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IMPROVING THE MANAGEMENT OF PHYSICAL ACTIVITY AND RECREATIONAL SPORT PROGRAM TO PROMOTE HEALTH AND WELLBEING FOR EU CITIZENS USING MATHEMATICAL SIMULATION

Abstract. *We live in a fast, constantly changing, and stressful environment, and physical activity and recreational sport are representing useful social methods to diminish its impact on our lives. The goal of this study is to determine future trends for sport and recreation activities for the EU population using data from the Special Eurobarometer 525/2022 and simulation based on Markov chains and MATLAB. The results indicated that EU citizens are maintaining the regularity of doing sport*

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and recreational activities (60%), it increases the engagement in cycling, dancing, or gardening (from 14% in 2022 to 14.45% in 2026), the preference for walking from 69% to 72.34%, the greater time allocated for sitting is decreasing from 43% to 41.5%, time allocated for fun activities and for gaining new skills are increasing, only for health is decreasing from 60% to 55.5%, and lack of time is considered the most important reason for not doing these activities, increasing from 48% to 55.6%. The results are showing that the desire to practice sport and recreational activities is increasing easily, and for others it is decreasing. Thus, the development of specific plans, objectives, and measures could be advanced to improve health and well-being. If the EU-27 citizens and specialists knew about these issues, as the calculation based on simulation and registered official data, they would take measures from now on.

Keywords*: physical activities, recreational sport, well-being, social activities, simulation and modelling, performance*

JEL Classification: L83, A13, C15, P47

1. Introduction

Practicing physical exercise and sport is not limited, it is addressing to all social categories without any age limit, according to their moral, aesthetic, and cultural valences, having formative goals. This practice becomes a necessity in terms of the need for movement and manifestation of the psychomotor potential. The institutions or individual forms of physical exercise can have both positive and negative meanings depending on the individual behaviour and on the specific conditions in which they are organised and practiced. One of the positive meanings is reflected in the socialisation approach, acquiring new values and behaviours and takes place with the family, colleagues and friends, school, community and the media, sport, and leisure activities. This process is complex and of great diversity, being influenced by country-specific sports policies.

Most of the investigations in this regard demonstrate the positive influence of sports activities on the personality and health of those who practice it. The advantage of sport lies in the influence it has on both the body and the mind so that the effects contribute to the development of personality. Sport can have an impact on role-taking, adaptation to the need for compliance, strengthening self-respect, self-identity, and solidarity. Cultural values, individual and social attitudes and behaviours obtained through physical activity could also be transferred to different fields, by helping people, obtaining fair-play learning, better working together and building cohesion through communication, mutual respect. The novelty of this study is consisting in the use of simulation on past data (from 2022) to forecast a possible future for physical activity and recreational sport in order to observe from an early time possible issues and to develop efficient policies for the improvement of these activities necessary for a healthy EU society and well-being. The study is structured as follows: Introduction, in Section 2 elements about physical activity and

recreational sport are presented, but also the Research Methodology where there are presented the goal, the specific objectives, the research hypothesis, and the development of conceptual model analysis based on using Markov chains in order to forecast future values and perceive future issues. Section 3 is dedicated to the research design that consists of data collection and analysis. Section 4 presents the results and research discussion, and in the last section, possible policies developed for EU citizens and their state of health and wellbeing are presented. Theoretical and managerial contributions are also presented along with limitations and future research directions.

2. Materials and Methods

2.1. Materials

Sport has an important role in all societies; it helps us to develop ourselves, to increase values, to co-operate, to improve health, and reduce the likelihood of disease (Morton and Harrison, 2023). Sport is vital for the community and contributes to the improvement of health, it improves mental health results (Petersen et al., 2023), reduces sedentary life, risks, and increases life values (Schoemaker, 2023; Volkwein-Caplan, 2013). Over the past 40 years, sport and physical activity have been delivered in a community for three reasons: sport for sport, sport for good, and sport for social inclusion (Wilson, 2018). According to Jowett and Lavalle (2007), social psychology in sport brings together the latest thinking on social interaction, relationships, and social perceptions.

The COVID-19 period had a negative impact on participation of individuals in sport activities influencing well-being (Che et al., 2023) and everyday life of people, rising serious concerns (Runcan et al., 2023), thus, health must have as a priority the task of making plans to maintain health (Skukla et al., 2023).

