Gym Access: proposal of a synthetic variable in the fight against Non-communicable Chronic Diseases

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Resumo
This paper aims to infer the importance of gyms and health clubs in the fight against non-communicable chronic diseases (NCDs) and the fight against obesity and physical inactivity amid a global pandemic. Neither scholars nor health associations present a clear indicator of devices dealing with physical inactivity, unlike what was done with hospital beds. In this gap lies this article's purpose: in light of upstream social marketing, to propose that the number of gyms per 100,000 inhabitants, with the physical activity penetration rate, combined in a synthetic variable is an indicator in the fight against physical inactivity and obesity. We strive to offer a synthetic variable, namely Gym Access. We proposed a Gym Access ranking amongst the 61 countries utilizing the new variable. We analyzed secondary data from 61 countries using Confirmatory and Exploratory Factorial Analyses, Linear and Multiple Regression, Process Mediation Analysis, and One-way ANOVA. The latent variable positively impacts the country's life expectancy, and NCDs absolute risk rate mediates the impact of Gym Access on the country's life expectancy. Finland ranks first in the Gym Access ranking, and Indonesia ranks last. There is a significant statistical difference between OECD countries compared to other countries.

GYM ACCESS: PROPOSAL OF A SYNTHETIC VARIABLE IN THE FIGHT AGAINST NON-COMMUNICABLE CHRONIC DISEASES

ABSTRACT

This paper aims to infer the importance of gyms and health clubs in the fight against non-communicable chronic diseases (NCDs) and the fight against obesity and physical inactivity amid a global pandemic. Neither scholars nor health associations present a clear indicator of devices dealing with physical inactivity, unlike what was done with hospital beds. In this gap lies this article's purpose: in light of upstream social marketing, to propose that the number of gyms per 100,000 inhabitants, with the physical activity penetration rate, combined in a synthetic variable is an indicator in the fight against physical inactivity and obesity. We strive to offer a synthetic variable, namely Gym Access. We proposed a Gym Access ranking amongst the 61 countries utilizing the new variable. We analyzed secondary data from 61 countries using Confirmatory and Exploratory Factorial Analyses, Linear and Multiple Regression, Process Mediation Analysis, and One-way ANOVA. The latent variable positively impacts the country's life expectancy, and NCDs absolute risk rate mediates the impact of Gym Access on the country's life expectancy. Finland ranks first in the Gym Access ranking, and Indonesia ranks last. There is a significant statistical difference between OECD countries compared to other countries.

Keywords: Upstream Social Marketing; Public Health; Noncommunicable Diseases; Physical Inactivity; Fitness & Well-being.

1. INTRODUCTION

Sedentary lifestyle, obesity, and overweight are risk factors for an increasingly growing set of non-communicable chronic diseases (NCDs) worldwide (Brasil, 2018; Munaier, 2021; Myers *et al.*, 2017). Additionally, it impacts aspects of physical and mental well-being in the lives of overweight and obese people, such as the associated discrimination they face in their daily lives, for instance, the workplace, interpersonal relationships, and transportation (Besson *et al.*, 2020; Tweneboah-Koduah *et al.*, 2019). Research on adopting strategies to fight obesity and embrace healthier lifestyle habits, such as physical activity, has received increasing attention from scholars within social marketing (da Silva *et al.*, 2021; Kennedy *et al.*, 2018; Munaier *et al.*, 2021).

The attention given by social marketing scholars to the problems arising from a sedentary lifestyle and other behaviors that lead to NCDs is consistent with a proposal of this research field. Social marketing is a discipline that has successfully been used to alleviate many health problems and increase preventive behaviors, such as healthy eating and increased physical activity (Besson *et al.*, 2020; Kennedy *et al.*, 2018), attempting to effectively influence policies and positively change consumer behavior with a deeper view of the phenomenon to better serve the community (Johns, 2020; Schembri, 2020). Moreover, the upstream social marketing field does more than observe issues of critical social impacts, it proposes methods to influence the political judgments of decision-makers (Gordon, 2013; Kennedy *et al.*, 2018; Key & Czaplewski, 2017).

Thus, upstream social marketing is expected not only to address the issue of a sedentary lifestyle and public health but also to offer ways to mitigate complex problems, such as NCDs. For example, researchers have observed effective contributions of upstream social marketing in strategies for reducing alcohol and tobacco consumption (Dibb & Carrigan, 2013; Gordon, 2013; Munaier, 2021).

The World Health Organization (WHO) monitors the risks of NCDs faced by countries. Each country is evaluated according to the following variables: a) Harmful use of alcohol; b) Physical inactivity; c) Salt/sodium intake; d) Use of tobacco; e) Diabetes; f) High blood pressure; g) Obesity; h) Ambient air pollution; i) Domestic air pollution. In the compilation called "Non-communicable Diseases - Country Profiles 2018", the WHO notes the causal link between the four main NCDs (cardiovascular disease, cancer, chronic respiratory disease, and diabetes) and the four primary behavioral risk factors: tobacco use, harmful use of alcohol, physical inactivity, and unhealthy diet. "In turn, these behaviors lead to four key metabolic/physiological changes: raised blood pressure, overweight/obesity, raised blood glucose, and raised blood lipids" (WHO, 2018b, p. 14). It is estimated that in 2016, NCDs accounted for 71% of the world's deaths.

