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Frequency of Practicing of Different Types of Physical Activity, BMI and Tobacco/Alcohol Consumption Relationship: How They Are Associated with Our Physical and Mental Health in Different Ages, in Men and Women?

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Abstract: The purpose of this article was to check the relashionship of different types of physical activities, BMI, smoking and alcohol consumption (with control for age, sex and level of education) on health (physical and mental). The study was based on Belgium epidemiological data (10661 participants from 19 to 81 years old for whom we have health indicators over a period of 11 years) together with questionnaires about alcohol, tobacco consumption and the frequency of different types of physical activities. Descriptive statistics and regression analysis of epidemiological data was performed with use of STATA v.14. Our results indicate that the different categories of physical activities (PA) had some differences on health indicators impacts. Our findings confirm that leading a healthy life style (all types of physical activities and weight maintenance) is an important issue since it has a significant relationship with physical and mental health indicators, but outdoor physical activities and practicing leisure sport in group have shown slightly higher magnitude in association on general health. Magnitude of association of PA with physical and mental health indicators was similar to those observed with smoking and alcohol consumption.

Keywords: healthy life style; physical activity; physical and mental health

1. Introduction

Physical activity is a rather vague term, which includes a wide variety of types of differing intensity and frequency. In the most general way it is defined as an increase of energy expenditure by moving one's body [1,2]. Some researchers mention the importance of covering different domains of physical activity instead of referring only to sport and exercise. Those are walking, cycling, leisure time, housework, transportation, and occupational components of physical activity [3–6]. World Health Organization (WHO) mention that globally, one in four adults do not meet the global recommended levels of physical activity1 [7,8]. Regular physical activity is proven to help prevent and manage non-communicable diseases such as heart disease, stroke, diabetes and several cancers. It also helps prevent hypertension, maintain healthy body weight and can improve mental health, quality of life and well-being2.

There are different views on what frequency, duration, and intensity of physical activity is defined as "healthy" [7,8]. In several papers it is advised for general public to exercise moderately five days per week for about half an hour each time [6,8,9] and somewhat more for patients with

1 World Health Organization. (2021). Physical activity fact sheet (No. WHO/HEP/HPR/RUN/2021.2). World Health Organization

2 World Health Organization. (2021). Physical activity fact sheet (No. WHO/HEP/HPR/RUN/2021.2). World Health Organization

depression [10]. WHO recommended adults aged 18–64 years to do at least 150–300 minutes of moderate-intensity aerobic physical activity or at least 75–150 minutes of vigorous intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week3.

A particular problem is related to the way and objectivity of measuring physical activity. Physical activity is measured either through self-reports [4] or using pedometers, which appeared to be a valid means correlating with self-reports [11]. In different papers physical activity is classified into different levels, most often high, moderate and low [3,4]. In the position statement on physical activity and exercise intensity terminology Norton, Norton, and Sadgrove [12] offer a more distinct designation of physical activity: sedentary, light, moderate, vigorous or high [12]. For the purpose of our study, we have decided to focus on several levels of physical activity: (1) high-intensity sports (running, biking, swimming, Nordic walking), (2) moderate-intensity sports (yoga, Tai-Chi, stretching, Pilates), low-intensity physical activity and open air leisure group sport exercise (gardening, golf soccer, volleyball). It is shown that significant physiological change may happen with small increases in exercise intensity, these processes are similar in all healthy adults [12], and that the greatest effectiveness may be reached in the medium tertile physical activity [4].

There is an increased focus on physical activity as a possible solution in public health regarding its numerous positive effects. A number of research findings shows that an individual may benefit from being physically active in terms of general physical and mental health, emotional, psychological and general well-being [13–16].

Sport and exercise have positive effects on overall physical health [4,17–19] and reduce all-cause mortality [20]. Particularly regular physical activity is said to be cardio protective [5,8], reducing the cardiovascular and cerebrovascular risk [4,21,22] and the risk of stroke [10,21]. It supports treatment and prevention of non-alcoholic fatty liver disease [21] and of obesity [8,23]. Moreover, it helps manage several chronic conditions such as diabetes, heart disease [9] and slows down the progression of atherosclerosis [4].

Mental health is another dimension of the human condition that has showed to have positive outcomes for people who are physically active [24]. Regular exercise lowers anxiety, alleviates post-traumatic stress disorder (PTSD), social phobia (SP) and obsessive-compulsive disorder (OCD) [1]. It is effective as an adjuvant treatment in major depressive disorder [8], helps improve functioning parameters in depressed patients, lowers depression symptoms [8,10]. It also helps maintain cognitive function [5,25,26].

Adequate levels of physical activity have shown to result in emotional well-being. Not only does exercise deliver pleasurable feelings and energy [6], but also those who practice it rarely develop mood disorders [1]; some authors mention a decrease in negative or an increase in positive affect [23].

Psychological benefits, apart from emotional well-being, are reducing stress, better sleep [6,18], improving self-esteem and better functioning in social, working and leisure contexts [1,18]. Being physically active is related to overall subjective well-being [7,18,27] and quality of life [23] including higher long-term income [17], slower or partially reversed ageing process [5] and a greater chance to live longer independently in older ages [9].

