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Keywords: Physical exercise, Sports, Gender, Educational background, Body mass index, Health communication.

JEL Classifications: I18.

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Abstract:

Nowadays, physical exercise and sports activities are regarded as the best means for people to keep fit and boost their health. In Vietnam, exercising on a daily basis is still underappreciated as two-thirds of the population only exercise at trivial or low levels. Based on applying the baseline category logit model, we conduct an analysis to figure out the factors affecting people's level of exercise. The findings show that males tend to engage in physical activities more than females, with the difference potentially being as high as 18.9%. In addition, females with a high educational background (university or higher) usually exercise less than those with lower education, perhaps due to their job's attributes and their different routines. The opposite is the case in males, yet the differences for both genders are relatively small (only about 1%). The study also shows that those with higher BMI have higher activity levels. In particular, those with the highest BMI (BMI = 37.2) have a likelihood of regularly exercising as high as 74%. Furthermore, improved health communication systems and regular health check-ups at home are also associated with more frequent exercise and engagement in sport.

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Introduction

The benefit of exercise and sports (EAS) have been proven by a large range of studies. EAS do not only help maintain the body's fitness, as well as physical and mental health, but also improve mood, self-esteem, and social skills [1,2]. They show preventative effects among healthy individuals and treatment effects among sufferers of illness [2]. EAS are beneficial to those with hypertension; reduce the risk of obesity, heart disease, diabetes, and colon cancer; lower premature mortality rates; and enhance osteoarthritis function in older people [3-6]. Moreover, regular engagement in EAS is also related to improved respiratory function, is helpful in cases of chronic kidney disease, and leads to a possible reduction in inflammatory biomarkers [7].

There are various factors that impact the frequency and magnitude of an individual's physical training. Of these factors, gender is one of the most basic. Eccles and Harold (1991) proved that obvious sex differences in attitudes towards EAS emerged at an early age. Notably, these differences were seemingly derived from differences in social roles, rather than from congenital biological features [8]. While both genders enjoy taking part in calisthenics, cycling, swimming, and bowling; men tend to prefer weight lifting, golf, volleyball, soccer, and handball; and women are more attracted by walking, aerobics, and dancing [9]. Although the research of Lewis et al. (1986) showed that there was no gender difference in adaptations to training, women were still inclined to feel less confident in sports and to consider sports less important than other domains, whereas the opposite tendency goes for men [8]. Additionally, the reasons for the difference also come from various other factors, such as parental behaviours, muscle structure, lung size, respiratory mechanisms, and fat rates specific to the body of each gender [8,10,11]. The fat rate is proven to be associated with body mass index (BMI), which indicates the body's level of obesity [12].

The BMI, apart from varying by gender and ethnicity, also changes according to physical training and educational background [13-17]. Educational background has a general influence on the BMI of males, while for females, only lower educational level is proven to be related to higher BMI [18]. The higher educated women seem to exercise more regularly so that they have stronger muscles compared to the less educated [18,19]. Furthermore, Elsayed et al. (1980) demonstrated that the highly fit men had higher intelligence than the low fitness level group [20].

Health communication is a factor which should also be taken into account when considering EAS because of its effect on people's health behaviours and since it also changes in line with gender and educational background [21]. Women are more likely to be affected by emotional information which leads to community consequences, while men are more attracted to specific information which has direct effect on their health [22]. Besides this, family members and friends are also factors that have strong influences on people's healthcare and preventative behaviours, such as EAS [24,25]. Yet, doing EAS with an unsuitable frequency and magnitude might lead to detrimental results. Abusing EAS can make people dependent on it [2]. In the long term, exercising too much does not improve the mental health of normal people, and may even cause depression [1,2]. Conversely, training with insufficient intensity does not bring the results either. Appropriate exercise intensity is from >= 20 minutes/day, >= 3 days/ week. EAS practice can only begin to take effect when undertaken for about 30 minutes/day with moderate intensity [5]. In the same vein, Smart et al. (2013) suggested that the intensity of exercise should be >60% of the maximal capacity of the body, so as to produce the results of enhanced cardiac and respiratory functions [7].