The prolongation of life expectancy may be linked to the body's movement instead of its rest (Besson *et al.*, 2020; Malta *et al.*, 2017). Physical exercise has been called a 'miracle drug', and its benefits extend beyond the body (Wen & Wu, 2012). This 'miracle drug' could be an essential ally during the COVID-19 pandemic (Amini *et al.*, 2021). The NCDs' list, heart problems, hypertension, diabetes, and problems arising from obesity, are diseases identified as comorbidities in death cases of those affected by the coronavirus (Amini *et al.*, 2021; D'Antiga, 2020; Fang *et al.*, 2020; Hamer *et al.*, 2020).

Although organizations like the WHO have indicated in recent publications the importance of addressing physical inactivity and countries need to create active environments for their populations, neither scholars nor health associations present a clear indicator of devices to deal with physical inactivity. Having clear indicators for the management of inactivity in the world is necessary for the decision-making process.

In general, the definition of health management indicators has existed for a long time. The WHO recommends that countries have between 3 and 5 hospital beds per 1,000 inhabitants as excellent public health management indicators. Before the COVID-19 pandemic arrived, there was a worldwide movement of constant reduction of hospital beds (Malik & Teles, 2001; Richardson, 2017; Silveira, 2018). NCDs, currently the leading cause of death, could be prevented by adopting the most effective form of prevention: regular and guided physical activity habits, not only in gyms but also in public and open spaces (Munaier, 2021; Tweneboah-Koduah *et al.*, 2019).

In this gap lies the objective of this article: considering upstream social marketing, to propose concrete indicators for public health management in the fight against physical inactivity. After all, upstream social marketing is a method for social marketing professionals to influence the adoption of policies and solutions and is suitable for problems that inflict high costs on society (Kennedy *et al.*, 2018; Key & Czaplewski, 2017).

We quantitatively analyzed secondary data from reliable sources on life expectancy at birth, NCD risk indicators, number of gyms per 100,000 inhabitants, and the country's oriented physical activity rate in 61 countries. The objective is to understand the importance of gyms and health clubs in the fight against NCDs, particularly in the battle against obesity and physical inactivity, and offer possible extra indicators for public health analyses on a global spectrum. The reason and justification are offered in the following chapters. Section 2 introduces the literature review on the NCDs context, physical inactivity, and secondary data from 61 countries. This allows the authors to present the hypotheses and methodological model and matrix. The research methods are presented in Section 3. Section 4 presents the multivariate quantitative techniques results, discussions, and a Gym Access ranking of 61 countries. Finally, conclusions, limitations, and future research appear in Section 5.

2. THEORETICAL FUNDAMENTALS

2.1 Obesity and physical inactivity: contributors to premature deaths from non-communicable diseases

NCDs include cardiovascular diseases, cancer, particularly cervical and breast cancer in women and stomach and lung cancer in men, Diabetes Mellitus, and chronic respiratory diseases. World organizations to control and combat diseases and health promotion have created strategies to prevent and control NCDs (WHO, 2018b). Among the strategies are the monitoring of physical inactivity and obesity, which are central themes of this article as part of an innovative and practical contribution of upstream social marketing to the fight against NCDs, an extremely relevant topic in this discipline's research (Besson *et al.*, 2020; Munaier *et al.*, 2021; Tweneboah-Koduah *et al.*, 2019; van Esch *et al.*, 2019).

The current obesity and sedentary lifestyle numbers in Brazil and the world show them as a global epidemic (Besson *et al.*, 2020; Brasil, 2018). The 2017 Surveillance of Risk and Protection Factors for Chronic Diseases Survey by Telephone (Vigitel, in Portuguese), prepared by the Ministry of Health, indicated that more than 54% of the population of the Brazilian capitals is overweight, and almost 20% of the Brazilian capital's population is obese (Brasil, 2018). Young people were among the age groups with the most significant increase between 2008 and 2017. The obesity rate between 18 and 24 years of age has more than doubled, reaching 110% (Brasil, 2018). Moreover, sedentary Brazilians aged 15 years or more totaled 100.5 million, according to the 2015 National Household Sample Survey prepared by the Brazilian Institute of Geography and Statistics (IBGE, in Portuguese). Women (66.6%) are more sedentary than men (Brasil, 2017).

2.2 The cost of obesity and physical inactivity, and Active action of the WHO

Obesity and physical inactivity generate a high cost for modern society. For example, the expenses related to the treatment of NCDs cost approximately US$1 trillion per year only in the United States (Gualano & Tinucci, 2011). Conversely, In Brazil, there would be a savings of US$ 1.14 billion in health resources if the sedentary lifestyle were reduced to half of what is observed today, as there would be a reduction in hospitalizations for type 2 diabetes and the decrease in the use of medicines for diabetes and hypertension (Bueno *et al.*, 2016).