Recreational sport benefits natural facilities and provide socio-cultural learning and other benefits, such as:

- for participants: tolerance, moral reasoning, responsibility, motivation (Raca et al., 2023), improved self-esteeem, positive experiences, altruism, hope (Zhang et al., 2023), new knowledge and skills (Szentesi et al., 2021) cognitive, psychomotor, and affective development reducing marginalisation and social isolation (Li et al., 2022).
- for the community: social interaction and hedonic perspectives (Oshimi & Kinoshita, 2022), volunteering and positive feelings (Pi et al., 2022), increased dynamism by using ethnic events (Chung, 2022), revitalisation and psychological balance (Tang, Guan, 2023), recreation and sport (Filo et al., 2022).
- for organisations: it improves employees behaviour, delivers safety, and improved productivity (Tapps, Wells, 2018), improved health progam and knowledge, club sports, and supportive cultures based on voluntary activity such as in Nordic countries (Hertting et al., 2022), creating outdoor education with results for students' and for adults and healthy work programs after a long-term sickness (Cantonnet et al., 2022).

Today, the value of physical activity and sport is increasingly recognised: these activities are made for children (in educational institutions), for individuals with disabilities (Iosim et al,2022), but also for middle-aged and older adults.

2.2. Methods

Research Design

The purpose of the paper is to analyse the physical activities and recreational sport situation at the EU level and to show the importance of these activities for citizens, organisations, and the community as social activities. Data used were secondary, from the Eurobarometer 525 published in April-May 2022 and the analysis was made on EU-28 countries level on 26,580 EU citizens (https://europa.eu/eurobarometer/ surveys/detail/2668). As methods the following were used: simulation and modelling techniques (Markov chains and stochastic function) and MATLAB program to observe from time the trend of these activities, the behaviours, or policies.

Research hypotheses

Based on the literature review from the field and the data presented at the EU 27 level regarding the sport and recreational activities, the following research hypotheses were identified:

- **H1** the EU population is slowly decreasing in time, its interest in doing exercises and playing sports,
- **H2** the regular engagement of the EU population in cycling, dancing, or gardening is increasing,
- **H3** spending time between 30 and 90 minutes in doing vigorous activities is increasing,
- **H4** EU population is spending at least 30 minutes of walking every day, for health improvement,
- **H5** the greater time allocated for sitting (43% for 2h31'-5h30'), is decreasing in the next period,
- **H6** the time allocated for sport as a social activity (fun and gaining new skills) is increasing,
- **H7** lack of time is considered the most important barrier in practicing sports.

Sample

The Special Euro-barometer survey results of 26,580 EU citizens on sport and physical activity (April-May 2022).

Data Analysis

From this survey a few questions were extracted, and the results obtained from the report were transformed using simulation and modelling (the stochastic

function) into a matrix (the responses on different criteria) and a vector line (which are the total responses for a certain characteristic from the EU27 level).

Findings

The study consists in analysing a few issues linked by the physical activity and recreational sport as a social activity, using Markov chains modelling:

3. Analysing how EU-27 citizens exercise or play sport

According to the Eurobarometer results, 40% from Europeans citizens play sport or do exercises at least once weekly. There is an increase from 42% (2013) to 46% (eurobarometer.2018) and a decrease to 45% in 2022 (eurobarometer.2022) for EU citizens that never practice sports. In eleven EU countries (2018), over half of the respondents never practice sports. This category is met in Greece, Bulgaria, and Portugal (68%), followed by Romania (63%) and Italy (62%). In 2022, eight countries say they never practice sports (Portugal with 73%, Greece with 68%, and Poland with 65%). According to question QB1R („How often do you exercise or play sports?") The answers were as follows (Table 1).

Table 1. EU citizens exercising or playing sports (%-EU, p.11)

Age/exercising or playing sports	Never	Seldom	With some regularity		Regularly
15-24	19	15	54		12
25-39	32	20	42		6
40-54	41	21	32		6
>55	61	13	21		5

Source: calculations made by the authors

using the stochastic function, the following matrix and the line vector for EU 27 level was formed:

$$\begin{matrix} 0.12 & 0.54 & 0.15 & 0.19 \\ 0.06 & 0.42 & 0.20 & 0.32 \\ 0.06 & 0.32 & 0.21 & 0.41 \\ 0.05 & 0.21 & 0.13 & 0.61 \end{matrix} \times \begin{matrix} 0.06 & 0.32 & 0.17 & 0.45 \end{matrix}$$

Using Markov chain method and MATLAB program we obtained the following results for the next period (2022-2026) (Table 2).

