

# Sport and leisure-time physical activity over the life course

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## ORIGINAL ARTICLE

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## ABSTRACT

It is desirable to get as many people as possible to engage in long-term leisure-time physical activity (LTPA) due to the health-enhancing effects. Although the proportion of individuals who are physically active in their leisure time appears to have increased in Switzerland in the past years (e.g., Lamprecht et al., 2020), little is known so far about the dynamic of change in LTPA trajectories over the life course. LTPA trajectories of 1,456 Swiss residents aged 35 to 76 years (random sampling) were reconstructed with the help of a retrospective telephone interview (CATI method). To address the difficulties of retrospective data collection, the article presents the careful development of the questionnaire on the basis of current evidence. The majority of the respondents (approx. 73%) show a long-term LTPA without dropout (dropout = LTPA less than once a week over one year and longer), only a minority of whom (approx. 18%) took up their LTPA after the age of 20. In addition, there is also a group with a somewhat unstable LTPA trajectory (approx. 24%) that includes at least one dropout. For members of the latter group, the longer the inactive episode lasted, the lower were their chances of entering an LTPA. While the different LTPA trajectory groups differed only slightly with regard to socioeconomic characteristics, analyses of their sport- and physical activity-related history reveal that self-organized LTPA in childhood and youth may be seen as a success factor for lifelong LTPA. The proportion of people practicing (long-term) LTPA is presumably overrepresented in the sample. This limitation should be taken into account, but analyses of possible advantageous conditions of long-term or lifelong LTPA are nevertheless possible. The results indicate a demand for more specific theories related to the causality behind the observable LTPA behavior.

**Keywords**

*leisure-time physical activity (LTPA), stability, life course, retrospective longitudinal study, Switzerland*

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**Introduction**

Many societal protagonists aim to provide as many people as possible access to a lifestyle of physical activity and sport throughout their lives due to the health-enhancing effects of physical as well as sport activity. So far, however, this has not been achieved to a satisfactory degree. Physical inactivity costs Switzerland around two billion Swiss francs per year in direct treatment costs (Bundesamt für Sport et al., 2013). These costs could be lowered if a larger part of the population maintained an active lifestyle and participated regularly in sport activities. The achievement of health-enhancing effects requires avoidance of inactive behavior (e.g., sitting for too long) and maintenance of regular engagement in sport and physical activity over a long period, if possible for one's entire life (Bundesamt für Sport et al., 2013; Rütten & Pfeifer, 2016). Around 35 percent of adults in Switzerland do not meet the national recommendations for health-enhancing physical activity (Bundesamt für Sport et al., 2013). A closer look also reveals that particular social groups (such as the elderly, persons with a low level of education or a migration background) have found access to health-enhancing physical activity less often up to now (Jekauc et al., 2018; Lamprecht et al., 2020). However, time-series studies have shown that the proportion of physically active persons in Switzerland has increased in the past decades (Bundesamt für Sport et al., 2013; Storni et al., 2019). Although such repeatedly conducted cross-sectional studies can show a certain trend, they cannot portray the maintenance of physical activity or the dynamic of changes in

terms of entering and exiting health-enhancing sport and physical activities. In this context, it seems significant for the promotion of physical activity and sport to obtain more knowledge on trajectory and maintenance in order to achieve the goal of long-term or lifelong health-enhancing sport and physical activity. The trajectories of persons who participate in sports and physical activity on a long-term basis are of particular interest for finding out more about the conditions for the success of long-term and lifelong sport and physical activity. Altogether, the stability of LTPA over the life course appears to be "low to moderate" (Aggio et al., 2017; Beunen et al., 2004; Borgers et al., 2018; Engel & Nagel, 2011; Hirvensalo & Lintunen, 2011; Jekauc et al., 2018; Klostermann & Nagel, 2011; Kristensen et al., 2008; Malina, 2001; Telama, 2009; Trudeau et al., 2004). To date, little evidence is available on the issue of which factors influence the trajectory of health-enhancing physical activity. Initial findings indicate that significant determinants include socioeconomic factors (e.g., LTPA is less stable in younger women and in persons with a lower level of education; see Hirvensalo & Lintunen, 2011; Lamprecht et al., 2020) as well as the particular sport and its organizational setting (e.g., Kjønnsen et al., 2009; Klostermann & Nagel, 2011; Telama, 2009). In summary, a review of the current state of research shows that there are relatively few longitudinal studies on health-enhancing physical activity that measure it over the entire lifespan. Related considerations of

the life-course trajectory of sport and physical activity as a process of change, investigation of possible connections, and advantageous conditions have not yet been taken into account.

This article builds on these findings and research gaps by focusing on LTPA over the entire life course as an element of health-enhancing physical activity (HEPA).<sup>1</sup> The central questions addressed are how LTPA develops over the life course and what stability it exhibits, as well as to what extent the life-course trajectories of LTPA differ across various groups of individuals. Taking the theoretical and methodological approach of life course research developed by Mayer (1990, 2009) as a starting point, we analyzed the trajectories of LTPA over the life course of individuals in middle and later adulthood in a retrospective longitudinal study.