However, there is an ambiguity of findings in different research concerning effects of physical exercise [4,10,23]. Some researchers believe it is due to a lack of good studies in the field [1,8]. In this study we address methodological difficulties mentioned by those scholars in the following ways. First of all, it is a larger sample size. Secondly, it is a narrower focus on the moderate intensity and a clear definition of different types of physical activity.

Lifestyle is another important term for this research because physical activity and other lifestyle factors are interdependent in many ways [3,5]. According to a number of scholars, lifestyle factors or elements of healthy lifestyle are: regular moderate physical activity(PA) [7,28,29], avoiding smoking

3 World Health Organization. (2021). Physical activity fact sheet (No. WHO/HEP/HPR/RUN/2021.2). World Health Organization

[18,30,31], moderate alcohol consumption [7,28], maintaining normal weight [29–31], diet [7] mostly meaning consuming more fruits, vegetables, fish, and milk [29–31]. Eguchi et al. [29] add to this list moderate sleep duration, and Södergren et al. [5] add TV viewing. Lifestyle can also be seen, as Macovei, Tufan, and Vulpe [18] put it, as physical exercise plus avoiding any kind of abuse.

Wholesome lifestyle is viewed as paramount for maintaining one's health status [18] including longer life duration, postponement of age associated diseases [5], better mental health [1] normal body weight [26], and lower risk of mortality [7]. Lifestyle behaviors are more beneficial together: researchers show that combined synergistic effect of positive lifestyle factors result in better health status, including weight and lower mortality risk [5,7,28].

As opposed to an active way of living there is a notion of "sedentary behavior"; some of the scientists emphasize that it is not the same as physical inactivity, though they are related [5]. It is shown to be linked to obesity [9], mortality [6] and depression [23]. Negative lifestyle choices include also smoking, excessive alcohol consumption, unhealthy diet, etc. and are associated with higher mortality risk [5,30] and a range of health problems, such as cardiovascular disease [30], obesity [32], incidence of stroke [29], and major non-communicable disease [7].

Smoking alone is related to a range of health problems, including mood and anxiety disorders [1], earlier aging and death [5]. Along with physical activity it is seen as one of the most important lifestyle factors in terms of preventing chronic diseases [5,7]. Interdependence of smoking and physical activity is controversial. Negative effects of smoking are more detrimental for physically inactive youth, as Katano, Ohno, and Yamada [4] show, and high intensity exercise may be protective in terms of maximum carotid intimamedia thickness (IMT) [4]. Henchoz et al. [3] citing other authors mention that sportive activity was show to have a negative correlation with smoking and positive with alcohol use. They have discovered a similar result: all sorts of physical activity were associated with at-risk use of alcohol, and all sorts of it apart from sport and exercise are associated with at-risk use of cigarettes and cannabis [3].

Unhealthy lifestyle patterns are prevalent nowadays and the number of people who cling to them is growing in the whole world [18,30,32,33]. Its negative effects put pressure on social and health care sectors [5,7,9]. Unhealthy lifestyle can be self-reinforcing [9]. One research has shown that there is a lack of belief in one's ability to live a healthy lifestyle, and it is negatively related to reported healthier behaviors in children [34]. Other paper displayed that many adult individuals lack the ability required to change their lifestyle [20].

Lifestyle modification is beneficial in different ages and health status [29,35], but Fenner et al. [36] claim that there is a lack of interventions that promote such a modification [36]. However, some lifestyle intervention programs have shown to be effective against adiposity [37,38], stroke risk factors [11,29], recession of cognitive function and brain metabolism [22], and excessive use of Primary Health Care center, meaning that patients who went through an intervention program would visit health center less frequently [27]. New technologies are at work: the application STEP UP helps increase the motivation to walk more, and adding a social component was found to be important [9]. The program "Healthy Dads, Healthy Kids" working with overweight fathers and their children was effective in increasing the number of healthy behaviors and decreasing weight in fathers and children [32]. The World Health Organization encourages to promote physical activity to be healthier with its program "Global action plan on physical activity 2018-2030: more active people for a healthier world"4.

This study's main strengths were having a large representative sample from the general population and simple categories defining physical activity, making it easier to identify for general public. Our findings add experimental evidence in support of extant research [30] to suggest a positive influence of physical activity on reducing the frequency of visits to a doctor. This data is needed to better tailor further interventions. It is important to know more about the association

4 World Health Organization. (2021). Physical activity fact sheet (No. WHO/HEP/HPR/RUN/2021.2). World Health Organization

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between healthy lifestyle behaviors and physical activity in order to better formulate public health strategies. The novelty of this study is to see different types of physical activities relationships with public health (general and mental). The preliminary results of this study have been presented at the ISEE (International Society of the Environmental Epidemiology) conference [37].

General aim of this study:

To check whether different physical activity (PA) types and the frequency of practicing are associated with consumption habits (smoking and alcohol), BMI, level of study, age, sex, public general and mental health indicators.