Active Societies	Implement positive behavior change communication campaigns and build workforce capacity to change social norms.
Active Environments	Promote safe, well-maintained infrastructure, facilities, and public open spaces that provide equitable access to places for walking, cycling, and other physical activity.
Active People	Ensure access to opportunities, programs, and services across multiple settings to engage people of all ages and abilities in regular physical activity.
Active Systems	Strengthen leadership, governance, multisectoral partnerships, workforce, research, advocacy, and information systems to support effectively coordinated policy implementation.

Figure 1. **Active Program.** Note. Source: Active - A technical package for increasing physical activity (WHO, 2018a).

Aware of this challenge for health, in 2018, the WHO launched the program Active - A technical package for increasing physical activity (WHO, 2018a). Its guidelines focus on four areas: communication, infrastructure, groups and people, and government, as shown in Figure 1.

2.3 The contribution of the fitness and wellness industry in the fight against NCDs

According to the latest Global Report published by the International Health Racquet and Sportsclub Association (IHRSA), an institution that monitors and promotes physical activity and wellness markets in 62 countries, 16.8% of Finland's population uses gyms and is practicing physical exercise with some regularity. In Finland, there are 27.91 gyms per 100,000 inhabitants. As seen in Table 1, of the 62 countries, Finland is among the six countries with the highest penetration of oriented physical activity rate in the population (IHRSA, 2018).

Table 1: The six countries with the best physical activity rate

COUNTRY	PHYSICAL ACTIVITY RATE	LIFE EXPECTANCY	RISK OF NCD	GYMS PER 100K	BEDS HOSP PER 1K	GDP PER CAPITA (US$)
Sweden	21.4%	82.2	9	16.09	2.9	53,200.34
Norway	20.9%	82.5	9	21.37	3.9	75,628.93
USA	20.3%	78.7	15	11.81	2.9	59,822.68
Denmark	18.3%	80.7	11	23.62	2.5	57,173.00
Netherlands	17.0%	81.5	11	11.67	4.7	48,478.36
Finland	16.8%	81.8	10	27.91	4.4	45,778.98

Sources: (WB, 2016), (WB, 2017), (WHO, 2017) and (IHRSA, 2018). Compiled by the authors.

Sweden, with 21.5%, is the best oriented physical activity rated country. Norway has exceeded 20% population of their using a gym. Denmark is one of the countries with the most significant number of gyms per 100,000 inhabitants (23.62). New Zealand finds itself in the 10th position in the penetration rate in the oriented physical activity in gyms. There are 14.39 gyms per 100,000 inhabitants and a 13.6% penetration rate.

These countries have a life expectancy of over 80 years (USA excluded) and have seen the number of hospital beds per one thousand inhabitants decreasing in the last few years, before the Covid-19 pandemic. Some even have less than the WHO recommended amount of three hospital beds per thousand inhabitants (IHRSA, 2018; WB, 2016; WB, 2017; WHO, 2018a). Therefore, a causal relationship between the drop in the number of hospital beds per thousand inhabitants and the number of gyms per 100,000 inhabitants is not considered here.

The article's first hypothesis emerges from what has been supported by the consulted literature, demonstrating that a more active population has lower disease incidence resulting from a sedentary lifestyle. In addition, (Wen *et al.*, 2011) demonstrated an increase in life expectancy in favor of physical activity practitioners versus the inactive group in a prospective cohort study with 416,175 individuals. Thus, it is proposed:

H_1: The oriented physical activity rate impacts the country's life expectancy.

Assuming that practicing physical activity impacts the prospect of longer life and this practice needs to be possible and oriented in someplace, gyms can be essential assets of a country to fight NCDs. Undoubtedly, gyms are not the only possible place for physical activity, but, among the alternatives, such as open public spaces and in homes, gyms are defined areas with access control, allowing the practitioners' regularity and frequency management. In several countries, gyms are private enterprises where, for their admission, users need to pay a fee for the service (García-Fernández *et al.*, 2018; Munaier, 2012, 2019; Munaier & da Costa, 2021; Munaier & Serralvo, 2019). Philanthropic or public gyms are also offered in several countries, and scholars express their results for the populations' health (Hallal *et al.*, 2010; Malta *et al.*, 2009).

It is possible to observe in Table 2 that the six worst countries classified in terms of oriented physical activity penetration share a GDP per capita that represents less than 10% of the countries listed in Table 1, as well as has a substantially smaller number of gyms per 100,000 inhabitants. The USA, which appears as one of the countries with the highest penetration rate of physical activity, has an even greater risk of NCDs than Honduras, El Salvador, and Nicaragua. However, with a GDP per capita many time greater than its American neighbors, it is credible that their higher life expectancy is due to access to more sophisticated medicine, despite a significantly higher risk of obesity than the others listed.