## Theoretical Framework

The sociological life course approach developed by Mayer (1990, 2009) and the “life course cube” published by Bernardi et al. (2019) provide a suitable theoretical and methodological framework for our question of interest. Accordingly, LTPA is conceptualized at the individual action level as a sequence of activities (e.g., participation in sport activities) and events (e.g., entering or exiting the sport activity) over the life course, which include exercise, sport, and unstructured recre-

ation practiced at least once a week. In other words, the trajectory of LTPA over the life course is characterized by alternating episodes of activity and inactivity (LTPI), the maintenance of which may be influenced by various factors (see also Allmer, 2002). To date, only very few studies have investigated LTPA empirically over the life course as alternating episodes of activity and inactivity (Engel & Nagel, 2011; Jekauc et al., 2018). In view of the central questions of the present study, various temporal dependencies of LTPA over the life course are of particular interest. The “life course cube” by Bernardi et al. (2019) illustrates the complexity of time-related interdependencies over the life course. For example, individual behavior and decisions are affected by social (normative) expectations, such as typical development tasks at different stages of life (e.g., becoming a parent, entering retirement). As Mayer (1990, pp. 11, translated) states, “events, phases, transitions, and stages of life cannot be considered in isolation or situationally. [...] Lifetime in particular is a constraint for actions”. According to the notion of path dependency, current individual actions and decisions (e.g., entering or exiting a sporting activity) are influenced by previous experiences, and they also constitute the starting point for future individual actions and decisions (Bernardi et al., 2019). What is considered relevant in this connection is the duration of the episodes (e.g., duration of LTPA or LTPI in years). The longer the episodes last, the lower is the probability of an entry or exit (e.g., Engel & Nagel, 2011). The history of sport participation and LTPA over the life course and in its entirety (e.g., experiences in various sport activities in different sport organizations with and without competition participation) seems to be of greater importance than individual autobiographical “states” at individual points in the life course (Bernardi et al., 2019). In other words, it is believed that just the state of being physically active in one specific year will have less influence on the future trajectory of sport and physical activity than the entire experiences over a longer period of time. However, the current state of research cannot answer the question of which periods are crucial and what the difference is between long-term stable LTPA trajectories and less stable LTPA tra-

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1. Health-enhancing physical activities (HEPA) are understood as all physical activities that lead to an increase in energy metabolism through the use of the skeletal muscles, thereby promoting health and functional capacities (e.g., Foster, 2000). They include both occupational physical activities (OPA) and leisure-time physical activities (LTPA). This study is focused on LTPA and the used definition refers to Khan et al. (2012), who distinguish four types of physical activity: occupational; transport; domestic; and leisure time, which includes exercise, sport, and unstructured recreation. Accordingly, e.g., regularly going for a walk or riding a bicycle during leisure time (and not as a transport activity for the purpose of going to work) counts as LTPA in this study if it is practiced at least once a week, but not gardening as a domestic physical activity.

jectories? Initial research findings indicate that it is advantageous for the stability of sporting activity to engage in several sports and physical activities which can be maintained over the entire life course, such as swimming and cycling, or to participate in them in a club (e.g., Kjønnes et al., 2009; Klostermann & Nagel, 2011; Lunn, 2010; Tammelin et al., 2003; Telama, 2009). In addition, the question of particularly relevant and sensitive periods for lifelong sport and physical activity is not yet settled. The stage of childhood and youth is traditionally attributed special importance, in the sense that this is the stage at which the foundation for long-term or even lifelong sport and physical activity is laid (e.g., Batista et al., 2019). However, several empirical studies indicate that it is also possible to take up regular sport and physical activity in adulthood and that this can also lead to long-term activity (e.g., Frändin et al., 1995; Hirvensalo & Lintunen, 2011; Klostermann & Nagel, 2011).

In summary, these theoretical considerations lead to the question of what kinds of temporal dependencies should be regarded as relevant for LTPA over the life course. The following research questions can be specified:

Q1: To what extent can LTPA over the life course be described as a sequence of activity and inactivity?

Q2: To what extent does the duration of episodes of LTPA or leisure-time physical inactivity (LTPI) influence the probability of an entry or exit?

Q3: What characteristics of sport and physical activity-related history (e.g., type of sport and physical activities, organizational setting, competition participation) do persons who are physically active in their leisure time on a long-term to lifelong basis exhibit?

Q4: What role do socioeconomic factors (e.g., level of education) play with regard to the life-course trajectory of LTPA?

## Method

The theoretical considerations and assumptions lead in the next step to several methodological consequences. The theoretical demand for the most precise possible measurement of sport and physical activity-related history raises the question of how to measure LTPA over the life course in a sufficiently differentiated manner. On the whole, the life-course trajectories of LTPA should be portrayed over relatively long periods. Retrospective interviews are suitable for this purpose, not only for reasons of research pragmatism but also in the interest of avoiding systematic sample bias and recall bias. However, such interviews in turn place great demands on the autobiographical memory of the respondents. Various methods and procedures for enhancing recall in retrospective data collection have been developed and evaluated in recent years (Glasner & Van der Vaart, 2009; Matthes et al., 2007; Morselli et al., 2018). We endeavored to implement them in this study through the further development of an existing questionnaire for telephone interviews (CATI method) on the retrospective measurement of LTPA over the life course (e.g., Klostermann & Nagel, 2011). In view of the temporal dependencies of LTPA over the life course, an empirical analysis requires at least year-specific dating of the activities and events so that the respective durations can be determined. In addition, the life-course trajectory of LTPA should be defined in as broad terms as possible through the inclusion of different forms of participation (e.g., organizational setting, physical or sport activity, competition participation, age of entry).

## Instruments

We structured the questionnaire in accordance with the idea of thematic recall pathways (Matthes et al., 2007), thus beginning in very general terms by covering current sport and physical activity with a dichotomous yes–no question and continuing with a list of all sports and physical activities practiced. Then, increas-

ingly specific questions were asked on frequency, organizational setting, and the date each sport and physical activity was begun (see A for an extract from the questionnaire).

Recall of previous sport and physical activities was supported through the adoption of a sequential approach starting from childhood and youth through younger adulthood to middle adulthood, with questions on particular sport and physical activities at the individual stages again proceeding from the general to the specific. We tried to initiate cross-thematic recall pathways in accordance with Matthes et al. (2007) by including important life events in the areas of family, education, and career, as well as history of living situation before the questions about previous sport and physical activities (e.g., Lenze et al., 2021). Overall, the combined sequential and modular approach in the interviews provided targeted support for the recall work of the respondents (e.g., Matthes et al., 2007).

In addition, we tried to encourage recall by individualizing the interviews in some respects. To be specific, information previously provided by the respondents was automatically transferred to modules appearing later in the interview (e.g., if the respondent's current sport and physical activity started in childhood, this fact was automatically transferred to the questions about this life stage in the interview).