2. Materials and Methods

This is a secondary analysis of data study. In original study was based at general Belgium population with involvement of 10661 participants from 19 to 81 years old (M=56.5, SD=14, 59% female). The demographic data (age, level of studies, BMI) and epidemiological data such as indicators of general and mental health represented by a number (N) of visits to general practitioner and all doctors except of psychiatrist and psychiatrist doctors respectively during 11 years prior to the original study {Citation} [37], smoking and alcohol consumption habits were collected together with questionnaire about doing three types of physical activities (1 - sport – medium to high intensity exercises as aerobics, running, biking, swimming, Nordic walking; 2 – stretching exercises of yoga type – yoga, Tai-Chi, Pilates, and 3 – outdoor physical activities like practicing sport in group – golf, football and other activities like gardening) (see Appendix 1 & 2 for more details). The descriptive statistics and ordered regression analysis were performed for two man outcomes – general (physical) and mental health with use of STATA v.14.

The original study [37] received approval from the Ethical Committee of the Psychological Science Department and from the collaborative entity Mutualité Chrétienne-Christelijke Mutualiteit (MC-CM), the law service of the Mutual Benefity Society and their financial and organization help. All respondents received detailed information about the study and the data processing and provided separate written consent for the questionnaire study and the coupling of their answers with their medical records in possession of the MC-CM. Only people who provided written consent for both parts were included in the study. The realization of this study (planning of the hypothesis and data analysis) was supported by the MC-CM, by the 2012 Belgian-American Education Foundation (BAEF) alumni awarded granted to M.M. The MC-CM helped for the data collection by providing us with the email address of their members and by providing us with the health records of people who consent that we coupled their answers with their health records. None of our funding providers had any role in the data analyses and interpretation, or had any right to approve or disapprove the writing and publication of the manuscript.

3. Results

The study variables, taken from the epidemiological data for an adult Belgian population, can be described by two general categories: 1) healthy life style (BMI; as well as frequency of practicing sport or other physical activities, categorised in three groups as described in Methods) and 2) health indicators: (for a general physical health – as a proxy was taken a total sumatory number of visits to all doctors' consultations except on psychiarists and a proxy for the mental health –a total number of visits to psychiatrists). Other factors of unhealthy habits (as smoking and alcohol consumption) were included in the study analysis as well as confounding factors such as sex, age and education level (see Table 1).

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Table 1. Descriptive statistics for the study variables.

Variables	Descriptive Statistics					
	Frequency N (%)					
Groups	**1**	**2**	**3**	**4**	**5**	**6**
Age group	1,861 (18%)	4,747 (45%)	4,053 (38%)	-	-	-
Level of studies	458 (5%)	1,588 (17%)	2,866 (30%)	2,971 (31%)	1,464 (15%)	213 (2%)
BMI	179 (2%)	4,103 (39%)	3,538 (33%)	2,841 (27%)	-	-
General health: N of all doctor visits except psychiatrists (a sum)	2,411 (25%)	2,405 (25%)	2,412 (25%)	2,389 (25%)	-	-
Mental health: N Psychiatrist visits (a sum)	8,017 (75%)	966 (9%)	633 (6%)	1,044 (10%)	-	-
Sport and PA type, consumption habits:	Frequency N (%)					
	Almost never		**Sometimes**		**Almost always**	
PA type 1: Sport (Medium to high intensity exercises: running, aerobics, swimming)	3,986 (42%)		2,867 (30%)		2,764 (29%)	
PA type 2: Sport (low to medium intensity, stretching exercises - Yoga type)	8,335 (87%)		854 (9%)		428 (5%)	
PA type 3: Outdoor leisure group sport and other PAs (gardening)	3,536 (37%)		3,494 (36%)		2,587 (27%)	
Smoking (>2 cigarettes/ day)	8,328 (87%)		197 (2%)		1,092 (11%)	
Alcohol (>2 beers/day)	6,033 (63%)		2,370 (25%)		1,214 (13%)	

Legend: The categories for variables are represented in Appendix 1.2.

The descriptive statistics for sex subgroups is represented in Appendix 2 (Table A2.1 for women, Table A2.2 for men). All study variables differed for both sex subgroups at statistically significant level (p<.001, except the PA type 1 -intensive to medium sport exercises-, were p-value was .015) mesured as per bivariant analysis (chi-square).

The regression analysis was performed in order to observe where exist (and in which magnitude) the significant relationship between three types of physical activities and observed variables of the healthy life style (BMI, health indicators and substances consumption habits – smoking and alcohol). For general (physical) health indicators as proxy was used a sum of number of visits to doctors all, except of psychiatrists and for mental health, a sum of number of visits to psychiatrist from clinical histories records. The results are shown for the total group, and also for women and men in both analyses for each type of physical activity: 1) PA type 1 – Table 2; 2) PA type 2 – Table 3; and 3) PA type 3 – Table 4.

Additional regression analysis also showed that physical health indicators of the participants of this study have a statistically significant (p<.05) direct relationship with their age and an inverse relationship with the level of education. In contrast, mental health indicators have a statistically significant (p<.05) inverse relationship with the age of the participants and a direct relationship with the level of education.