Table 2: The six countries with the worst physical activity rate

COUNTRY	PHYSICAL ACTIVITY RATE	LIFE EXPECTANCY	RISK OF NCD	GYMS PER 100K	BEDS HOSP PER 1K	GDP PER CAPITA (US$)
Vietnam	0.46%	76.3	17	0.67	2.6	2,342.24
Honduras	0.31%	73.6	14	1.24	0.7	2,480.13
El Salvador	0.31%	73.5	14	1.40	1.3	3,889.31
Nicaragua	0.25%	75.4	14	1.09	0.9	2,221.81
Indonesia	0.18%	69.2	26	0.14	1.2	3,846.42
India	0.15%	68.6	23	0.28	0.7	1,979.36

Source: (WB, 2016), (WB, 2017), (WHO, 2017) and (IHRSA, 2018). Compiled by the authors.

Table 3 presents the Brazilian data. In absolute numbers, Brazil is the second-largest market in the number of gyms globally: 34,509 (IHRSA, 2018). This number reflects the number of gyms per 100,000 inhabitants. Brazil has an even more significant number than Sweden (16.49 vs. 16.09), a country with the best oriented physical activity rate among its inhabitants. In Sweden, GDP per capita also signals the difference in consumption access (US$ 9,812.28 in Brazil vs. US$ 53,200.34 in Sweden).

Table 3 Brazilian data

COUNTRY	PHYSICAL ACTIVITY RATE	LIFE EXPECTANCY	RISK OF NCD	GYMS PER 100K	BEDS HOSP PER 1K	GDP PER CAPITA (US$)
Brazil	4.59%	75.5	17	16.49	2.2	9,812.28

Source: (WB, 2016), (WB, 2017), (WHO, 2017) and (IHRSA, 2018). Compiled by the authors.

The elements that constitute the NCDs' groups are comprehensive. This article seeks to analyze gyms' participation in the fight against NCDs, focusing on obesity and physical inactivity, with no previous studies seeking to correlate such indicators. There is no attempt to defend gyms as the only way to put the body in motion as there are several other ways to work out. However, it aims to insert gyms as essential allies in combating sedentary lifestyle, an analysis not performed by the WHO, and help public health management decision-making while contributing to the upstream social marketing strategy. Thus, as proposed by Key and Czaplewski (2017), who recommend as stage one of every research in upstream social marketing the determination of an upstream target audience to address the manuscript's results, this manuscript's results aim to contribute to the WHO and public health managers wherever sedentary lifestyle is a real problem in their society.

Brasil (2018) recognizes the importance of combating obesity and warns of the risks of childhood obesity which can be triggered by unhealthy eating habits present at an early age. Therefore, for a lower risk of obesity, it is necessary to promote food-based work in childhood, reducing the risk of childhood obesity, and encouraging adults to practice regular physical activity (Bracco *et al.*, 2003; Cavalcanti *et al.*, 2005; Martinasek *et al.*, 2010; Ruiz *et al.*, 2021).

Gym access is a powerful ally in developing countries genuinely attuned to the needs regarding access to physical activity as an effective way to combat NCDs, thus impacting their population's life expectancy (Staiano *et al.*, 2017). This article aims to observe the impact of a

single latent variable that brings together the number of gyms per 100,000 inhabitants and percentage of population enrolled in a gym and propose this hypothesis:

H₂: A synthetic variable named Gym Access, composed by the number of gyms per 100,000 inhabitants and the oriented physical activity rate positively impacts the country's life expectancy.

H₂ᵦ: Gym Access better impacts the country's life expectancy mediated by NCDs' absolute risk rate.

It is possible to observe in Figure 2 the article's theoretical model and, in Figure 3, the methodological matrix where the hypotheses and article's objectives are consolidated, and the techniques implemented to analyze the results.
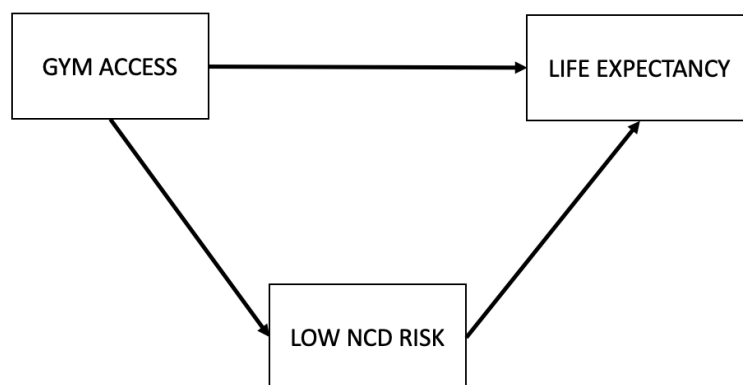