We tested and evaluated the resulting "Sport and Physical Activity over the Life Course" questionnaire in several pre-studies.

## Measures

LTPA: For the analyses in this paper, we observed only regular sport and physical activities. The term "regular" refers to at least once a week. The definition of LTPA we applied (Khan et al., 2012) includes all physical activities performed during leisure time, without those performed for occupational, domestic, or transport purposes. We collected data on specific types of LTPA, frequency of participation, organizational setting, and competition participation at the particular life stages.

As suggested by Sudeck et al. (2011), we categorized the statements on the specific sport and physical activities into 10 activity groups (walking and endurance activities, fitness, gymnastics and multi-sport activities, athletics, compositional-creative activities, release-oriented activities, outdoor and mountain activities, sports games, martial arts, equestrian).

To portray the LTPA trajectories over the life course, we used the respondents' statements on entry to and exit from the particular sport and physical activities as well as their statements on interruptions of over one year's duration. Thus, episodes of activity and inactivity were built, with years as the time unit.

We already took some socioeconomic data into account in the sampling process using the data of the Swiss Federal Statistical Office (e.g., sex and age) and verified them at the beginning of the interview. Level of education was included in the survey of vocational and educational life events and was classified for the present analyses into one of two groups, "obligatory school-leaving qualification & vocational training" and "higher education entry qualification & tertiary education". Nationality was included at the end of the interview. All persons who currently had Swiss nationality (Swiss citizens and dual citizens with Swiss nationality) and those who had exclusively foreign nationality were included in the present analyses.

## Pre-studies

### *Pre-study 1, "Cognitive pretest"*

The aim of this first pre-study was to evaluate the questionnaire for comprehensibility as well as for possible difficulties in the recall process through the think-aloud protocol, confidence rating, and coding of behavior in responding to the questions (Dürnberger et al., 2011; Moosbrugger & Kelava, 2020). We conducted a total of nine face-to-face interviews (six female and three male respondents; aged 18 to 83 years;  $M_{\text{age}} = 41$ ,  $SD = 20.57$ ). In the confidence rating, the respondents stated that they were fairly certain of their response (Likert scale from 1 = not certain to 4 = very

certain;  $M = 3.63$ ,  $SD = 0.55$ ,  $Min = 2$ ;  $Max = 4$ ). In the think-aloud protocol and coding of behavior (e.g., hesitation or moaning), the respondents exhibited a certain level of uncertainty in responding to questions on the frequency with which they participated in sport and physical activities.

#### *Pre-study 2, "Test-retest study"*

This pre-study aimed at testing the reliability of the retrospective statements on sport and physical activity in the life course. For this purpose, we conducted telephone interviews with the questionnaire twice on a total of 29 persons (17 women and 12 men) aged 23 to 75 years ( $M_{age} = 51.41$ ,  $SD = 19.09$ ). The average interval between the first and second interview was 95.07 days ( $SD = 15.34$ ). For reliability testing, we calculated the values of Krippendorff's alpha. Krippendorff's alpha is similar to Scott's pi for a nominal scale and to Pearson's intraclass correlation coefficient for an interval scale. As suggested by Hayes & Krippendorff (2007), we conducted 10,000 bootstrap sampling distributions (CI = confidence interval). Except for the data on the frequency of participation in sport and physical activities and the data on competition participation in childhood and youth, all data have satisfactory reliability (see Table 1). As providing the data on the frequency of participation in sport and physical activities was already difficult for the respondents in the cognitive pretest, these data were excluded from further calculations, as were the data on competition participation in childhood and youth.

#### *Interviewer training and pretest*

The interviewers were trained prior to data collection by the LINK Institute for Market and Social Research, and they received support from full-time supervisors throughout the data collection process. The training focused on enabling the interviewers to provide assistance if respondents were uncertain, as well as to

point out possible inconsistencies in content during the interview. The interviewers were supported in this respect by appropriate interviewer notes in the questionnaire.

The survey institute conducted a pretest of 20 interviews with persons aged 15 to 74 years to test the technical functionality of the questionnaire.

#### *Check for consistency*

The first step after data collection was to check the data for completeness. To do so, we began by examining logical missing values to check the aforementioned links in the questionnaire. Such logical missings appeared only in individual cases, but were then very pronounced. We thus did not consider imputation permissible and excluded these cases. The second step was to test the plausibility of the data via (cross-)comparison of the statements made by the respondents. For example, we analyzed the data respondents provided on the times of the particular LTPA episodes (exit from first active episode to start of second active episode). Furthermore, we checked the content of different items that provide similar information for consistency. For example, we made sure that the age of entry respondents provided for current sport and physical activities did not lie before their general entry to LTPA, or whether respondents with a general entry age of 15 years provided detailed information on LTPA in childhood and youth (e.g., organizational setting, competition participation). This check for consistency led to the exclusion of a total of  $n = 218$  cases with contradictory data.

### **Design and Sample**

This study is part of a project funded by the Swiss National Science Foundation and in collaboration with the federal survey "Sport Schweiz 2020." The study was conducted according to the guidelines of the Declaration of Helsinki and was approved by the Ethics Committee of the University of Teacher Education, University of Applied Sciences and Arts Northwestern