Table 2. Regression analysis - PA type 1: Sport of medium to high intensity exercises: running, aerobics, swimming) with the study factors.

	Variables/Statistics	Total			Women			Men		
PA type1 frequency	**Factors**	**RRR**	**p-value**	**CI (95%)**	**RRR**	**p-value**	**CI (95%)**	**RRR**	**p-value**	**CI (95%)**
	1 - Almost never – a baseline									
2. Sometimes	Sex	1.03	.24	0.98-1.09			na			
	Age group	1.03	.40	0.96-1.12	**1.13***	**.018**	**1.02-1.25**	0.91	.803	0.80-1.03
	Level of studies	**1.07****	**.003**	**1.02-1.12**	**1.12****	**.001**	**1.04-1.19**	1.03	.339	0.97-1.10
	BMI	**0.76****	**<.001**	**0.71-0.81**	**0.77****	**<.001**	**0.71-0.83**	**0.74***	**<.001**	**0.67-0.83**
	SUM of doctors' visits (all doctors except psychiatrists)	**0.91****	**<.001**	**0.87-0.95**	**0.90****	**.001**	**0.84-0.95**	0.93	.069	0.87-1.01

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	SUM of psychiatrist' visits	0.92	.091	0.84-1.01	0.94	.267	0.84-1.05	0.90	.192	0.78-1.05
	Smoking (>2 cigarettes/day)	**0.71****	**<.001**	**0.65-0.76**	**0.74****	**<.001**	**0.67-0.82**	**0.67****	**<.001**	**0.59-0.75**
	Alcohol (>2 beers/day)	1.04	.203	0.97-1.13	1.02	.681	0.92-1.14	1.08	.151	0.97-1.20
3. Almost always	Sex	**1.15****	**<.001**	**1.09-1.22**			na			
	Age group	**1.10***	**.02**	**1.02-1.20**	**1.20****	**.001**	**1.08-1.34**	0.99	.861	0.87-1.12
	Level of studies	**1.14****	**<.001**	**1.09-1.20**	**1.23****	**<.001**	**1.16-1.33**	**1.07***	**.050**	**1.00-1.14**
	BMI	**0.53****	**<.001**	**0.49-0.57**	**0.55****	**<.001**	**0.50-0.60**	**0.51****	**<.001**	**0.45-0.57**
	SUM of doctors' visits (all doctors except psychiatrists)	**0.87****	**<.001**	**0.83-0.91**	**0.85****	**<.001**	**0.80-0.91**	**0.90****	**.005**	**0.83-0.97**
	SUM of psychiatrist' visits	**0.91***	**.046**	**0.82-0.99**	0.92	.180	0.81-1.04	0.89	.143	0.76-1.04
	Smoking (>2 cigarettes/day)	**0.59****	**<.001**	**0.47-0.57**	**0.54****	**<.001**	**0.47-0.61**	**0.50****	**<.001**	**0.43-0.57**
	Alcohol (> 2 beers/day)	1.07	.09	0.99-1.15	**1.12***	**.045**	**1.00-1.25**	1.03	.565	0.93-1.15

* p < 0.05, ** p < 0.01. Legend: Baseline: Sex (for the total group), age group and level of studies were included as confounding factors in the regression analysis.

Age was directly associated at the statistically significant level with practicing PA type 1 only in women (Table 2), meaning that with increasing age, more frequent engagement in such physical activities was reported by the study participants. Men are more prone to practice such sport activities at level "almost always" compared to women due to direct relationship between variable sex (men were coded with a higher number, see Annex 1) compared to women (Table 2). BMI was reversely associated with practicing PA type 1 (more frequent practicing sport – less BMI) (Table 2).

Level of study played a significant relationship with practicing PA type 1, indicating the direct relationship between level of study and the frequency of practicing PA type 1. The results showed a 23% increase in women (and 7% in men) in practicing "almost always" the PA type 1 (Sport (medium to high intensity exercise: running, aerobics, swimming) compared to a baseline ("almost never") (Table 2).

Higher frequency of visiting of GP (indicator of general health) was significantly associated with less frequent practicing of PA type 1; and with a frequency of psychiatrist (indicator of mental health) was shown a weaker relationship, also, in the reverse direction and only for the whole group level if compare "almost always" with a baseline – "almost never" (p=.046) (Table 2).

As for consumption habits, more frequent smoking was associated with less frequent practicing PA type 1; whereas no significant relationship was observed with alcohol consumption, on the exception of a weak direct (more frequent alcohol consumption is associated with more frequent practicing PA type 1) observed in men (RRR=1.12; p=.45) (Table 2).

Similar to PA type 1 results, the trends in BMI (reverse); age and educational level (direct) were observed in relationship with physical activity type 2 -Sport (stretching exercises, low to medium intensity - Yoga type), showing (Table 3). Whereas the sex variable, it showed the inverse to PA type 1 association, indicating more frequent practice in women compared to men (Table 3) due to reverse relationship between variables.

A weak relationship with indicator of mental health (sum of number of visits with psychiatrists) was observed at the whole group level when comparing "sometimes" practicing PA type 2 to a baseline or "almost never". When split by sex subgroups this relationship is shown on a marginal p-levels (Table 3). More frequent smoking is associated with less frequent practicing the stretching and relaxation exercises in both men and women (Table 3).