Table 2. The trend regarding the regularity on age of practicing sports using simulation

Practicing sports	2022	2023	2024	2025	2026
Regularly	0.06	0.0591	0.0598	0.0599	0.0599
With some regularity	0.32	0.3157	0.3176	0.3184	0.3184
Seldom	0.17	0.1672	0.1688	0.1691	0.1691
Never	0.45	0.4744	0.4701	0.4689	0.4686

Source: calculations made by the authors

Using MATLAB, it may be observed that practicing sports regularly is slowly decreasing (from 0.06 in 2020 to 0.0599 in 2026), as well for some regularity (from 0.32 to 0.3184) and for seldom as well (from 0.17 to 0.1691); only for the group that never practices sport is increasing, thus, the hypothesis *H1- the EU population is slowly decreasing in time its interest in playing sport*, is fulfilled.
Therefore, a plan is necessary to make the population aware of the impact that it could have on health, by creating a good infrastructure so that sport becomes a symbol of ethics, non-discrimination, and practicing recreational activities in parks, as is the case of Japan, which started this trend in 1880 (Manzenreiter, 2013).

4. Analysing the engagement of EU-27 citizens in physical activities such as cycling, dancing, or gardening

According to the same Eurobarometer, less than 50% of EU respondents engage in activities such as cycling, dancing, or gardening. The proportion that never does this kind of activity, has decreased (-4%) reaching 31%, while the proportion, that does so with some regularity, has increased (+6%) reaching 36%. According to this report, only 14% of EU citizens add that they are doing this kind of activity regularly, while 19% seldom do so. For this activity, the highest level is in Finland for some regularity (54%) and the lowest levels are in nine countries for never doing, as for Portugal (72%) and for Romania (52%). According to question QB2R („How often do you engage in physical activities such as cycling, dancing, or gardening?") and the answers registered in the Report (Table 3), using stochastic function, we formed again the matrix and the line vector.

Table 3. EU citizens' engagement in cycling, dancing or gardening (%-EU, p.14)

Age/cycling, dancing, gardening	Never	Seldom	With some regularity	Regularly
15-24	16	20	44	20
25-39	25	23	38	14
40-54	28	24	36	12
>55	40	15	31	14

Source: calculations made by the authors

Using the stochastic function the matrix below was obtained.

$$\begin{matrix} 0.20 & 0.44 & 0.20 & 0.16 \\ 0.14 & 0.38 & 0.23 & 0.25 \\ 0.12 & 0.36 & 0.24 & 0.28 \\ 0.14 & 0.31 & 0.15 & 0.40 \end{matrix} \times \begin{matrix} 0.14 & 0.36 & 0.19 & 0.31 \end{matrix}$$

The calculations were performed according to the Markov chains method and using the MATLAB program and the following trends were obtained (Table 4).

Table 4. The trend regarding engagement in cycling, dancing, or gardening

Engagement	2022	2023	2024	2025	2026
Regularity	0.14	0.1446	0.1446	0.1445	0.1445
With some regularity	0.36	0.3629	0.3643	0.3645	0.3644
Seldom	0.19	0.2029	0.2045	0.2047	0.2048
Never	0.31	0.2896	0.2865	0.2861	0.2860

Source: calculations made by the authors

As we may observe (Table 4), in the analysed groups with regularity (from 0.14 to 0.1445), with some regularity (from 0.36 to 0.3644), and for seldom (from 0.19 to 0.2048) practicing these activities is increasing (for never doing these activities is decreasing from 0.31 to 0.2860), thus the hypothesis *H2- the regularly engagement of EU population in cycling, dancing, or gardening is increasing* is totally fulfilled.

The fact that physical activity and recreational sport are increasing is comforting. Their increase is small, a plan for increasing the engagement in physical activities is required for young European groups: improved infrastructures, challenging curriculums, improving financial motivation using rewards and sponsorships, and nonfinancial measures (boards, diplomas, programs for congratulation).