**Table 1**Values of the Krippendorff's alpha for the test–retest reliability ( $n = 29$ ).

Variable	Scale	Krippendorff's alpha	
		Point estimate	Bootstrap 95%–CI <sup>1</sup>
Entering and exiting LTPA in life course			
First entry to LTPA in life course (age)	ratio	.81	.72 – .89
Interruption(s) of LTPA (longer than 1 year) in life course (yes/no)	nominal	.90	.70 – 1.00
Number of interruptions of LTPA in life course	ratio	.88	.67 – 1.00
Timing of interruptions of LTPA in life course (age)	ratio	.98	.94 – 1.00
Information per life stage			
Youth (until 20 years of age)			
Type of activities practiced	nominal	.95	.89 – .99
Frequency: days per week	ratio	.61	.38 – .82
Frequency: hours per week	ratio	.61	.43 – .77
Organizational setting	nominal	.93	.87 – .99
Competition participation	nominal	.73	.46 – 1.00
Young adulthood (21–30 years of age)			
Type of activities practiced	nominal	.93	.87 – .99
Frequency: days per week	ratio	.52	.14 – .82
Frequency: hours per week	ratio	.46	.05 – .78
Organizational setting	nominal	.90	.81 – .97
Competition participation	nominal	.93	.78 – 1.00
Middle adulthood (31+ years of age)			
Type of activities practiced	nominal	.90	.83 – .97
Frequency: days per week	ratio	.45	.01 – .80
Frequency: hours per week	ratio	.42	.02 – .77
Organizational setting	nominal	.81	.69 – .93
Competition participation	nominal	1.00	–

Note: Krippendorff's alpha is similar to Scott's pi for a nominal scale and similar to Pearson et al.'s intra-class–correlation coefficient for an interval scale (see Hayes & Krippendorff, 2007, for further information).

<sup>1</sup>As suggested (Hayes & Krippendorff, 2007), 10,000 bootstrap sampling distributions were performed (CI = confidence interval).

Switzerland (30 January 2019). A retrospective telephone survey with computer-assisted telephone interviews (CATI method) was conducted in 2019. The interviews lasted 25.5 minutes on average.

The random sample was recruited via the Federal Statistical Office ( $n = 569$ ) and with persons from the panel of the survey institute ( $n = 950$ ). The sample consists of 1,456 Swiss inhabitants aged 35–76 years. They were interviewed during 2019 (April–August). The mean age ( $M_{age}$ ) was  $60.5 \pm 10.1$  years, and  $n = 909$  of the study cohort (62.4 %) were women (see Table 2).

In comparison with the population data of the Swiss Federal Statistical Office for the year 2019, the sample contains a somewhat higher number of women and persons with higher education. Persons with a foreign nationality are significantly underrepresented in the sample. In comparison with other national surveys on sport and physical activity behavior in Switzerland (especially Lamprecht et al., 2020; Storni et al., 2019), the sample shows a higher proportion of persons who stated that they participate regularly in LTPA.

## Data analyses

For the description of LTPA over the life course, we first used descriptive methods (frequencies and percentages) and then subjected them to simple inferential statistical analyses (chi-square analysis using cross tabulation). We applied the Kaplan–Meier estimator to calculate the probabilities of entering or exiting LTPA as a function of the duration of episodes.

## Results

LTPA over the life course may be described as cycles of activity and inactivity. For many respondents, an initial episode of LTPI is followed by an episode of LTPA. Only a very small proportion of the respondents (approx. 3%) did not participate in any sport or physical activities for their entire lifespan. Around 25 percent of the respondents exited the first LTPA episode and entered a second episode of LTPI. In contrast, around 73 percent of the respondents stated that they

had always engaged actively in sports. On the whole, LTPA seems to be quite stable over the life course. There are relatively few transitions between LTPA and LTPI (5 entries or exits max.). Dropouts from LTPA occur less frequently across the particular episodes (approx. 20–40 percent of those active) than entries (approx. 80–98 percent of those inactive). In addition, it is striking that the LTPA episodes are maintained several years longer on average than the LTPI episodes. If the trajectory of LTPA shows a certain instability, however, the average duration decreases clearly after the third LTPA episode (see Table 3).

It is possible on the basis of the stability of LTPA to differentiate between several trajectories of LTPA (see Allmer, 2002): persons who are “always active,” who entered a LTPA episode once and have never exited it; persons who are “never active or always inactive,” who have never entered an LTPA episode that lasted over a year; and persons who show an unstable LTPA, meaning that their trajectory is characterized by at least one entry and exit (see Figure 1). As shown in Figure 1, the group of “always active” persons is the largest and the group of “never active” persons the smallest. In addition, the group of “always active” persons can be differentiated on the basis of age of entry to lifelong LTPA: the “always active early starters,” who began their LTPA before the age of 20, and the “always active late starters,” who did not participate in any LTPA before the age of 20 and started only later. Somewhat more than half of the respondents (approx. 59%) may be classified as belonging to the group of “always active early starters” (see Table 4).

The group with “unstable LTPA” is of particular interest for investigating the question of what influence the duration of episodes has on the probability of entries and exits (research question Q2). According to the definition of “unstable LTPA,” all persons in this group have entered and exited at least one sport and physical activity over their life course. Figure 2 makes it clear that the risk of dropout is greater at the start of this first LTPA episode, both in women and in men, but that individual dropouts are also possible after many years of LTPA. The male respondents exit LTPA earlier than



**Table 2**

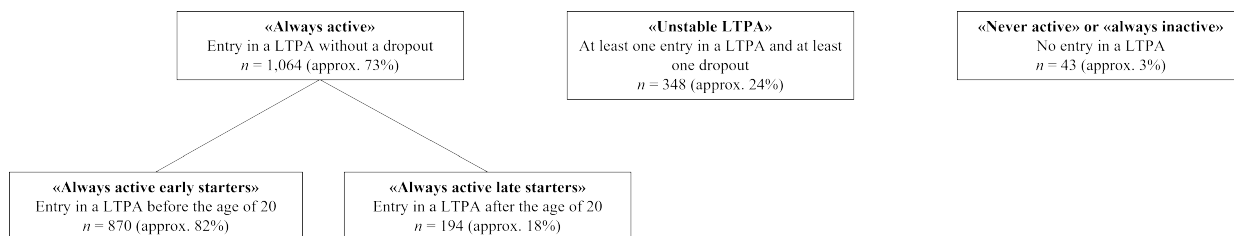
Description of the sample

	<i>n</i>	%
Total	1,456	
Sex		
Female	909	62.4
Male	547	37.6
Level of education		
Vocational training	703	48.3
Higher education entrance qualification & tertiary education	753	51.7
Age groups		
Under 55 years	439	30.2
56 years or older	1,017	69.8
Migration background		
Swiss nationality	1,361	93.5
Foreign nationality	95	6.5
Current LTPA		
Yes	1,362	93.5
No	94	6.5