Based on these above findings, we conduct an analysis to clarify the reality of engagement in EAS in the Vietnamese population. The levels of EAS regularity are analysed in relation to gender, educational background, BMI, health communication quality, and regular health check-ups at home. The findings will be valuable for policy makers.

Materials and Methods

The analysis in this study is based on the dataset from periodic general health examinations conducted by the Vuong & Associate research team during September-November 2016. The survey was executed adhering to ethical standards under the license of V&A/07/2016 (15 Sep, 2016). The subjects of the survey were chosen randomly and without discrimination.

The data is structured and analysed in R (3.1.1). The estimations are computed using the baseline category logit model (BCL), according to [26]. The general equation of the baseline-categorical logit model is:

$$\ln\frac{\pi_j(\mathbf{x})}{\pi_J(\mathbf{x})} = \alpha_j + \beta_j^{\mathrm{T}}\mathbf{x}, \qquad j = 1, \ldots, J-1.$$

in which $\mathbf{x}$ is the independent variable; and $\pi_j(\mathbf{x}) = P(Y = j|\mathbf{x})$ its probability. Thus $\pi_j = P(Y_{ij} = 1)$, with Y being the dependent variable.

The estimated coefficients attained in multivariable logistic models are used to calculate the empirical probabilities according to the following formula:

$$\pi_j(\mathbf{x}) = \frac{\exp\left(\alpha_j + \boldsymbol{\beta}_j^{\mathrm{T}}\mathbf{x}\right)}{1 + \sum_{h=1}^{J-1} \exp\left(\alpha_h + \boldsymbol{\beta}_h^{\mathrm{T}}\mathbf{x}\right)}$$

with $\sum_j \pi_j(\mathbf{x}) = 1$; and n observations in the sample, j the categorical values of an observation i, and h a row in basic matrix $\mathbf{X}_i$. Estimated probabilities can be used to predict the possibilities of Y in different conditions of $\mathbf{X}_i$ [27-29]. The statistical significance of independent variables in the model are determined based on z-value and p-value; with $p < 0.05$ being the conventional level of statistical significance required for a positive result.

Specifically in this study, we examine and compute the probabilities of different levels of physical exercise in relation to gender, BMI, educational background, medical practice in the family, and health communication quality.

Analysis

In the process of collecting data, an average of one out of every six people invited to the interview refused to answer. Participants took roughly 10-15 minutes to complete the questionnaire. Out of a total of 2,068 observations obtained, the majority of participants were young people (<30 years old) (63.15%), with the proportion of middle-aged and elderly participants (>= 50 years old) only accounting for 5.76% (Table 1). Women appeared to be more willing to take part in the survey, accounting for 64.08%.

Table 1. Descriptive statistics of the sample.

Characteristics	N	Percentage (%)
Age		
<30	1306	63.15
30-49	643	31.09
≥50	119	5.76
Gender		
Male	728	35.20
Female	1340	64.80
Educational background		
Highschool or less	558	26.98
University or above	1.510	73.02

BMI		
<18.5 (Underweight)	408	19.73
18.5-22.99 (Normal)	1242	60.06
23-24.99 (Pre-obese)	279	13.49
25-29.99 (Obese level I)	128	6.19
>=30 (Obsese level II)	11	0.53
Checking up health in the family regularly (blood pressure, weight, eyesight ...)		
Yes	1242	60.06
No	826	39.94
The level of exercise and sports regularity		
Absolutedly sufficient	132	6.38
Relatively sufficient	591	28.58
Little	863	41.73
Trivial	482	23.31

It can be seen in Table 1 that the majority of respondents are highly educated, with nearly three-quarters of participants having university education or a higher degree (73.02%). This somewhat increases the reliability of the information provided by the respondents, thereby increasing the reliability of the results obtained. With respect to BMI, more than half of the participants are physically normal (60%), with the rest is distributed evenly between being lean or overweight. The average BMI is also in the normal range, at 20.85 (95% CI: 20.73-20.97) (Table 2). Most participants (60.06%) habitually receive simple health checks at home, including measurements of blood pressure, height, weight, eyesight, and tracking of symptom signs.