5. Analysing the time spent on vigorous physical activity for EU-27

Among these respondents, the majority (49%) spend time for vigorous activity between 31 and 90 minutes, 16% do it for 30 minutes or less, and 14% for over 91 minutes. Six in ten countries responded that they spend between 31 and 90 minutes, like Finland (65%), Sweden (64%), or Poland (60%). The lowest percent is registered in Austria with 40% and with 42% in France and Latvia. According to question QB4 („In general, on days when you do a vigorous physical activity, how much time do you spend with it?") and the answers registered in the Report, resulted the data (Table 5).

Table 5. Time spent on vigorous physical activities on age (%-EU, p.20)

Age/vigorous physical activities	Never	>30'	31'-90'	>91'
15-24	10	12	62	16
25-39	15	16	56	13
40-54	21	17	48	14
>55	30	17	39	14

Source: calculations made by the authors

$$\begin{matrix} 0.12 & 0.62 & 0.16 & 0.10 \\ 0.16 & 0.56 & 0.13 & 0.15 \\ 0.17 & 0.48 & 0.14 & 0.21 \\ 0.17 & 0.39 & 0.14 & 0.30 \end{matrix} \text{ x } \begin{matrix} 0.16 & 0.49 & 0.14 & 0.21 \end{matrix}$$

Making the calculation we obtain (Table 6):

Table 6. The trend of time spent on vigorous physical activities

Time for vigorous PA	2022	2023	2024	2025	2026
>30'	0,16	0,1571	0,1617	0,1615	0,1616
31'-90'	0,49	0,5527	0,5442	0,5441	0,5440
>91'	0,14	0,1383	0,1418	0,1420	0,1420
Never	0,21	0,1819	0,1822	0,1822	0,1822

Source: calculations made by the authors

We may observe that for the first three groups between less than 30 minutes and over 91 minutes for doing vigorous activities is increasing and for never doing vigorous activities is decreasing and for vigorous activity with the biggest percent from all the analysed categories, are for the group between 31 and 90 minutes, which will register an increase from 0.49 to 0.544. Thus, we may add that *H3- spending time between 31 and 90 minutes in doing vigorous activities is increasing*, is fulfilled.

To do vigorous activities is important, a new plan for improving this activity is important: more involved coaches and more attractive programs of doing vigorous activities, better sport lessons and context from the physical educators will influence the youth and not only this category of age to do vigorous activities.

6. Analysis of time spent on walking for EU 27 citizens

More than two-thirds of Europeans generally spend an hour or less walking per day; seven out of ten respondents (69%) spend an hour or less walking. Less walking or less than 30 minutes is registered in Portugal with 47% and with 45% for Greece and Bulgaria. The lowest proportions are registered in Latvia (22%), Estonia (24%), and Finland (27%). According to question QB8 („In the last 7 days, on how many days did you walk for at least 10 minutes at a time?"), data indicated on age that walking have registered the following values (Table 7).

Table 7. Time spent on walking on age (%-EU, p.30)

Age/walking	Never+dk	30'-60'	61'-120'	>121'
15-24	5	73	18	4
25-39	9	70	17	4
40-54	9	69	17	5
>55	14	67	16	3

Source: calculations made by the authors

Using the stochastic function, we formed the following matrix.

$$\begin{matrix} 0.73 & 0.18 & 0.04 & 0.05 \\ 0.70 & 0.17 & 0.04 & 0.09 \\ 0.69 & 0.17 & 0.05 & 0.09 \\ 0.67 & 0.16 & 0.03 & 0.14 \end{matrix} \times \begin{matrix} 0.69 & 0.16 & 0.04 & 0.11 \end{matrix}$$

Using Markov chain and MATLAB we obtained the following trend for the analysed variable (Table 8).

Table 8. The trend of walking time on age

Time for walking	2022	2023	2024	2025	2026
30'-60'	0.69	0.717	0.724	0.7235	0.7234
61'-120'	0.16	0.183	0.1777	0.1776	0.1775
>121'	0.04	0.0393	0.04	0.03999	0.03998
never+dk	0.11	0.0679	0.065	0.0648	0.0648

Source: calculations made by the authors

As we may observe for the first two categories the preference is increasing (from 0.69 to 0.7234 and also from 0.16 to 0.1775) and for walking more than 121 minutes is decreasing (from 0.04 to 0.03998) and for never walking or do not know

(from 0.11 to 0.0648) the trend is negative, which is good; thus, the hypothesis H4-*EU population is spending at least 30 minutes of walking every day for health improvement* is totally fulfilled.
Walking is an efficient and a non-expensive way of sport, so, a plan is consisting in making time for at least 30 minutes of walking everyday in order to improve heart health, based on a social triad: the self, the doctor and the social environment, creating the feeling of self-confidence and overall well-being.

