health knowledge of actions to prevent CVD and taking anti-hypertensive medication (N=4,032)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Total population** | **Model 1** | **Model 2** | **Model 3** |
| **Knowledge on health actions to prevent CVD score** |  |  |  |  |
| Low health knowledge | 1344 (33.3) | Reference | Reference | Reference |
| Moderate health knowledge | 1329 (33.0) | **1.74 (1.36,2.21)** | **1.72 (1.34,2.22)** | **1.69 (1.30,2.20)** |
| High health knowledge | 1359 (33.7) | **2.58 (1.57,4.22)** | **2.54 (1.52,4.23)** | **2.46 (1.46,4.15)** |
| **Education** |  |  |  |  |
| None or primary only | 1265 (31.8) | Reference | Reference | Reference |
| Secondary | 1300 (32.7) | 1.18 (0.85,1.64) | 1.14 (0.87,1.48) | 1.05 (0.82,1.36) |
| **Trade, college or university** | 1410 (35.5) | 1.32 (0.95,1.84) | 1.18 (0.86,1.61) | 1.07 (0.82,1.39) |
| **Wealth** |  |  |  |  |
| Poorest third | 1673 (41.6) | Reference | - | Reference |
| Middle third | 1343 (33.4) | 1.18 (0.90,1.55) | - | 1.13 (0.89,1.45) |
| Richest third | 1007 (25.0) | **1.49 (1.03,2.16)** | **-** | **1.39 (1.02,1.90)** |
| *-2logLikelihood (smaller is better)* |  | 3525 | 3520 | 3477 |

Model 1s are individual models of association between knowledge of health effects of smoking score, education and wealth - adjusted for a basic set of covariates in Table 1.Model 2 is adjusted for model 1 plus education. Model 3 is adjusted for model 2 plus wealth. Likelihood ratio test defined as l )bigger model) – l (smaller model) ~ c 2p. Where, l is the maximum log-likelihood, and p is the number of extra parameters in the bigger model. c 2p is chi-squared value with p degrees of freedom.

**Figure 2.** Relative ranking health effects of smoking (10 questions) and health actions to prevent CVD (11 questions) associated with smoking cessation (N=1,608**)** and hypertension treatment (yes, no) (N=4032) from mutually adjusted model in PURE study, odds ratio (ORs) and 95% confidence interval. The analysis is adjusted for a basic set of covariates in Table 1.



Low

High

**Hypertension treatment**

**Smoking cessation**