Regarding level of physical training, which can be observed in Table 1 and Figure 1, participants do not pay much attention to regularly engaging in physical activities. This is clear from the fact that those engaging in little exercise account for the largest proportion (41.73%), those engaging in relatively sufficient and trivial levels of training come next, accounting for 28.58% and 23.31%, respectively. The proportion of participants engaging in a completely sufficient level of exercise is quite low (>6%).

Figure1. Distribution of respondents towards level of EAS regularity and gender.

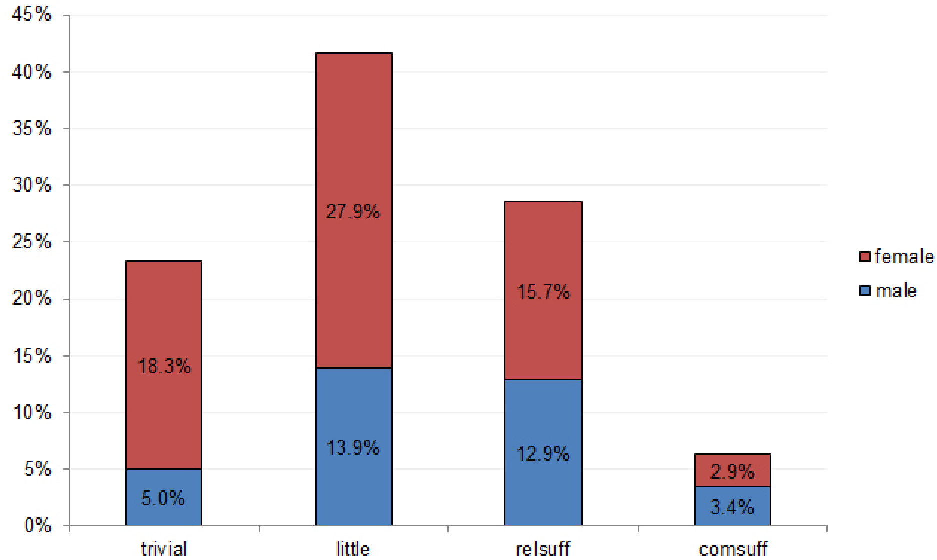


Figure 1 shows that men and women are distribute unevenly at different activity levels. Specifically, men account for a larger percentage of those exercising at a completely sufficient level compared to women (3.4% and 2.9%, respectively), while women account for a higher proportion in the remaining levels.

In addition, the quality of healthcare communications also plays an important role. In the questionnaire, we divided this factor into 5 levels of quality, which corresponds to a scale of 1 to 5 with 1 being the lowest and 5 the highest. The collected data showed that health communication was only at the average level (2.83 points, 95% CI: 2.79-2.87) (see Table 2).

Table 2. Descriptive statistics for continuous variables.

Characteristics	**Min**	**Max**	**Average**	**SD**	**CI**
Age	18	83	29.17	10.09	28.73-29.60
BMI	14.48	37.20	20.85	2.69	20.73-20.96
Health communication quality	1	5	2.83	1.170	2.79-2.87

Results

EAS regularity affected by gender, educational background and BMI. Firstly, we consider the effects of gender and education. The regression model is constructed with the dependent variable being “EvalExer” (the level of EAS regularity), classified into four levels: “Comsuff” (completely sufficient), "Relsuff" (relatively sufficient), "little" (do exercise but little), and "Trivial" (rarely do exercise); and two predictor variables are "Sex" (gender) and "Edu" (educational background). "Sex" includes "Male" and "Female", while "Edu" is categorised into 2 groups: "Highschool" (the people with high-school education or less) and "Graduate" (the people with university education or higher). The estimation results are provided in Table 3/subtable 3a.

Table 3. Estimation results based on empirical data.