7. Analysing the time on sitting for EU-27 citizens

EU citizens declare that around 11% sit for more than 8 hours and 30 minutes, 30% of them are sitting between 5 hours 31 minutes and 8 hours 30 minutes. A large percent (43%) of the population is sitting between 2 hours 31 minutes and 5 hours 30 minutes. The highest values are with 56% in Spain and at the opposite level are Hungary with 24%, Croatia, and Romania with 23%. According to QB9R („How much time do you spend sitting on a usual day?" (the time for sitting is referring to the time spent at a desk, studying, or watching TV).

From the 5 columns used in the report, we made a 4 columns matrix, introducing the last one (don't know answers) in the first column (Table 9).

Table 9. Time spent on sitting on age (%-EU, p.33)

Age/sitting	2h30'+don't know	2h31'-5h30'	5h31'-8h30'	>8h31'
15-24	13	37	37	13
25-39	20	40	28	12
40-54	20	44	26	11
>55	18	46	28	10

Source: calculations made by the authors

$$\begin{matrix} 0.13 & 0.37 & 0.37 & 0.13 \\ 0.20 & 0.40 & 0.28 & 0.12 \\ 0.20 & 0.44 & 0.26 & 0.11 \\ 0.18 & 0.46 & 0.28 & 0.10 \end{matrix} \times \begin{matrix} 0.18 \\ 0.43 \\ 0.28 \\ 0.11 \end{matrix}$$

Table 10. Trend of time spent on sitting using simulation

Time for sitting	2022	2023	2024	2025	2026
>2h30'+don't know	0.18	0.185	0.184	0.185	0,186
2h31'-5h30'	0.43	0.411	0.412	0.413	0,415
5h31'-8h30'	0.28	0.288	0.290	0.291	0.292
>8h31'	0.11	0.116	0.116	0.116	0,117

Source: calculations made by the authors

For the categories of sitting (>2h30' and 5h31'-8h30') the time increases, and for the other two categories (2h31'-5h30' and for more than 8h31') it decreases.

Thus, the hypothesis H5- *the greater time allocated for sitting (43% for 2h31'-5h30'), is decreasing in the next period*, is fulfilled.
Thus, being the opposite of practicing sports, it is imposed to propose a plan of our own or to follow a plan which already exists; people must follow it in order to keep a healthy mind and body and be in good shape.

8. Analysing the reasons for engaging in sport and physical activity (PA) for EU-27 citizens

For EU citizens, the main reasons to engage in sport activity are improving health (54%), fitness (43%), fun (27%), weight control (25%), improve self- esteem (13%) and for a better integration into society (3%). At EU level, the most increased percent is with 71% for Sweden and the most decreased values are with 31% in Romania and with 33% in Bulgaria. For fun, the highest increase percent is found with 46% in Lithuania and with 52% in the Netherlands; the lowest decrease percent is found with 10% in Hungary and with 12% in Cyprus. To control weight, the highest levels are in the Netherlands (41%) and Finland (39%), to improve their self-esteem, the highest scores are found with 27% in Denmark and with 20% in Bulgaria, and to better integrate into society (9% in Austria and Romania).
According to QB11 („Why do you engage in sport or physical activity? (%), we kept only 4 from 17 analysed reasons, forming a new matrix, but keeping the same values using the stochastic function. The reasons are now set into 4 groups as follows:

Group1- health, physical appearance, reduce ageing, improve physical performance, fitness, and weight control, Group 2- fun, relax, make friends, new acquaintances, new people from new cultures, Group 3- self-esteem, new skills, spirit of competition, integration into society, and Group 4- other reasons and don't know. Thus, summing up each value from the group on age and dividing to the total number of respondents by age, using the stochastic function we obtained (Table 11).