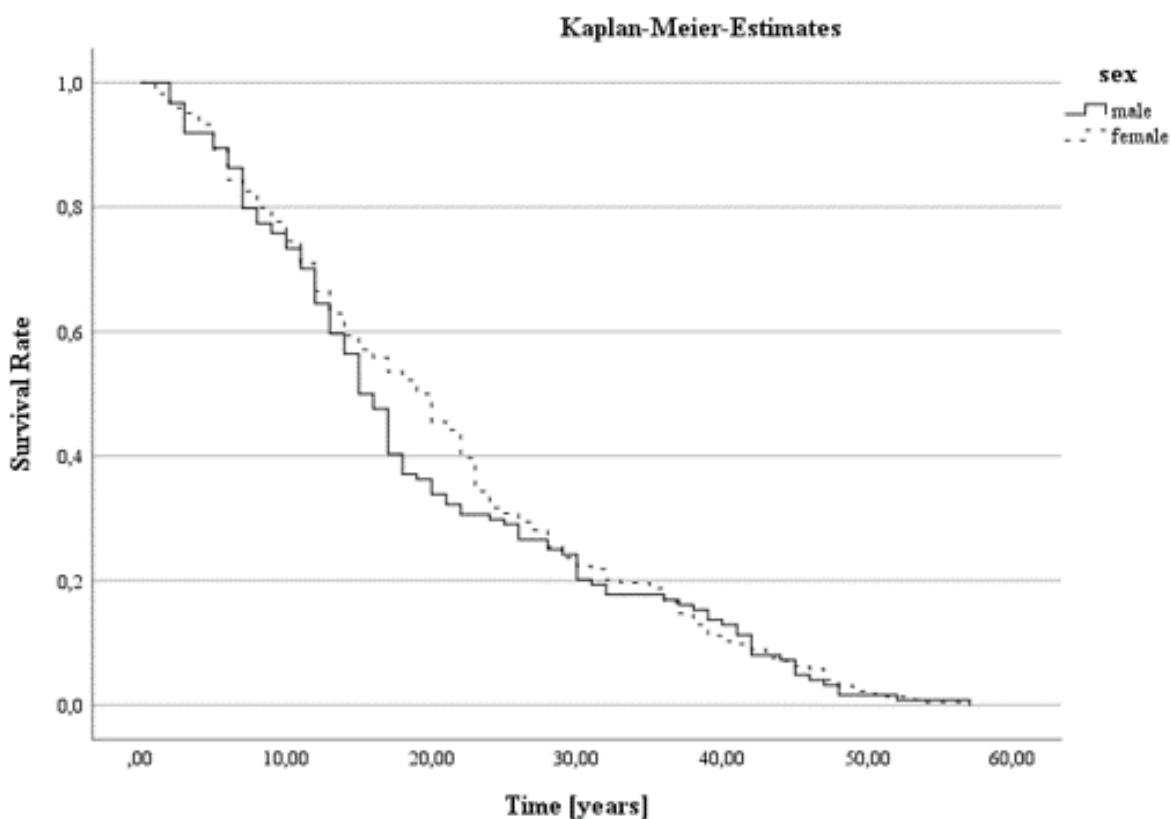
**Table 3**

Episodes of leisure-time physical activity (LTPA) and inactivity (LTPI)

Episodes	Total		Exits		Duration [years]			
	<i>n</i>		<i>n</i>	%	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
1 <sup>st</sup> LTPI episode	1,456		1,413	97.05				
1 <sup>st</sup> LTPA episode	1,413		349	24.70	39.85	17.69	1	71
2 <sup>nd</sup> LTPI episode	349		314	89.97	6.48	8.88	1	53
2 <sup>nd</sup> LTPA episode	314		91	28.98	15.93	13.44	1	61
3 <sup>rd</sup> LTPI episode	91		79	86.81	2.80	3.64	1	27
3 <sup>rd</sup> LTPA episode	79		32	40.51	13.44	10.51	1	42
4 <sup>th</sup> LTPI episode	32		29	90.63	1.84	1.39	1	6
4 <sup>th</sup> LTPA episode	29		6	20.69	6.72	5.30	1	21
5 <sup>th</sup> LTPI episode	6		5	83.33	3.83	6.01	1	16
5 <sup>th</sup> LTPA episode	5		1	20	7	5.20	2	14



**Figure 1** Groups of LTPA trajectories over the life course



**Figure 2** Risk of an exit from the first LTPA episode for the group with unstable LTPA; differentiated by sex ( $n = 348$ ; male:  $n = 124$ ; female:  $n = 224$ ; Kaplan–Meier estimates)

the female respondents: After a duration of around 15 years, 50 percent of male respondents have already exited their first LTPA episode, whereas the median for women is around 19 years.

The phase of inactivity after the first LTPA episode is of relatively short duration ( $M = 6.48$ , see Table 3), and 50 percent of the respondents have already entered a second LTPA episode after around 3 years. Altogether, around 90 percent of the persons with “unstable LTPA” enter a second LTPA episode, from which every third

of them exits again. The respondents exit from the second LTPA episode somewhat faster than from the first one, with 50 percent already having exited it after around 12 years. For the episodes of inactivity in particular, the probability of entering an LTPA episode decreases significantly as episode duration increases. For LTPA episodes, the risk of an exit is somewhat greater at the start of the episode, but the probability of an exit does not decrease as much with increasing episode duration.