Figure 2. Theoretical model. Prepared by the authors

Theoretical Reference	Research Objectives	Hypotheses	Analysis Techniques	Expected search results
Besson *et al.* (2020); Bueno *et al.* (2016); (IHRSA, 2018); Gualano & Tinucci (2011); Tweneboah-Koduah *et al.* (2019); van Esch *et al.* (2019); Wen *et al.* (2011); Wen & Wu (2012); (WB, 2016), (WB, 2017); (WHO, 2017); (WHO, 2018b)	Analyze if the oriented physical activity rate impacts the country's life expectancy	H₁	Linear regression	Oriented physical activity rate is expected to impact country's life expectancy, supporting H1 positively
(IHRSA, 2018); (WB, 2016); (WB, 2017); WHO (2018b)	Analyze if the synthetic variable named "Gym Access" impacts the country's life expectancy mediated by NCDs' absolute risk rate	H₂ₐ H₂ᵦ	Confirmatory and Exploratory Factorial Analyses, Multiple Regression, Process Mediation Analysis	It is expected that Gym Access positively impacts the country's life expectancy. It is expected that NCD's absolute risk rate mediating improves the positive impact of Gym Access on the country's life expectancy

Figure 3. Methodological matrix. Prepared by the authors from (Mazzon, 2018)

3. METHOD

The research performed is of a quantitative nature (secondary data). All variables used were previously normalized. As data treatment methods, we used Confirmatory and Exploratory Factorial Analyses, Linear and Multiple Regression, Mediation Analysis, and Analysis of Variance – One-way ANOVA. We also used the statistical software SPSS, version 22, Smart PLS, version 3.3.2, and Process Macro, version 3.3.

From studies on physical activity globalization to research on gender issues and a healthy lifestyle, data extracted from the IHRSA reports have been used by scientific research and presented as reliable (Andreasson & Johansson, 2013, 2017; Johansson & Andreasson, 2016). The authors chose 61 countries among those observed by the WHO due to the possibility of comparing, in equal numbers, with the countries observed by the IHRSA. Unfortunately, China was excluded since the IHRSA data show only the numbers of the ten main Chinese cities, not allowing a more in-depth analysis of the Asian country.

4. RESULTS

The WHO's Active Program presents an extensive set of actions to raise awareness and seek to increase the practice of physical activity in people's daily lives. However, there is no mention of the already available operators to society as regular physical activity providers: gyms. None of the Active program lines mention gyms (WHO, 2018a). Therefore, in this gap lies this article's importance, which aims to contribute with hypotheses regarding gyms' significance for a more active society.

Study 1

H_1: The oriented physical activity rate impacts the country's life expectancy.

We performed linear regression to verify whether the penetration rate of oriented physical activity (PENRATE) in a given population had a significant impact on a country's life expectancy (LIFE_EX). Pearson's correlation between PENRATE x LIFE_EX = 0.66. The analysis resulted in a statistically significant model [F (1, 59) = 46.43; p = 0.000; R^2 = 0.44; Durbin-Whatson = 2.37]. The penetration rate of physical activity in the population (β = 0.66; t = 6.81; p = 0.000) has a positive impact on a country's life expectancy, **validating H_1**.

Study 2

H_{2a}: A synthetic variable named Gym Access, composed by the number of gyms per 100,000 inhabitants and the oriented physical activity rate positively impacts the country's life expectancy.

The next study analyzed how the synthetic variable called "Gym Access", composed of GYMP100K and PENRATE, impacts LIFE_EX. Pearson's correlation between variables is moderate (PENRATE x GYMP100K = 0.64). To collinearity statistics, VIF = 1.61. We observed that together, confirmatory and exploratory factor analyses present Cronbach's α = 0.76, average variance extracted (AVE) = 0.81, composite reliability = 0.89, and F^2 = 0.76. In the exploratory analysis, the outer loadings assumptions (≥0.7) were fulfilled (Hair, Jr. *et al.*, 2009), and the variables combined into a single main component explained 82.16% of the entire variance. The regression resulting from the exploratory factorial analysis of PENRATE and GYMP100K was saved as GYMACCESS.

We performed linear regression to observe how GYMACCESS impacted LIFE_EX. Pearson's correlation between GYMACCESS x LIFE_EX = 0.71. The analysis resulted in a statistically significant model [F (1, 59) = 59.89; p = 0.000; R^2 = 0.5; Durbin-Whatson = 2.49].

The Gym Access variable (β = 0.71; t = 7.74; p = 0.000) positively impacts the country's life expectancy, **validating hypothesis 2a**.

H2b: Gym Access better impacts the country's life expectancy mediated by NCDs' absolute risk rate.

We utilized process' model 4 (Hayes, 2017; Lopes *et al.*, 2020), version 3.3, to test hypothesis 2b. As described by (Prado *et al.*, 2014), mediation analysis, also called conditional effect, is the process by which an independent variable (X), GYMACCESS in this article, affects the dependent variable (Y), represented by LIFE_EX variable in this article, employing the indirect effect of one or more mediating variables (M).

As justified in the theoretical framework, although physical activity access is a necessary offer to the country's population to fight against sedentary lifestyle, impacting on reducing the risk of NCDs, other elements comprise NCDs and other essential actions on the part of countries public health management for a populations' longer life expectancy. Therefore, it was sought to observe whether the impact of the Gym Access variable on the country's life expectancy is mediated by the NCDs less risk (LOWNCD) variable. Originally, the variable developed by the WHO of NCDs risk had the sense that the higher the number, the greater the country's risk. However, for the analysis purpose, the data had their meanings reversed. In this article, the higher the indicator, the lower the NCDs country's risk. Thus, 'LOWNCD'.