Table 11. Reasons to engage in sport on age (%-EU, p.47)

Age/reasons	Health	Fun	New skills	o+dk
15-24	52	33	14	1
25-39	59	29	11	1
40-54	62	28	9	1
>55	62	30	6	2

Source: calculations made by the authors

$$\begin{matrix} 0.52 & 0.33 & 0.14 & 0.01 \\ 0.59 & 0.29 & 0.11 & 0.01 \\ 0.62 & 0.28 & 0.09 & 0.01 \\ 0.62 & 0.30 & 0.06 & 0.02 \end{matrix} \times \begin{matrix} 0.60 & 0.30 & 0.09 & 0.01 \end{matrix}$$

Table 12. The trend for reasons of engaging in sport using simulation

Reasons for sport	2022	2023	2024	2025	2026
Health	0.60	0.551	0,555	0,555	0,555
Fun	0.30	0.313	0,311	0,311	0,311
New skills	0.09	0.126	0,124	0,124	0,124
o+dk	0.01	0,01	0,01	0,01	0,01

Source: calculations made by the authors

Practicing sports for group 2 (for fun activities is increasing from 0.30 to 0.311) and group 3 (gaining new skills) is increasing in the next period from 0.09 to 0.124, and motivation in practicing sport activity found in group 1 (health and other reasons) is decreasing in the simulated future from 0.6 to 0.55; thus, it is mandatory a plan and some measures to activate the desire of practicing sport and recreational activity for a healthy life. At least for the group 4 (other reasons and don't know) is maintaining at 0.01 for the forecasted period. Thus, the Hypothesis *H6- the time allocated for sport and physical activity made for health and well-being* is partially fulfilled because is decreasing for health and is increasing for well-being.

A plan to increase the motivation to practice sports is consisting in a few triggers based on information, communication, linked by the problems that may appear and invited persons which had health problems and managed to solve them by practicing sports.

9. Analysing the barriers in practicing sports for EU-27 citizens

The main barrier found is with 41% registered for lack of time, or registered with 25% for lack of motivation or interest (increasing with 5% compared to 2018), with 14% for having a disability or illness, with 10% for the fact that it is too expensive, with 9% for disliked competitive activities, and with 8% for fear of injuries. The highest proportion is with 53% in Cyprus and with 49% in Malta (49%), and the lowest percent is registered in Austria with 32% and in Germany and France with 37%. According to QB14 („What are the main reasons currently preventing you from practising sports more regularly?"), the 12 answers were summed up according to the authors reasoning and divided on four types of barriers, as follows:

Group 1 – lack of time, the high price, with dislike for competitive activities, or due to the reduced access to infrastructure, Group 2 – disability or illness, lack of opportunities, lack of motivations, no friends to do sport, feeling discrimination, afraid of injuries, Group 3 – already practicing sports regularly, Group 4 – other and don't know.

Table 13. Reasons for not practicing sports on age (%-EU, p.51)

Age/reasons	Lack of time	Illness	Already practicing sports	o+dk
15-24	54	30	13	3
25-39	59	31	9	1
40-54	57	34	6	3
>55	33	54	7	6

Source: calculations made by the authors

Using the stochastic function the following matrix results.

$$\begin{matrix} 0.54 & 0.30 & 0.13 & 0.03 \\ 0.59 & 0.31 & 0.09 & 0.01 \\ 0.57 & 0.34 & 0.06 & 0.03 \\ 0.33 & 0.54 & 0.07 & 0.06 \end{matrix} \times \begin{matrix} 0.48 \\ 0.41 \\ 0.07 \\ 0.04 \end{matrix}$$

Making the calculation using Markov chains method, the following future simulated values for the next 5 years (2022-2026) are obtained.

Table 14. The trend of barriers in doing PA using simulation

Barriers in doing PA	2022	2023	2024	2025	2026
lack of time	0.48	0,554	0,556	0,555	0,556
Illness	0.41	0,316	0,313	0,313	0,315
already practicing sports	0.07	0,11	0,11	0,12	0,10
o+dk	0.04	0,02	0,021	0,021	0,02

Source: calculations made by the authors

As we may observe, the number of EU citizens who are already practicing sports is increasing from 0.07 to 0.10 but also for Group 1- the ones who don't have time (from 0.48 to 0.556). As for Group 2 and 4 who are not practicing sports due to illness, lack of friends, lack of motivation, or they are afraid of injuries, the motivation to practice sport is decreasing from 0.41 to 0.315. Thus, the hypothesis *H7- lack of time is considered the most important barrier in practicing sport*, is fulfilled.

To practice more sports, even the lack of time is a problem for many people, it is important to inform them that prioritising the daily tasks is a solution with results on long run.