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Table 3. Regression analysis: PA type 2: Stretching exercises, low to medium intensity - Yoga type.

	Variables /Statistics	Total			Women			Men		
PA type 2 frequency	**Factors**	**RRR**	**p-value**	**CI (95%)**	**RRR**	**p-value**	**CI (95%)**	**RRR**	**p-value**	**CI (95%)**
	1 - Almost never – a baseline									
2. Sometimes	Sex	**0.74****	**<.001**	**0.68-0.81**			na			
	Age group	1.02	.730	0.91-1.14	1.02	.756	0.89-1.17	1.04	.741	0.84-1.29
	Level of studies	**1.09***	**.038**	**1.02-1.17**	**1.13****	**<.001**	**1.03-1.23**	1.03	.581	0.92-1.16
	BMI	**0.72****	**<.001**	**0.65-0.79**	**0.69****	**<.001**	**0.61-0.78**	**0.80***	**.021**	**1.02-1.06**
	SUM of doctors' visits (all doctors except psychiatrists)	1.00	.790	0.94-1.08	0.99	.826	0.91-1.08	1.05	.454	0.92-1.19
	SUM of psychiatrist' visits	**1.16***	**.021**	**1.02-1.31**	*1.14*	*.087*	0.98-1.32	*1.25*	*.071*	0.98-1.60
	Smoking (>2 cigarettes/day)	*0.76*	*.052*	*0.66-0.87*	**0.82***	**.015**	**0.70-0.96**	**0.63****	**.001**	**0.48-0.82**
	Consumption of alcohol (>2 beers/ day)	0.99	.983	0.89-1.12	1.03	.706	0.90-1.18	0.95	.586	0.92-1.14
3. Almost always	Sex	**0.72****	**<.001**	**0.64-0.81**			**na**			
	Age group	**1.44****	**<.001**	**1.23-1.69**	**1.52****	**<.001**	**1.26-1.83**	1.15	.341	0.86-1.55
	Level of studies	**1.18****	**.001**	**1.07-1.30**	**1.12***	**.053**	**1.00-1.27**	**1.32****	**.001**	**1.12-1.55**
	BMI	**0.54***	**.041**	**0.47-0.63**	**0.58****	**<.001**	**0.49-0.69**	**0.44****	**<.001**	**0.33-0.59**
	SUM of doctors' visits (all doctors except psychiatrists)	1.01	.914	0.91-1.11	1.01	.864	0.90-1.13	1.02	.809	0.85-1.23
	SUM of psychiatrist' visits	*1.19*	*.053*	*1-1.42*	*1.19*	*.091*	0.97-1.46	1.16	.404	0.82-1.65
	Smoking (>2 cigarettes/day)*	**0.71****	**.001**	**0.58-0.86**	**0.74***	**.010**	**0.59-0.93**	**0.62***	**.015**	**0.42-0.91**
	Consumption of alcohol (>2 beers/ day)*	*1.14*	*.070*	0.99-1.32	*1.19*	*.053*	*1.00-1.42*	1.07	.589	0.84-1.37

* p < 0.05, ** p < 0.01. Legend: Sex (for the total group), age group and level of studies were included as confounding factors in the regression analysis.

Finally, for the PA type 3 - Outdoor leisure group sport and other physical activities (gardening) showed similar with PA type 1 trends on relationship with Sex (men are more prone to practice it more frequently); age and educational level (direct: with higher age, more frequent practice and reverse relationship with BMI and smoking (Table 4).

Both proxies of general and mental health indicators are associated with higher frequencies of practicing PA type 3 since a reverse relationship is observed between N of doctors' visits and frequency of practice for the whole group, as well as separately for men and women (Table 4).

Table 4. Regression analysis PA type 3: Outdoor leisure group sport and other physical activities (gardening).