Figure 4 shows the total, direct and indirect results of the proposed theoretical model.
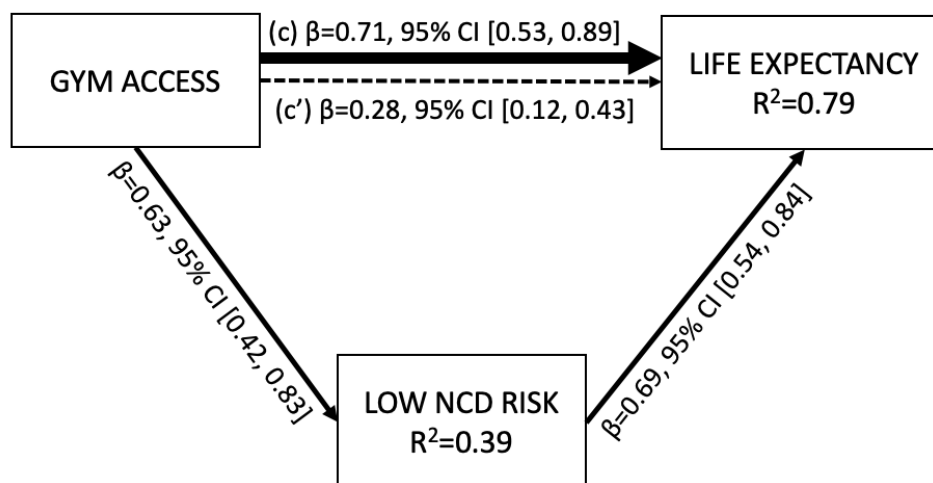

Figure 4. Theoretical model with results. Prepared by the authors using Process version 3.3

The GYMACCESS's impact on LIFE_EX showed in hypothesis 1, without mediation, presented $R^2 = 0.5$. Mediated by the variable LOWNCD, the final model presented a $R^2 = 0.79$ [F (2, 58) = 110.69; p = 0.000], being statistically significant and considerably increasing R^2. Without mediation, the GYMACCESS and LIFE_EX (c) path had β = 0.71; t = 7.74; p = 0.000; 95% CI [0.53, 0.89]. In the model in mediation (c '), this same path had β = 0.28; t = 3.61; p <0.001; 95% CI [0.12, 0.43].

Indirect effect of GYMACCESS on LIFE_EX: LOWNCD: Effect: 0.43; BootSE: 0.09; BootLLCI: 0.28; BootULCI: 0.63. Thus, it is possible to maintain that the variable LOWNCD mediates and improves the impact of GYMACCESS on LIFE_EX, **validating hypothesis 2b**.

4.1 Further analysis

The variables contingents that can be analyzed as a mediator, moderator, and covariant of the proposed variable are substantial. From GDP per capita to basic sanitation access or organic food access, they can increase or modify this proposal variable. However, this article seeks to bring new contributions that advance the data collection for public health managers' decision-making in the light of upstream social marketing. In this case, with a specific cut of sedentarism lifestyle in the fight against NCDs.

All the variables mentioned above have consumption access in common. The economic issue is sensitive, being reported in this article from the beginning of the theoretical review. For the public health management analysis purpose, as noted in the reports of the World Bank and the World Health Organization (WB, 2016, 2017; WHO, 2018b) and presented in Tables 1 and 2, it is expected that countries classified according to their economic groups, such as OECD countries (Organization de Coopération et de Développement, in French), a league of 38 countries that seek answers and share experiences, solutions, and good practices among its members, and/or geographic position, such as the Latin American countries not belonging to the OECD, have different Gym Access means. This work has data from 61 countries, 25 of which (41%) belong to the OECD, 16 (26.2%) belong to the group called LATAM (Latin American countries, except those belonging to the OECD), and 20 countries (32.8%) classified as OTHERS. The complete table of countries and their data has been made available in the article's repository. Using Bonferroni's post-hoc test, we conducted a one-way ANOVA test to analyze statistical differences between economic groups.

Table 4. Bonferroni's post-hoc test

Dependent Variable: GYM ACCESS (GYM + PEN)

(I) ECONOMIC GROUPS	(J) ECONOMIC GROUPS	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
OECD	LATAM	1,40218661*	,21920331	,000	,8617632	1,9426101
	OTHERS	1,55410143*	,20540283	,000	1,0477016	2,0605012
LATAM	OECD	-1,40218661*	,21920331	,000	-1,9426101	-,8617632
	OTHERS	,15191482	,22964735	1,000	-,4142574	,7180870
OTHERS	OECD	-1,55410143*	,20540283	,000	-2,0605012	-1,0477016
	LATAM	-,15191482	,22964735	1,000	-,7180870	,4142574

*. The mean difference is significant at the 0.05 level.