10. Results and Discussion

10.1. Results

The purpose of the study is to analyse the literature in the field, from two points of view: that of sport and of recreational activities as social activities, and to implement a simulation model to observe the future trends of these activities and any problems that could arise from not practicing them regularly. Using simulation and official EU data, the purpose was to discover a possible trend of sport and recreational activities, and specific plans when the trend is found negative.

10.2. Conclusions and Proposals

Sport and physical leisure activities involve more and more people who become active or passive participants in this social phenomenon, in the fact that some practice them, others are just spectators. Sport and physical activities are important for individuals, for families, for organisations, for society, in general.

To have active citizens, clear policies, objectives, and measures could be developed in order to have, for each analysed variable, real results:

1. for doing exercises or playing sports – the development of a plan is necessary for an increased desire to practice sports: making the population aware of the impact it could have on health, on duration of life, of social life, or of mental health, and implication of society to make a good infrastructure, a symbol of ethics, non-discrimination, altruism, health, and doing recreational activities in nature.

2. for the implication in practicing activities such as dancing, cycling, or gardening: improved infrastructures, challenging curriculums for the students from schools and universities, making contests and improving motivating measures, also financial ones (rewards, bonuses, sponsorships), and nonfinancial measures (boards, diplomas, programs for congratulation, better communication, better commitment, encouraging, coaching, or mentoring programs) which could improve social activities.

3. for the time spent on vigorous physical activity – development of a plan to involve population and information of the citizens about its benefits: decreasing heart disease, lowering the level of the cholesterol, improving the weight and the trust, the involvement of coaches, and a more attractive program.

4. for time for walking – walking is an efficient and a non-expensive way of practicing sports, resulting in mental, spiritual, and psychological health. Therefore, a plan is necessary to increase walking for at least 30 minutes daily, by using the social triad: the self, the doctor, and the social environment, by using IoT and new technologies at work (green room, green 15 minutes pause for walking) or at home.

5. for the time of sitting – sitting is the opposite of practicing sports and it has negative effects on health and well-being. The highest percentage for time allocated for sitting (2h31'-5h30'), according to forecasted data is following a decreased trend in the next five simulated years, so a plan for reducing the time allocated for sitting is consisting in continuous information from doctors, society, sport persons, coaches, mentors and conviction to be involved in sport activity from childhood.

6. analysing the reasons of practicing sports and physical activities – the reason of practicing sport for health is decreasing in percentage in a forecasted future, so is important to increase the awareness of being active, and challenge the population

of practicing sport for many reasons, as health, fun, relation, and well-being, it is necessary a plan which may consist in: a better information of EU citizens by using: sport campaigns, a community sport alliance, recreation programs for different categories: for young mothers, for children, for adults, using customised communication one-to-one or one-to-few, based on persuasion by examples.

7. analysing the barriers in practicing sport for EU-27 citizens – usually, persons who are practising sports are doing it for performance in sport. In general, women are involved in household work, their time is limited for sports, and women have less time for sport than men. Thus, sport is not their priority. A plan is necessary at the EU level to improve this activity and reduce the main barriers, such as: making sport a main priority at least for health, if not for well-being, increase the enjoying of practicing sports, by making a balance between the implication of both sexes in household work, rising the signal about practicing sports ahead of time, information using traditional ways, virtual ways or new ways based on live presentation, park presentations, special events, and a campaign such as „Sport for everyone, anytime, anywhere".

10.3. Discussions

Analysing the results from the study, it may be observed that practicing sport for the group with regularly (from 0.06 in 2022 to 0.0599 in 2026), with some regularity (from 0.32 to 0.3184) and for seldom (from 0.17 to 0.1691) is also decreasing as the interest in practicing sports; only for group that never practice sports is increasing from 0.45 to 0.4686, thus, the hypothesis H1- the EU population is slowly decreasing in time its interest in doing exercises and playing sport is fulfilled.

The forecasted future trend for engagement in physical activities has an increasing registered at the analysed groups with regularity (from 0.14 in 2022 to 0.1445 in 2026), with some regularity (from 0.36 to 0.3644), and for seldom (from 0.19 to 0.206). Only for never doing these activities is decreasing, thus the hypothesis *H2- the regularly engagement of the EU population in cycling, dancing, or gardening is increasing* is totally fulfilled.