	Variables /Statistics	Total			Women			Men		
PA type 3 frequency	**Factors**	**RRR**	**p-value**	**CI (95%)**	**RRR**	**p-value**	**CI (95%)**	**RRR**	**p-value**	**CI (95%)**
	1 - Almost never – a baseline									
2. Sometimes	Sex	**1.10****	**<.001**	**1.05-1.16**			na			
	Age group	**1.20****	**<.001**	**1.11-1.30**	**1.26****	**<.001**	**1.14-1.39**	1.10	.115	0.97-1.25
	Level of studies	**1.09****	**<.001**	**1.05-1.15**	**1.10****	**.002**	**1.04-1.18**	**1.09***	**.010**	**1.02-1.17**
	BMI	**0.76****	**<.001**	**0.71-0.81**	**0.75****	**<.001**	**0.69-0.81**	**0.77****	**<.001**	**0.68-0.85**
	SUM of doctors' visits (all doctors except psychiatrists)	**0.89****	**<.001**	**0.84-0.93**	**0.87****	**<.001**	**0.82-0.92**	**0.90****	**.009**	**0.84-0.97**
	SUM of psychiatrist' visits	**0.88****	**<.001**	**0.81-0.96**	*0.90*	*.056*	*0.81-1.00*	**0.90***	**.012**	**0.84-0.97**
	Smoking (> 2 cigarettes/per day)	**0.76****	**<.001**	**0.71-0.82**	**0.79****	**<.001**	**0.71-0.87**	**0.72****	**<.001**	**0.64-0.80**
	Alcohol (>2 beers/day)	1.06	.113	0.99-1.14	1.06	.255	0.96-1.17	1.05	.299	0.95-1.17
3. Almost always	Sex	**1.38****	**<.001**	**1.31-1.47**			na			
	Age group	**1.47****	**<.001**	**1.35-1.60**	**1.55****	**<.001**	**1.40-1.73**	**1.34****	**<.001**	**1.17-1.53**
	Level of studies	**1.13****	**<.001**	**1.07-1.19**	**1.13****	**.001**	**1.05-1.22**	**1.12****	**.001**	**0.97-1.11**
	BMI	**0.53****	**<.001**	**0.49-0.57**	**0.54****	**<.001**	**0.49-0.59**	**0.50****	**<.001**	**0.44-0.56**
	SUM of doctors' visits (all doctors except psychiatrists)	**0.80****	**<.001**	**0.76-0.85**	**0.80****	**<.001**	**0.75-0.86**	**0.81****	**<.001**	**0.75-0.87**
	SUM of psychiatrist' visits	**0.81****	**<.001**	**0.73-0.90**	**0.80****	**.001**	**0.70-0.91**	**0.91***	**.028**	**0.84-0.99**
	Smoking (>2 cigarettes/day)	**0.63****	**<.001**	**0.57-0.69**	**0.69****	**<.001**	**0.61-0.78**	**0.78****	**<.001**	**0.68-0.89**

Alcohol (>2 beers/day)	1.03	.486	0.95-1.11	1.00	.985	0.89-1.12	1.05	.348	0.94-1.17

* $p < 0.05$, ** $p < 0.01$. Legend: Sex (for the total group), age group and level of studies were included as confounding factors in the regression analysis.

4. Discussion

To our knowledge it is the first huge study reporting about the different types of PA at population level linked to physical or general and mental health indicators with a split analysis by sex groups. Since it is a transversal type of study, these associations do not represent the casual relationship and could be also bidirectional or to have invers possible causal effects. For example, if people have very poor physical and mental health, it might be more difficult for them to practice any type of physical activity at all. For this reason, other recent studies also observe only statistically significant association related to changes in increasing of PA leads to increasing only physical health [38].

In case if the health becomes poorer and started to require more attention to maintain it, doctors might prescribe also to do more exercise also due to the scientific evidence found on improving mental health (specifically, depression) by doing mild sport exercises [8,13,39–42]. And this fact could be one of the possible relationship we observed in our study with respect of poor both general physical and mental health with a higher frequency of practicing mild to medium intensity sport activities (PA type 2) Yoga, Pilatus and Tai-chi. It would not mean in this case the opposite: that practicing these types of sport would increase to a number of visit of doctors in general population context if we would try to interpret the results directly.

An analysis of the frequency of practicing different types of physical activity in our study showed that, in general, the Belgian population is not very active in any 3 types of physical activity: only about 1/3 of the population practices physical activity on a regular basis (about 1/3 of men and ¼ of women practice one of the 3 types of physical activity 15 to 30 minutes at least 3 times per week). Men as well as women, as per frequencies observed, prefer PA type 1 (medium to intensive sport exercises such as aerobics, swimming, running, etc.) and PA type 3 (leisure outdoor group sport exercises and other PA as gardening, fishing, etc.). About the same percentage of the Belgian population practices physical activity at least sometimes. If we look at the distribution of the sample in our study, we see that a very small percentage of the population is engaged in PA type 2, and there are frequency of practicing of it are quite similar in men and women: "sometimes": 11% in women and 9% in men; "almost always": 5% in both women and men.

The findings are broadly consistent with The State of Health in the EU's Country Health Profiles[5], which indicates that at least 44% of the Belgian population did not meet the WHO recommendation of at least 2.5 hours of moderate physical activity per week in 2018.

In suplementary analyses results also showed the controversial relationship was observed in Level of study variable with relationship to physical (direct) and mental health (inverse). It could mean that people who have higher level education have more knowledge about the general health compared to those who does not or the latter subgroup would work more on physical types of work or poorer environmental work and residence conditions due to related socio-economic status (SES). It had been shown that people with less SES had more stress and less resilience capacity to manage it [43]. However, our positive association of higher level of studies with mental health, observed in our study, could imply also negative aspects of working with intellectual works on mental health (they could have a higher psychological stress and less practice of PA).

To sum up, comparing three types of PA associations with health (physical and mental) in our study, in general, we observe that types of PA: type 1 (medium to intensive sport exercises such as aerobics, swimming, running, etc.)) and type 3 (leisure outdoor group sport exercises and other PA as gardening, fishing, etc.) had either a trend to or significant relationship with both: practicing and more frequent practicing were associated with having a better health (less visits to all doctors). The

5 https://health.ec.europa.eu/system/files/2021-12/2021_chp_be_english.pdf

low and medium intensity sport activities (PA type 2) had shown an inverse association with mental health indicator. However, such type of PA is less frequently practiced in general: 87% of population had never or almost never practiced it compared to 42% (PA type 1) and 37% (PA type 3).