Source: Prepared by the authors using SPSS version 22

A one-way ANOVA returned with $F_{GYMACCESS}$ (2, 58) = 35.0 and p = 0.00.0 demonstrating the difference between mentioned groups. The Bonferroni post-hoc test observed in Table 4 and Figure 5 showed a statistically significant difference between OECD countries regarding LATAM countries and countries classified as OTHERS. There are no statistical differences between LATAM and OTHERS countries.

Observing the 61 countries regarding the Gym Access variable, it is possible to describe a ranking in decreasing order where the highest score, Finland (OECD), appears ranked as 1st, in contrast to Indonesia (OTHERS), at the bottom of the ranking. Table 5 shows the classification of these countries for this proposed synthetic variable. Brazil occupies 20th place. No countries with extreme values were observed.
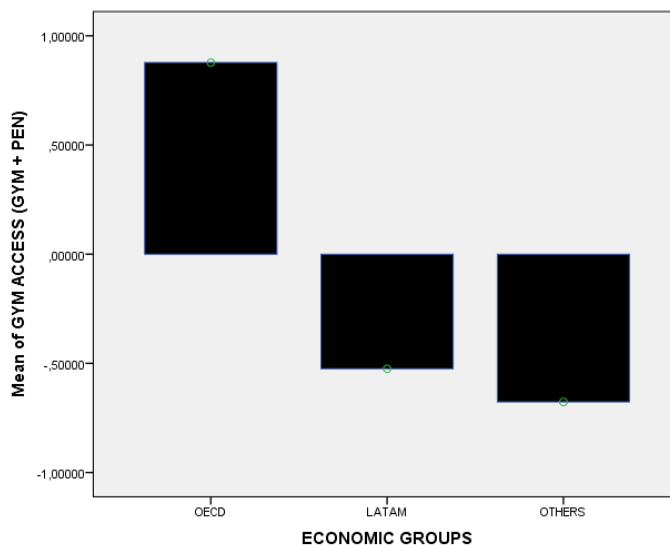
Figure 5. One-way ANOVA between Gym Access x Economic Groups. Prepared by the authors using SPSS version 22

Table 5. Gym Access Ranking

RK	Country	GYM ACCESS	RK	Country	GYM ACCESS
1	Finland	2.425	32	Uruguay	-0.352
2	Norway	2.302	33	Bolivia	-0.370
3	Denmark	2.197	34	Costa Rica	-0.375
4	Japan	1.982	35	Singapore	-0.387
5	Sweden	1.908	36	Panama	-0.401
6	Canada	1.414	37	Lebanon	-0.508
7	USA	1.408	38	Ecuador	-0.572
8	Australia	1.290	39	Peru	-0.626
9	Netherland	1.216	40	Dominica R.	-0.628
10	New Zealand	1.146	41	Colombia	-0.749
11	United Kingdom	0.924	42	Oman	-0.750
12	Austria	0.888	43	Ukraine	-0.754
13	Switzerland	0.846	44	Saudi Arabia	-0.766
14	Ireland	0.810	45	South Africa	-0.807
15	Germany	0.793	46	Russia	-0.824
16	Kuwait	0.719	47	Turkey	-0.856
17	Argentina	0.679	48	Guatemala	-0.912
18	Italy	0.543	49	Venezuela	-0.950
19	Spain	0.525	50	Egypt	-0.978
20	Brazil	0.485	51	Jordan	-0.990
21	South Korea	0.392	52	Malaysia	-1.017
22	Bahrain	0.312	53	Morocco	-1.027
23	France	0.087	54	Philippines	-1.038
24	Poland	0.040	55	Thailand	-1.041
25	United Arabia	0.002	56	El Salvador	-1.092
26	Belgium	-0.005	57	Honduras	-1.104
27	Portugal	-0.020	58	Nicaragua	-1.116
28	Chile	-0.112	59	Vietnam	-1.147
29	Qatar	-0.171	60	India	-1.176
30	Mexico	-0.211	61	Indonesia	-1.186
31	Paraguay	-0.314			

Source: Prepared by the authors

5. CONCLUSIONS, SUGGESTIONS, AND LIMITATIONS

As recommended by the World Health Organization, a country's population's life expectancy plays a central role in the offered health support apparatus and action to combat disease-causing agents. For this reason, so much importance is given to the sedentary lifestyle in the world. The public health management's role is to find the best strategies to combat NCDs and their causes. The sedentary lifestyle is a global threat since it is associated with NCDs in normal times and because it is associated with the comorbidities that aggravate the pandemic of COVID-19.

The most recent social marketing literature has paid attention to important topics such as the adoption of physical activity among younger populations (Tweneboah-Koduah *et al.*, 2019), elderly populations (van Esch *et al.*, 2019), the adoption of technology for weight loss (Besson *et al.*, 2020), among others. Furthermore, the WHO has established the importance of paying more attention to the necessary actions to increase the consumption of regular physical activity worldwide (WHO, 2018a).

However, unlike what we have in terms of public health management in general, as a clear indicator of how many hospital beds are needed per 1,000 inhabitants, there is no clear indicator through which public health managers can guide their strategic decisions to combat sedentary lifestyles/obesity.