On the whole, the influence of socioeconomic factors on the four different life-course trajectories of LTPA may be regarded as low (see Table 4). The proportion of “always active late starters” is significantly lower among the younger respondents than among the older age cohort (adjusted standardized residual: -4.3). The same is true of the men: They too are statistically

underrepresented in the group of “always active late starters” (adjusted standardized residual: -4.4). In the younger age cohort, the proportion of “never active” persons, who have never in their lives participated in an LTPA for longer than one year, is lowest (adjusted standardized residual: -3.4). The younger respondents more frequently show a more unstable LTPA trajectory (adjusted standardized residual: 4.0). If one looks at level of education, one sees that there are slightly fewer persons with higher education among the “always active late starters” (adjusted standardized residual: -3.4). Persons with higher education are more likely to belong to the group of “always active early starters.” A somewhat higher amount of persons with a lower level of education have never entered an LTPA episode in their life course. (see Table 4).

**Table 4**  
Different LTPA and LTPi trajectories differentiated by socioeconomic factors

LTPA trajectories	Total		Age				Sex				Education			
	35 – 55 years		56 – 76 years		Male		Female		Vocational training	Higher ed. entry qual., tertiary ed.				
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%		
			<i>(adj. stand. resid.)<sup>1</sup></i>		<i>(adj. stand. resid.)</i>		<i>(adj. stand. resid.)</i>		<i>(adj. stand. resid.)</i>		<i>(adj. stand. resid.)</i>			
Always active early starters	870	59.8	268	61.0	602	59.2	367	67.1	503	55.3	390	55.5	480	63.7
				0.7		-0.7		4.4		-4.4		-3.2		3.2
Always active late starters	194	13.3	33	7.5	161	15.8	45	8.2	149	16.4	116	16.5	78	10.4
				-4.3		4.3		-4.4		4.4		3.4		-3.4
Unstable LTPA	349	24	135	30.8	214	21.0	124	22.7	225	24.8	163	23.3	186	24.7
				4.0		-4.0		-0.9		0.9		-0.7		0.7
Never active	43	3	3	0.7	40	3.9	11	2.0	32	3.5	34	4.8	9	1.2
				-3.4		3.4		-1.6		1.6		4.1		-4.1
Total	1456	100	439	100.0	1017	100.0	547	100.0	909	100.0	703	100.0	753	100.0
			<sup>2</sup> Ch <sup>2</sup> (3, N = 1456) = 39,108, p < 0,0005, CI = 0,164				<sup>2</sup> Ch <sup>2</sup> (3, N = 1456) = 28,240, p < 0,0005, CI = 0,139				<sup>2</sup> Ch <sup>2</sup> (3, N = 1456) = 31,124 p < 0,0005, CI = 0,146			

<sup>1</sup> An adjusted standardized residual of more than 2.0 (or less than -2.0) can be interpreted as an indication that the number of cases is significantly larger (or smaller) than would be expected if the null hypothesis were true (see Agresti [2002] for further information).

<sup>2</sup> All expected cell frequencies were greater than 5.

In the following, we investigate the sport and physical activity-related history of the respondents. In doing so, we focus on the persons who were active in the long term or throughout their lifetimes to find possible stability factors (see Table 5). For this purpose, we consider LTPA in the three life stages childhood and youth (up to 20 years), young adulthood (up to approx. 30 years), and middle adulthood (from 31 years on).

In childhood and youth, the group of “always active late starters” was by definition not yet active. In comparison to the “always active early starters,” the group with an unstable LTPA trajectory entered LTPA on average several years later. The “always active early starters” perform their sport and physical activities somewhat more frequently in a self-organized manner in childhood and youth than the group with an unstable LTPA trajectory. In young adulthood, the proportion of persons in the groups of “always active early starters” and “unstable LTPA” who participate in organized LTPA decreases. The proportion of self-organized performance increases only slightly in these two groups in young adulthood in comparison to childhood and youth. For the “always active late starters,” who began their LTPA only after the age of 20, the organized performance of their sport and physical activity and competition participation in particular hardly play a role at all in young adulthood. In middle adulthood, self-organized LTPA gains importance across all groups; however, the increase is greatest in the “always active late starters.” The proportion of organized LTPA in middle adulthood remains relatively stable in the groups of “always active early starters” and “unstable LTPA” in comparison to young adulthood, whereas an increase may be seen in the group of “always active late starters.” Competition participation decreases slightly from young to middle adulthood in the “always active early starters” and the group with an “unstable LTPA.” The “always active later starters,” on the other hand, participate less often in competitions in comparison to the other two groups, but the proportion even increases slightly in middle adulthood. The most frequently performed activities both in the individual life stages and across all three groups of LTPA trajec-

tories are walking and endurance activities and the outdoor and mountain activities typical of Switzerland. Sports games play a much smaller role for the “always active late starters,” and they also become increasingly less important for the groups of “always active early starters” and “unstable LTPA,” in particular from childhood and youth to young adulthood. Fitness activities are the third most frequently performed activity in middle adulthood for the “always active late starters” and the group with “unstable LTPA” (see Table 5).

## Discussion

The aim of this article was to describe LTPA trajectories as cycles of activity and inactivity over the life course, and in doing so to shed light on temporal dependencies. Contrary to the research findings available so far, which show a low to moderate stability of LTPA trajectories (Aggio et al., 2017; Beunen et al., 2004; Borgers et al., 2018; Engel & Nagel, 2011; Hirvensalo & Lintunen, 2011; Jekauc et al., 2018; Klostermann & Nagel, 2011; Kristensen et al., 2008; Malina, 2001; Telama, 2009; Trudeau et al., 2004), this study found a high stability. The large majority of the respondents show a long-term LTPA without interruptions over the course of years (research question Q1). This could be attributable, first, to historical changes in LTPA. The representative “Sport Schweiz” studies periodically conducted in Switzerland, for example, show a steady increase in LTPA in the past decades (Lamprecht et al., 2020). If one compares the proportion of sport and physical activities, however, it turns out that the proportion of 93.5 percent found in the present sample is higher than the 80 percent found in the “Sport Schweiz 2020.” This indicates that the sample in the present study is a selective one, with a majority of individuals who engage actively in sports and exercise. Second, the high stability of the individual LTPA trajectories found in the present study could be attributable to the fact that respondents in a retrospective survey tend, in a kind of autobiographical smoothing, to remember their sport and physical activity better than the interruptions (for educational and occupational trajectories