(3a)	Intercept	"Sex" "Male"	"Edu" "Highschool"
	β_0	β_1	β_2
logit(trivial|comsuff)	1.846***	-1.437***	-0.071
	[12.065]	[-6.926]	[-0.338]
logit(little|comsuff)	2.387***	-0.808***	-0.536**
	[16.134]	[-4.256]	[-2.686]
logit(relsuff|comsuff)	1.805***	-0.315	-0.491*
	[11.818]	[-1.623]	[-2.394]
(3b)	**Intercept**	**"Edu" "Highschool"**	**"BMI"**
	β_0	β_1	β_2
logit(trivial|comsuff)	4.006***	-0.14	-0.127***
	[5.297]	[-0.677]	[-3.586]
logit(little|comsuff)	4.158***	-0.568**	-0.100**
	[5.837]	[-2.860]	[-3.025]
logit(relsuff|comsuff)	1.919**	-0.514*	-0.012
	[2.658]	[-2.510]	[-0.366]
(3c)	**Intercept**	**"ExamTools" "Yes"**	**"HealthCom"**
	β_0	β_1	β_2
logit(trivial|comsuff)	2.563***	-0.622**	-0.297**
	[7.566]	[-2.867]	[-2.976]

logit(little|comsuff)	2.973***	-0.616**	-0.236*
	[9.144]	[-2.960]	[-2.497]
logit(relsuff|comsuff)	2.205***	-0.464*	-0.132
	[6.600]	[-2.171]	[-1.358]

Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1; z-value in square brackets; Baseline category for: “Sex” = “Female”; and “Edu” = “Graduate” (3a); “Edu” = “Graduate” (3b); “ExamTools” = “No” (3c). Log-likelihood: -36.94 on 3 d.f. (3a); -2533.25 (3b); -2546.62 (3c) on 6195 d.f. Residual deviance: 4.17 on 3 d.f. (3a); 5066.50 (3b) and 5093.25 (3c) on 6195 d.f.

With $P<0.05$, most of estimated coefficients are statistically significant. Therefore, the correlation between the variables is confirmed. The estimation equations performing the relationship are presented as follows:

$$ln\frac{\pi_{trivial}}{\pi_{comsuff}} = 1.846 - 1.437 \times MaleSex - 0.071 \times HighschoolEdu \quad \text{(Eq.1)}$$

$$ln\frac{\pi_{little}}{\pi_{comsuff}} = 2.387 - 0.808 \times MaleSex - 0.536 \times HighschoolEdu \quad \text{(Eq.2)}$$

$$ln\frac{\pi_{relsuff}}{\pi_{comsuff}} = 1.805 - 0.315 \times MaleSex - 0.491 \times HighschoolEdu \quad \text{(Eq.3)}$$

From that, the probability that a man with high-school education or lower exercises relatively sufficiently is:

$$\pi_{relsuff} = \frac{e^{1.805-0.315-0.491}}{e^{1.805-0.315-0.491} + e^{2.387-0.808-0.536} + e^{1.846-1.437-0.071} + 1} = 0.341$$

Likewise, the remaining probabilities can also be calculated.

Next, we consider the effect of BMI on EAS levels. In this BCL estimation, the response variable is still “EvalExer”, the predictors are “Edu” and “BMI”. The results are reported in subtable 3b. From the results, it can be concluded that a relationship between these factors exists. The estimation equations are displayed in Eqs.4–6.

$$\ln\frac{\pi_{trivial}}{\pi_{comsuff}} = 4.006 - 0.140 \times HighschoolEdu - 0.127 \times BMI \quad \text{(Eq.4)}$$

$$\ln\frac{\pi_{little}}{\pi_{comsuff}} = 4.158 - 0.568 \times HighschoolEdu - 0.100 \times BMI \quad \text{(Eq.5)}$$

$$\ln\frac{\pi_{relsuff}}{\pi_{comsuff}} = 1.919 - 0.514 \times HighschoolEdu - 0.012 \times BMI \quad \text{(Eq.6)}$$

EAS regularity affected by health communication quality and habitual medical practice in the family.

Above, we have considered the inner factors. Now, we continue by taking into account some other outer factors, including health communication and periodic general health examination and medical practice in the family. The response is, again, "EvalExer", and the two predictors are "ExamTools" (habitually checking health status in the family with common medical tools), including 2 options, "Yes" and "No"; and "HealthCom" (quality of health communication about periodic general health examination), scored from 1 to 5, with 1 the lowest and 5 the highest. The estimation results are given in Table 3/subtable 3c.