Citing Wallack *et al.* (1993), Kennedy *et al.* (2018) identify one criticism of social marketing: a tendency to focus on changes at the individual and community level without addressing macro factors or allowing the public authorities to act in favor of actions that can promote effective changes to the identified situation. However, in the light of upstream social marketing, it seeks to present contributions that effectively impact the managers' decision-making process. This is what is proposed in this manuscript. This article presents a proposal for an indicator to monitor the fight against sedentary lifestyle and statistically demonstrates the validity of the proposed synthetic variable, Gym Access. Combining the services offered for the regular physical activity in gyms and the population's rate in this consumption, mediated by NCDs general risks, impact the country's life expectancy.

Obesity and inactivity need to be tackled. With the validated hypotheses of this article, the aim is to draw attention to the fact that global and national public health organizations put on their radar the valuable contribution of gyms, in their various possibilities of distribution, as allies against NCDs.

The complexity, uncertainty, and divergence in the interpretation of causes and immediate solutions for problems as perverse as sedentarism and obesity are enormous, and the efforts to combat them must be increased (Wen *et al.*, 2011; Wen & Wu, 2012). Sometimes, many solutions run through political judgments instead of scientific certainties (Kennedy *et al.*, 2018). Therefore, the findings of this article are presented as another tool in the debate of the organized civil society to demand, from the public authorities, the supply and/or mechanisms so that operators of the fitness and well-being market could be inserted into an understanding of its importance in combating NCDs.

Encouraging the population to attend gyms and promote discouragement for the consumption of foods high in sodium, salt, and sugars are presented as tasks of the public managers attentive to the challenges of the 21st century. Therefore, the number of gyms per 100,000 inhabitants constitutes an essential indicator of public health management and the percentage of its population, children and adults, who attend these facilities.

This encouragement is evident when the OECD countries are observed. Besides private sector gyms, countries like Finland, Sweden, Norway, and Canada offer public gyms with

various services for all styles. In addition to the possibility of access through purchase, citizens of these countries have free and universal access. Therefore, reinforcing this article's findings, having the number of gyms per 100,000 inhabitants, and measuring the oriented physical activity rate are effective public health management indicators. The Gym Access variable can be adopted to classify countries and define, based on it, strategies for public management.

Thus, as a contribution of this article in the context of upstream social marketing for public health management, it is recommended that access to the gym should be an economic possibility for the individual. From a more significant fiscal/tax exemption to the gyms that promote inclusion actions in their facilities for the low-income population, there are many possibilities for the public sector to subsidize the access. This recommendation is in line with what was proposed by Wen and Wu (2012, p.192): "treatment of physical inactivity is not a reimbursable item under most health insurance programs, and few financial incentives exist for health-care providers to spend time discussing exercise during medical visits". Therefore, it is necessary to place physical activity as a reimbursable treatment in insurance plans and public health care.

Cities like Recife (Brazil) have sought to provide access to regular and targeted physical activity with concrete results for the public health of their population (Hallal *et al.*, 2010). If we consider the possibility of saving US$ 1.14 billion in health resources if physical inactivity were reduced by half (Bueno *et al.*, 2016), it is not difficult to understand that the exemptions or subsidies would be a positive trade-off in public health expenses.

Gyms are not the only alternatives for the practice of physical activity. There is a vast list of other possibilities, such as walking outdoors, using bicycles as a means of transport, and participating in sports. However, a limitation is identified in these other possibilities: determining a clear indicator to be pursued and the difficulties monitoring their frequency. In gyms, it is possible to track the people enrolled and attending; therefore, being a measurable indicator. Thus, this is the article's contribution to its upstream target audience: the WHO and public health managers, this variable can be a practical tool, a quantitative metric, for concrete actions to combat the sedentary lifestyle and the diseases related to it.

Other research possibilities may arise from this article, which is highly encouraged. This article demonstrated that gyms and the oriented physical activity rate impact a country's life expectancy. Several controlling, moderating, and mediating variables can be tested in developing this proposal variable, such as GDP per capita, air pollution and basic sanitation access, organic food access, and a country's advertising regulation of over-processed foods. These are some of the limitations and suggestions for increasing future research. Still, it is possible to recommend that future studies seek to observe the data longitudinally, verifying its changes over time. A research suggestion may be to test rival models to the one proposed. Another suggestion is to observe the difference in activity participation in online deliveries versus in-person experiences. From there, verify the possibility of advancement in the proposed variable with the insertion of data such as the population's rate enrolled in online physical activity initiatives.

Among the limitations, the authors point out the absence of a previous research model seeking to test this same data or analyze rival models. It is anticipated that this first article will increase analyses that problematize the theme of public health and the gyms based on it. For analysis, we used techniques such as Confirmatory and Exploratory Factor Analyses, Analysis of Variance, and Regressions. Other methods can be used to seek new perspectives on the topic.

Data from China, a country with more than 1 billion inhabitants and representation of the size of its numbers, was not used, which is a limitation of this article. The lack of reliable data prevented it from being addressed in the article, suggesting further research.

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