As for smoking or alcohol consumption, in general, the population data show that 87% had never or almost never smoked more than 2 cigarettes per day, and 63% consume less than 2 beers per day indicating that the majority of Belgian population had healthier life style trends with respect of these substances consumptions. The associations found in our study with respect to physical and mental health are controversial, but also similar results were found previously on some aspects. Thus, for example; the inverse relationship between alcohol consumption and physical / mental health could be explained, for example, by the real life situations when a higher (excessive) consumption of alcohol may lead also to dropping of physical care and not visiting doctors at all. However, in our study women did not show any significant relationship between alcohol consumption and mental health, indicating that possibly for this population cohort and time period, for women alcohol consumption is not considered one of the main risk factors on either mental health conditions or taking care of their mental health.

Smoking frequency had direct relationship: more frequent smoking was associated with poorer mental health only. It could be interpreted inversely also: people with poorer mental health smoke more frequently. No significant association observed with a physical or general health might be due the fact that the analysis counted all doctors' visits. And in this case more exploration is needed with a specific doctors or risk related organs: lungs, cancer, etc. In our previous preliminary study on the same cohort, it was also observed that higher practicing sport was related statistically significant with higher alcohol consumption and with less smoking [37]. These results were congruent to some extent to the Henchoz's ones [3] since a positive relation of alcohol consumption for those who practice sport sometimes is interpreted as factor of "socialization" with others.

The longitudinal study by Paavola et al [44] examined the associations among smoking, alcohol use, and physical activity, and to assess how the health behaviors predicted changes in other health behaviors from adolescence to adulthood. The prevalence of leisure-time physical activity did not change significantly over time. Smoking and alcohol use were positively correlated in each study. Smoking was negatively correlated with leisure time physical activity. The best predictors for each healthy behavior were the same behaviors measured previously, but smoking had the strongest level of continuity. In our study, the age of the sample ranged from 19 to 81. Thus, the habit of smoking in those who had it, apparently, was formed earlier - in adolescence.

Some studies have found similar results about alcohol like our, for example, Piazza-Gardner & Barry [45] showed that alcohol consumers of all ages were more physically active than nondrinking peers. Some studies analyze the positive aspects of moderate alcohol consumption. For example, Peele & Brodsky [46] analyze the positive psychological concomitants of moderate alcohol consumption: subjective health, mood enhancement, stress reduction, sociability, social integration, mental health, long-term cognitive functioning, and work income/disability. In systematic review by Dodge et all [47] it was shown that nearly 88% of the studies with college students and 75% of studies with nonstudent adults reported a positive relationship between physical activity and alcohol use. Physical activity is a crucial factor in promoting good health; however, numerous studies emphasize a concerning correlation between high levels of regular physical activity and escalated alcohol consumption in society. This poses a significant challenge as excessive alcohol intake poses a grave risk to public health.

In our study, we also found a positive association between age of respondents and frequency of practicing all types of physical activity. The most significant associations are observed for 3 type PA. The most significant associations were observed for the 3 type of physical activity (for men, women & total groups). For the 1 & 2 types of PA significant associations were observed only for women and total group. This may indicate that with age there is a tendency not just to engage in active sports (like as type 1 PA), but rather to social activity (team games, group yoga, etc.).

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There are many contradictory data on the dynamics of physical activity with age. Generally, authors have noted a general tendency for physical activity levels to decrease with age [48]. Although other authors note the presence of an indirect linear decline in physical activity with age, which closer to old age may stabilize and even improve [49]. The tendencies to greater physical activity with age in women obtained in our study are consistent with literature data [48,49].

Limitations

One of the limitations of study is related to slightly higher percentage of women in the sample (59%) that could lead to the general results could be slightly biased by sex. Another study limitation consists in the transversal design for the Survey on sport activities and smoking and alcohol habits consumption that does not mean any existing causality and we report only the existing relationship between the variables of the study. For example, alcohol consumption was negatively related to number of days spent at the general hospital and doctor's visits of both category (general and psychiatrist); however, it could not be interpreted directly: "to consume more alcohol would benefit your health" since there could be other indirect causes of such reduction, more specific to these problem and related behaviour. To check it, longitudinal studies would help it.

5. Conclusions

Ours study results showed that different types of PA could have different associations with physical and mental health indicators. For the first time they could be compared on the (absolute) magnitude of association to see their role in maintenance of public health: a) for general health: 6% change association with PA type 1 (medium to high intensity – aerobic, running, swimming, etc.); 12% with PA type 2 (low to medium intensity and stretching exercises – Yoga type), and the highest one of 19% with PA type 3 (leisure outdoor group sport or other physical activities as gardening); b) for mental health, those associations were 1) 3%, 2) 30% and 3) 20% respectively. Thus, as per ORs observed, PA type 3 and 2 had highest magnitude of association with both, physical and mental health and could play more protective role in it. Those magnitudes of associations derived from practicing PA Types 2 and 3) are similar to those observed in relation to substances consumption, obtained from our study since alcohol consumption had 18% association in change of physical health and 12% with mental health; and smoking, 31% significant association with mental health change only.