With P<0.05, the relationships between the above variables are confirmed, with 8 out of 9 of the estimated coefficients being statistically significant. The empirical relationships are presented in Eqs.7–9.

$$\ln\frac{\pi_{trivial}}{\pi_{abssuff}} = 2.563 - 0.622 \times YesExamTools - 0.297 \times HealthCom \quad \text{(Eq.7)}$$

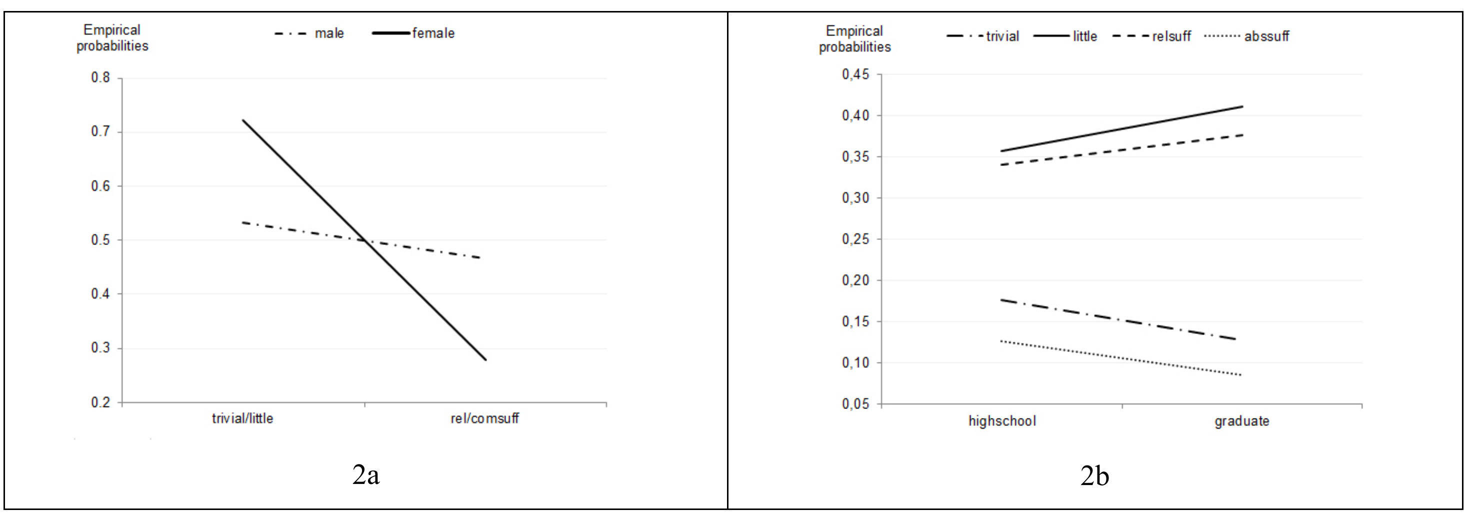
$$\ln\frac{\pi_{little}}{\pi_{abssuff}} = 2.973 - 0.616 \times YesExamTools - 0.236 \times HealthCom \quad \text{(Eq.8)}$$

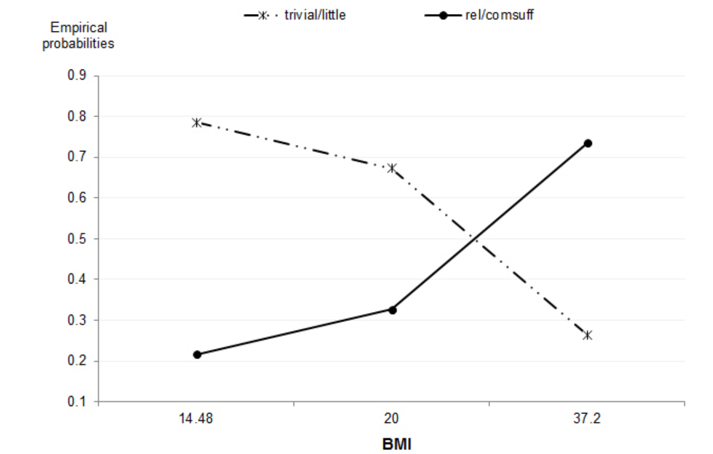
$$\ln\frac{\pi_{relsuff}}{\pi_{abssuff}} = 2.205 - 0.464 \times YesExamTools - 0.132 \times HealthCom \quad \text{(Eq.9)}$$