Analysing the graphical representation for vigorous activity, we may add that *H3- spending time between 30 and 90 minutes in doing vigorous activities is increasing,* is fulfilled. As we can see, for the first variant of under 30 minutes will increase the interest from 0.16 to 0.1616; for 31'-90' and is also increasing *(from 0.49 in 2022 to 0.544 in 2026).* Also, for the variant of above 91' from 0.14 in 2022 will increase at 0.142 in 2026, so, the interest of EU population is in a positive trend for vigorous activity. In general, for never practicing sport, the percent is decreasing, the EU population being conscious about health and well- being and their effects on long-term. Making the calculation for walking, it may be observed that for the first two categories the preference is increasing (from 0.69 in 2022 to 0.7234 in 2026 for 30'-60' of walking, and from 0.16 to 0.1775 for 61'-120' of walking) and for walking more than 121 minutes is decreasing, the preference for never walking or do not know the trend is negative, thus the hypothesis H4- *EU population is spending at least 30 minutes of walking every day for health improvement* is totally fulfilled. So

for the EU citizens, the desire to walk is becoming more and more important for health and well-being.

At EU-level for the categories of sitting (>2h30' and 5h31'-8h30') the time is increasing (from 0.18 to 0.186, respectively from 0.28 to 0.292), and for the other two categories (2h31'-5h30' and for more than 8h31') the sitting is decreasing (from 0.43 to 0.415, respectively, from 0.11 to 0.117). Thus, the hypothesis H5- *the greater time allocated for sitting (43% for 2h31'-5h30'), is decreasing in the next period*, is fulfilled.

As we may observe, the reasons for practicing sports for group 2 (fun activities) and group 3 (gaining new skills) is increasing in the next period (from 0.30 in 2022 to 0.311 in 2026, respectively from 0.09 to 0.124), and motivation in doing sport activity found in group 1 (health) is decreasing in the simulated future (from 0.60 to 0.555), and for other reasons and not don't know is remaining at the same value (of 0.01). Thus, the hypothesis H6- *the time allocated for sport and physical activity made for health* and well-being is partially fulfilled because it is decreasing for health and is increasing for well-being (as the percent are increasing for fun and gaining new skills).

As we could observe, the number of EU citizens who practise sports is increasing from 0.07 to 0.10 but also for Group 1- the ones who don't have time (from 0.48 in 2022 to 0.556 in 2026). As for Group 2 they are not practicing sports due to illness, lack of friends, lack of motivation, or afraid of injuries (from 0.41 to 0.315). Thus, the hypothesis H7- *lack of time is considered the most important barrier in doing sport*, is fulfilled.

Physical activity has grown in the last few years in the European Union, but today, people are more interested in having a good, happy, and long life. As we may see from calculations, many sport activities in a simulated future are about to know a decreasing level, thus, implication, commitment, encouragement will bring a real progress in practicing sport and recreational activity.

Implications for society, institutions, and citizens.

Making plans based on simulation (and using real data registered at EU-27 level), is leading to some important implications such as:

- implications for citizens: increased self-esteem, high motivation, energy, responsibility and tolerance, better moral, improved health and physical benefits, better communication, commitment, initiative, empathy, new knowledge and skills;
- implications for society: increased volunteering, commitment, and social interaction, cohesion and inclusion, life satisfaction and positive perspectives, interactions, decrease of antisocial behaviour, increased economic benefits;
- implications for institutions: it improves employees' behaviour, offers safety and improves productivity, improved health, gaining health knowledge, development of community club sports, and developing procedures for work and after sickness.

The study has some limitations, as not all the variables used in the EU Report from 2022 were used to have a future and possible vision on exercises and sport activity, but the fact that the data used in the study is close enough from a real perspective to calculate based on Markov chains a possible trend for analysed activities about sport and recreation for EU citizens. The effects of not doing any recreational activity are known: the concentration on every day activity is decreasing, the health of mind and of body is increasing, and the joy to live and to be happy and socialise is increasing. Using simulation may determine the causes of a problem, with little effort, less financial resources, and with the involvement of a team which have the opportunity to gain new knowledge and skills. Thus, making this study based on simulation, we will show that a good management, a sustainable strategy, and an effective plan will create a good balance between the personal and the professional life, by practicing sport and recreational activity as social activities, and by improving the EU's population health and well-being.

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