**Table 5**

Characteristics of sport- and physical activity-related history differentiated by the groups of LTPA trajectories

	<b>Always active early starters (n = 870)</b>	<b>Always active late starters (n = 194)</b>	<b>Unstable LTPA (n = 349)</b>
<b>Age of entry into LTPA</b>			
<i>Mean (SD)</i>	10.40 (4.84)	35.37 (12.36)	13.28 (9.21)
<i>Min</i>	3	21	3
<i>Max</i>	20	71	55
<b>Life stage of childhood/youth</b>			
LTPA (n; %)	870 (100%)	-	312 (89.4%)
Sport and physical activities (n; %)	1. Walking and endurance activities (n = 618; 71%) 2. Outdoor and mountain activities (n = 519; 59.7%) 3. Sports games (n = 320; 36.8%)	-	1. Walking and endurance activities (n = 195; 55.9%) 2. Outdoor and mountain activities (n = 164; 47%) 3. Sports games (n = 123; 35.2%)
Organizational setting		-	
Organized (n; %)	626 (72%)	-	249 (71.3%)
Self-organized (informal [n; %])	595 (68.4%)	-	176 (50.4%)
<b>Life stage of young adulthood</b>			
LTPA (n; %)	870 (100%)	118 (60.8%)	313 (89.7%)
Sport and physical activities	1. Walking and endurance activities (n = 594; 68.3%) 2. Outdoor and mountain activities (n = 470; 54%) 3. Sports games (n = 213; 24.5%)	1. Walking and endurance activities (n = 80; 41.2%) 2. Outdoor and mountain activities (n = 60; 30.9%) 3. Gymnastics and multi-sport activities (n = 25; 12.9%)	1. Walking and endurance activities (n = 192; 55%) 2. Outdoor and mountain activities (n = 137; 39.3%) 3. Sports games (n = 73; 20.9%)
Organizational setting			
Organized (n; %)	445 (51.1%)	46 (23.7%)	167 (47.9%)
Self-organized (informal [n; %])	627 (72.1%)	96 (49.5%)	194 (55.6%)
Competition participants (n; %)	292 (33.6%)	18 (9.3%)	79 (22.6%)
<b>Life stage of middle adulthood</b>			
LTPA (n; %)	870 (100%)	194 (100%)	332 (95.1%)
Sport and physical activities	1. Walking and endurance activities (n = 739; 84.9%)	1. Walking and endurance activities (n = 160; 82.5%) 2. Outdoor and mountain activities (n = 116; 59.8%)	1. Walking and endurance activities (n = 276; 79.1%)

	<b>Always active early starters (<i>n</i> = 870)</b>	<b>Always active late starters (<i>n</i> = 194)</b>	<b>Unstable LTPA (<i>n</i> = 349)</b>
	2. Outdoor and mountain activities ( <i>n</i> = 570; 65.5%) 3. Sports games ( <i>n</i> = 197; 22.6%)	3. Fitness ( <i>n</i> = 60; 30.9%)	2. Outdoor and mountain activities ( <i>n</i> = 197; 56.4%) 3. Fitness ( <i>n</i> = 93; 26.6%)
Organizational setting			
Organized ( <i>n</i> ; %)	424 (48.7%)	80 (41.2%)	165 (47.3%)
Self-organized (informal [ <i>n</i> ; %])	770 (88.5%)	170 (87.6%)	277 (79.4%)
Competition participants ( <i>n</i> ; %)	216 (24.8%)	22 (11.3%)	62 (17.8%)

cf. Matthes et al., 2007). Nevertheless, there are also several LTPA trajectories in the sample with multiple entries and exits. This shows, as in Engel & Nagel (2011), that the probability of an event occurring, in particular the chance of a (re)entry, decreases with increasing duration of the episode (research question Q2). The probability of an exit during the LTPA episodes does not decrease as much, and there is still a risk of exit even after many years of LTPA.

In accordance with our theoretical framework, the life course research approach (Bernardi et al., 2019; Mayer, 1990, 2009), we analyzed sport and physical activity-related history to determine possible advantageous conditions for long-term LTPA over the life course (research question Q3). The present state of research indicates that both the particular sport and physical activities and the organizational setting have an influence on the stability of LTPA over the life course (e.g., Klostermann & Nagel, 2011; Telama, 2009). In the present study, however, we found only slight differences when comparing the LTPA trajectory groups of “always active early starters and late starters” and “unstable LTPA.” The “always active early starters,” who maintain LTPA longest, enter slightly earlier on average and show a slightly higher proportion of self-organized performance even in childhood and youth. Self-organization in particular could be interpreted as a possible success factor for long-term LTPA, as this organizational practice becomes increasingly important in the

later stages of life (e.g., Eime et al., 2015, 2020), and it could therefore be advantageous to have gained experience with it at an early age (e.g., Lunn, 2010; Telama, 2009).

The influence of socioeconomic factors on LTPA has been widely documented in cross-sectional studies (e.g., Lamprecht et al., 2020; Rohrer & Haller, 2015) as well as in several longitudinal studies (e.g., Hirvensalo & Lintunen, 2011). We also included several socioeconomic variables in the analysis of long-term LTPA trajectories in the present study (research question Q4). As already demonstrated by Breuer (2003), women tend to enter LTPA at a later point and maintain it over the course of several years. In the present study, too, women are also statistically overrepresented in the group of “always active late starters.” In addition, although the younger age cohort of 35- to 55-year-old persons seems to have done a good job overall entering LTPA episodes, since they are hardly represented at all in the “never active” group, they are at the same time represented in a higher proportion in the “unstable LTPA” group. Time-series studies, as well as initial longitudinal studies on LTPA, also point to historical changes in LTPA (e.g., Klostermann & Nagel, 2014; Lamprecht et al., 2020): Younger age cohorts engage more frequently in sport and physical activity

ties, and the somewhat more unstable trajectories of the younger age cohorts could also be explained by the flexibilization of the entire life course in society as a whole.