Discussion

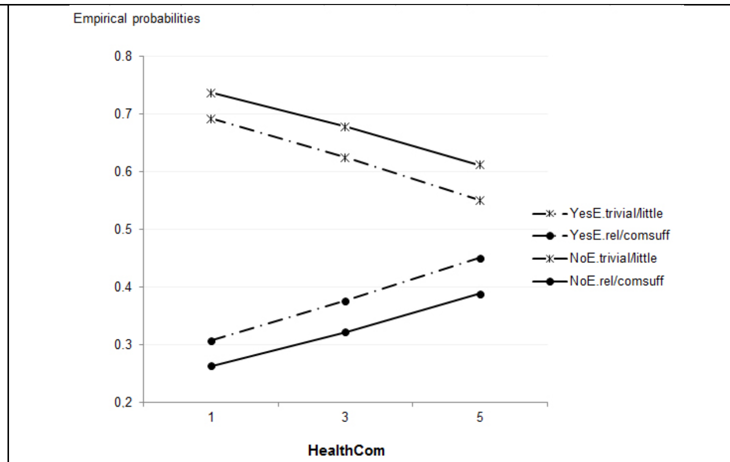
The regression results partly show preliminary assessments about the impact of the variables on people's EAS levels. The following discussion will give more details about both the degree and trend of each factor. The figures are built using the conditional probabilities (see Table Appendix, a–c).

Figure 2. Probability lines representing EAS regularity levels towards internal and external factors.





2c



2d

Internal factors. Figure 2a depicts the EAS tendency between men and women with high school education or less. It can be seen that, at the point of non-regular exercise ("trivial/little"), the probability of women is higher than men, and the opposite is the case for regular excercise ("rel/comsuff"). Specifically, the probability at the "trivial/little" point on the women's line could reach 70%, while the figure for men is only a little above 50%. Notably, the difference between the probability of regular and non-regular exercise among women is remarkably higher than men. The different slopes of the two lines demonstrate this.

Concerning the lines showing EAS changes in relation to educational background among men, in Figure 2b, it can be observed that the lines of "trivial" and "comsuff" have the same downward trend, while, in contrast, the "little" and the "relsuff" go up. The same goes for the women. Therefore, those with a higher education degree (from university or above) are inclined to be either much more or much less active in comparison to the less educated. However, this differentiation also varied between genders, following which, the probability of regular exercise of women in the "highschool" group is higher than those in the "graduate" group, with specific numbers of 72.2% and 70.9%, respectively. While the opposite trend is observed in men, with the probability of regular exercise in the "highschool" and "graduate" groups being 0.533 and 0.539, respectively. In addition, Figure 2c helps clarify the trends of changes in activity levels according to BMI. From this, it can be seen that, when BMI increases from 18 to 23, the "trivial/little" line (the probability of not exercising or training at negligible level) tends to go down and the "rel/comsuff" (the probability of exercising relatively and absolutely sufficiently) goes up. This proves that people with a large physique tend to take more exercise.

External factors. Previous studies have shown the influence of the media on health care quality assessment, as well as on medical care [21,22,30]. In this article, the media continues to be demonstrated to affect EAS regularity. The evidence suggests that the “trivial_little” line goes down and the “rel/comsuff” goes up when the communication quality scored from 1 to 5 (Figure 2d). This means that, when the communication quality is improved, people are more conscious about sports training, and this figure can be up to 45% (in this case of the regular check-ups at home being “yes”). On the other hand, those who examine their health frequently also tend to attend sport activities more regularly. The above position of the lines representing relatively and completely sufficient exercise of those who usually practise common health checks in their home (“YesE.rel/comsuff ”) compared to which of those who do not (“NoE.rel/comsuff”) provides support for this argument.

Conclusion

Overall, the above analyses prove that EAS regularity is not only impacted by objective factors, such as gender, education, and physique, but also by external factors. The analytical results show that men tend to be more active than women in both groups of educational background, with the difference amounting to as much as 18.9% (Figure 2a). This is easily explained by the fact that men are generally conceived as the strong genus, as tending to prefer physical activities to women, and as having to do hard work more often. On the other hand, women might think that they often do housework, shopping, and taking care of children, which already require a significant amount of mobilisation, so they do not necessarily participate in additional pure sports activities [3]. Moreover, a lot of the women who participated in the survey responded that they did not have enough time for themselves, as their official work and housework took up all their time.