Practical Implications

Different PA types could play different protective role in our physical and mental health.

The results show that even mild to moderate leisure group sport and physical activity like gardening may help improve our health and even are comparable or superior in the magnitude of the association of health indicator chosen in this study as proxy of health or health care indicators.

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Appendix 1: Questionnaire & Groups of variables

Appendix 1.1. Questionnaire

Physical activity three measured types:

1) *Sport exercises: medium to high intensity*: I practice … running, swimming, aerobics, Nordic walking ...) for 15 to 30 minutes at least 3 times per week (1 - almost never, 2 - sometimes, 3 - almost always)
2) *Low to medium intensity & stretching exercises* (Pilatus and yoga type): I practice yoga, stretching, Tai¬-Chi, Pilates or the like for 15 to 30 minutes at least 3 times per week (1 - almost never, 2 - sometimes, 3 - almost always)
3) *Outdoor leisure group sport & other physical activities*: I use some of my free time to participate in activities that maintain my condition (gardening, golf, …) (1 - almost never, 2 - sometimes, 3 - almost always)

Healthy life style (habits on substances consumption):

4) *Smoking*: I smoke more than two cigarettes a day (1 - almost never, 2 - sometimes, 3 - almost always)
5) *Alcohol consumption*: I drink at least 2 glasses of alcoholic beverages per day (1 - almost never, 2 - sometimes, 3 - almost always)

Note: The variable 4 & 5 were reverse for analysis.

Appendix 1.2. Main variables group divisions:

1) *Age groups* (adults, =>18 years old):
    1. <45 years
    2. 45-64 years
    3. >=65 years
2) *ex group* codification:
    -1 women
    1 men
3) *BMI groups*:
    1. Underweight = <18.5
    2. Normal weight = 18.5–24.9
    3. Overweight = 25–29.9
    4. Obesity = BMI of 30 or greater

Appendix 2: Descriptive statistics by sex groups:

Table A2.1. Descriptive statistic for the study variables for women.

Variables	Descriptive Statistics					
	Frequency N (%)					
Groups	**1**	**2**	**3**	**4**	**5**	**6**
Age group	1,351 (25%)	2,827 (51%)	1,309 (24%)	-	-	-
Level of studies	193 (4%)	776 (14%)	1612 (30%)	2,004 (37%)	787 (14%)	102 (2%)

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BMI	147 (3%)	2,765 (50%)	1,612 (29%)	963 (18%)	-	-
General health: N GP visits (groups)	1,210 (22%)	1,407 (26%)	1453 (27%)	1,417 (26%)	-	-
Mental health: N Psychiatrist visits (groups)	4,492 (82%)	587 (11%)	407 (7%)	-	-	-

Sport and PA type, consumption habits:	**Frequency N (%)**		
	Almost never	**Sometimes**	**Almost always**
Sport (medium to high intensity exercises: running, aerobics, swimming)	2,312 (42%)	1,664 (30%)	1,511 (28%)
Sport (stretching exercises, low to medium intensity - Yoga type)	4,586 (84%)	601 (11%)	300 (5%)
Outdoor leisure group sport and other physical activities (gardening)	2,196 (40%)	2,035 (37%)	1,256 (23%)
Smoking (> 2 cigarettes/per day)	4,824 (88%)	103 (2%)	560 (10%)
Consumption of alcohol (> 2 beers/per day)	3,894 (71%)	1,143 (21%)	450 (8%)

Table A2.2. Descriptive statistics for the study variables for men.

Variables	**Descriptive Statistics**					
	Frequency N (%)					
Groups	**1**	**2**	**3**	**4**	**5**	**6**
Age group	497 (13%)	1,801 (47%)	1,538 (40%)	-	-	-
Level of studies	241 (6%)	744 (19%)	1,177 (31%)	905 (24%)	653 (17%)	110 (3%)
BMI	30 (1%)	1,222 (32%)	1897 (47%)	777 (20%)	-	-
General health: N GP visits (groups)	1,137 (30%)	939 (24%)	889 (23%)	871 (23%)	-	-
Mental health: N Psychiatrist visits (groups)	3,266 (85%)	354 (9%)	216 (6%)	-	-	-

Sport and PA type, consumption habits:	**Frequency N (%)**		
	Almost never	**Sometimes**	**Almost always**
Sport (medium to high intensity exercises: running, aerobics, swimming)	122 (42%)	81 (28%)	91 (31%)
Sport (stretching exercises, low to medium intensity - Yoga type)	253 (86%)	26 (9%)	15 (5%)
Outdoor leisure group sport and other physical activities (gardening)	102 (35%)	103 (35%)	89 (30%)
Smoking (> 2 cigarettes/per day)	253 (86%)	8 (3%)	33 (11%)
Consumption of alcohol (> 2 beers/per day)	178 (61%)	76 (26%)	40 (14%)

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