## Limitations and prospects

The findings of the present study should nevertheless be interpreted with caution in view of several limitations. We made various efforts (e.g., by making reference to the established and recognized Sport Schweiz 2020 study and by recruiting the sample using data from the Swiss Federal Statistical Office) to recruit a representative sample. This is a methodological challenge for many population surveys, and attempts to overcome it in the past years have not yet been successful in all respects. This limitation should be taken into account, but analyses of possible advantageous conditions of long-term or lifelong LTPA are also possible with a somewhat selective sample. However, future empirical studies should make further efforts in this direction, such as compensation for participation (e.g., Berger, 2006; Pforr & Rammstedt, 2016) or a mix of methods (e.g., not only the CATI method but also face-to-face interviews), to also obtain findings about the group of persons who engage in little to no LTPA.

The present study undertook several measures to further develop and check retrospective data collection of lifetime LTPA trajectories. We succeeded in supporting the recall of the respondents through the methods applied, and the data appear to be reliable. However, future studies could implement further recall aids, particularly visual aids (e.g., event history calendar), or further individualize the questionnaires by means of innovative questionnaire programming.

The focus of the present study is on the description of trajectories of LTPA over the entire life course. It is like a wide-angle view: you can see the entire life, but you cannot observe the details. As Bernardi et al. (2019, p. 4) state, “the longer lives are studied, the more difficult it becomes to trace connections [...]. It is hard to know which variables are important, when they are important [...]”. There is still demand for research examin-

ing theoretically as well as empirically the temporal causality of LTPA during the life course. More specific theories related to the causality behind the observable LTPA behavior of human beings are still needed (e.g., resource-related explanatory approaches).

Due to the quantitative nature of the present study, it aimed in particular at portraying LTPA trajectories maintained in the long term. For the task of analyzing the temporal dependencies of LTPA over the life course in detail, the additional step of conducting qualitative analyses of theoretically selected cases would appear conducive to further insights (e.g., with a biographical approach). Quantitative surveys are only of limited use for measuring complex temporal dependencies across various time dimensions.

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## Competing interests

The authors have declared that no competing interests exist.

### **Data availability statement**

Datasets will be available at SWISSUbase upon acceptance of the manuscript.

## **A Appendix: Extract of the questionnaire (CATI-Survey)**

Wording and response categories of questions regarding current and previous sport and physical activity.

### **A.1 Part A: Current sport and physical activity**

Question A1: Do you practice sport?

Sport in this context means any kind of sport, gymnastics, or fitness activities.

Response categories: yes, no

Question A1.1: If "yes": How often do you practice?

Response categories: (almost) daily, several times a week, about once a week, once to three times a month, less than once a month, never

Question A1.2: If "at least once to three times a month": How many hours per week approximately?

Response categories: hours per week

Question A2: Which sport and physical activity do you practice?

Open response; max. 10 different sport and physical activities

For each mentioned sport and physical activity following questions were asked:

Question A2.1: How many days per year do you practice sport or physical activity X?

Response categories: days per year

Question A2.2: How many hours per training day do you practice the sport or physical activity X on average?

Response categories: hours per day

Question A2.3: How is the sport or physical activity X organized?

Response categories (multiple responses): organized in a sport club, organized in a fitness center, organized by the school, organized by another private sport provider (e.g., Dance studio), organized and led sports facilities (e.g., fixed walking or running groups), self-organized and unled

Question A2.4: Since when do you practice the sport or physical activity X?

Response categories: year of age or calendar year

### **A.2 Part B: Previous sport and physical activity**

Sport and physical activity in childhood and youth (i. e. until the age of 20 years)

If respondent have mentioned sports and physical activity with the beginning during childhood and youth previously: You have mentioned already that you practiced following sport and physical activity in childhood and youth... (A list of all sport and physical activities already mentioned in the interview that were entered at the particular life stage and practiced regularly (= at least once a week) were automatically transferred).

Question B1: Did you practice regularly (i.e., at least once a week) further sport and physical activities in childhood and youth?

Response categories: yes or no

Question B1.1: If yes: which further sport and physical activities did you practice during your childhood and youth?

Open response: max. 5 different sport and physical activities

If respondent have not mentioned sports and physical activity with the beginning during childhood and youth previously:

Question B2: Did you practice sport and physical activities regularly (i.e., at least once a week) in childhood and youth (i.e., until the age of 20 years)?

Response categories: yes or no

Question B2.1: If yes: which activities?

Open response: max. 5 different sport and physical activities

Question B3: How many days per week did you practice all the mentioned activities on average during childhood and youth?

Response categories: days per week

Question B4: How many hours per week did practice all the mentioned activities on average during childhood and youth?

Response categories: hours per week

Question B5: How were the mentioned activities organized?

Response categories (multiple responses): organized in a sport club, organized in a fitness center, organized by the school, organized by another private sport provider (e.g., Dance studio), organized and led sports facilities (e.g., fixed walking or running groups), self-organized and unled

Question B6: Did you compete during the childhood and youth?

Response categories: yes or no

The same questions were asked for the period “young adulthood” (i. e. between the age of 20 and 30 years) and the period “middle adulthood” (i.e. after the age of 30 years).

### **A.3 Part C: Interruption of the sport and physical activities**

Question C1: How old were you when you have started practicing regularly sport and physical activities?

Response categories: year of age or calendar year

Question C2: Did you ever interrupt your sport and physical activity longer than one year?

Response categories: yes or no

Question C2.1: If yes: How many interruptions of your sport and physical activity (longer than one year) can you remember?

Response categories: 1 interruption, 2 interruptions, 3 interruptions, 4 interruptions, 5 interruptions or more

Question C2.2: For each interruption (max. 5): when started the interruption and when ended it?

Response categories: year of age or calendar year