In terms of BMI, those with higher BMI have higher activity levels. In particular, those with the largest BMI (BMI = 37.2) have a likelihood of regularly exercising as high as 74%, whereas this figure for the thinnest person (BMI = 14.48) is only a little above 21% (Figure 2c). This can be explained by the fact that those who are overweight tend to choose exercise and sports as an effective and safe method to lose weight. In addition, in the case of Vietnam, the higher average BMI of men compared to women could also be an explanation [30]. The relationship between BMI and sex leads to the correlation between BMI, sex, and activity levels.

Educational attainment is also a factor that has an impact on people’s EAS levels. The findings show that those with a low level of education show two distinct trends, either engaging in much more or much less exercise compared to those with higher levels of education. In Vietnam, where the economy is developing and social mobility is still modest, those with low levels of education tend to have to do “blue-collar” jobs to earn a living, which makes them a lot more active than those with higher levels of education, who often do “white-collar” job in an office. On the other hand, those with higher levels of education will be able to earn more money, therefore, they have more opportunities to be exposed to various types of “luxury” sports, such as gym exercise, yoga, tennis, dance-sport, and golf. However, these sports are usually relatively expensive and not mandatory, which may reduce the motivation to exercise regularly. This leads to people with lower education levels taking part in sports and exercise either much less or much more. Furthermore, for women, those who graduate from university or have a higher degree usually exercise less than those with lower education, perhaps due to their job’s attributes and their different routines. This inference is consistent with the approaches of Sundquist et al. and Rantanen et al. [18,19]. However, in this study, we additionally find that the opposite propensity among men. However, the differences in both sexes are negligible.

Moreover, when the communication quality is increased, people also are likely to take part in sport and physical exercise more. Those who assess health communication quality as being at the highest level are 12% more likely to exercise frequently than those who assess it as being at the lowest (Fig.2d). The reason for this is that people often keeping track of health care information may prompt them to worry, so that they will be more concerned about their health [21,22]. On the other hand, the information helps them to understand the importance and benefits of habitual physical exercise, and, as a result, they will take engage in more EAS. The important point is that the external factors make people more aware of their own health status, so that they spontaneously take measures to take care of themselves. The findings also indicate that those who habitually conduct simple health checks at home tend to be more active. The regular check-ups at home are a further indication of self-concern. Furthermore, when considering the impact of media quality and regular monitoring of health status in comparison, the latter seems to have a greater influence, with the absolute value of the estimated coefficients being significantly larger.

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Appendix

Appendix a. Probabilities of EAS regularity towards gender and education.

"EvalExer"	"trivial"		"little"		"relsuff"		"abssuff"	
"Edu"|"Sex"	"male"	"female"	"male"	"female"	"male"	"female"	"male"	"female"
"highschool"	0.176	0.347	0.357	0.375	0.341	0.219	0.126	0.059
"graduate"	0.128	0.261	0.411	0.448	0.376	0.250	0.085	0.041

Appendix b. Probabilities of EAS regularity towards BMI.

		"EvalExer"			
"bmi"	"edu"	"trivial"	"little"	"relsuff"	"abssuff"
14.48	"highschool"	0.370	0.415	0.167	0.049
	"graduate"	0.286	0.493	0.188	0.033
20	"highschool"	0.292	0.381	0.249	0.078
	"graduate"	0.224	0.447	0.277	0.052
37.20	"highschool"	0.086	0.179	0.531	0.204
	"graduate"	0.066	0.209	0.589	0.135

Appendix c. Probabilities of EAS regularity towards health communication quality and usual medical practice in the family.

		"EvalExer"			
"HealthCom"	"Examtools"	"trivial"	"little"	"relsuff"	"abssuff"
1	Yes	0.265	0.427	0.256	0.051
	No	0.283	0.454	0.234	0.029
3	Yes	0.222	0.403	0.298	0.078
	No	0.241	0.437	0.277	0.045
5	Yes	0.180	0.370	0.336	0.114