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Promoting Sport for All to Age-specific Target Groups: the Impact of Sport Infrastructure

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ABSTRACT Sport management should contribute to making sport accessible for people of all ages. Therefore, sport management research must analyse the impact of different managerial opportunities. A special focus lies on the effects of infrastructural conditions. In this paper, the impact of sport infrastructure on sport participation has been analysed using data from a population survey in the city of Stuttgart, which are related to infrastructural data. The results show that the availability of sport infrastructure, regardless of individual socio-economic conditions, influences patterns of sport activity significantly. However, the influence of certain types of sport infrastructure varies between age groups. For example, the availability of swimming pools is important during childhood and adolescence, whereas the availability of fitness centres, gymnasias and sports fields is of greater importance in young adulthood. These findings have significance for the ways in which sport managers can influence patterns of lifelong sports activity.

Following Zeigler (2007, p. 304), one of the main tasks of a sport manager is to plan and evaluate “programs of sport for people of all ages, be they normal, accelerated, or special populations”. Consequently, sport management research has to analyse how this task can be optimised. A key question is how sport for all can be promoted to age-specific target groups. The perpetuation of sport activity throughout the course of life is argued to be one of the most important goals from a sports or health care policy perspective. Consequently, there are a wide range of research activities in sport management and related disciplines concerning the sport activity of

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age-specific target groups. A majority of these papers, however, focuses solely on individual socio-economic factors (e.g. Farrell & Shields, 2002; Stamm & Lamprecht, 2005). States, municipalities and other actors who are trying to promote sport for all to age-specific target groups are limited in how they may base their initiatives on socio-economic factors, because they can hardly influence them and, in most cases, they are trying to support sport activity by providing an adequate sport infrastructure. For example, in Germany, public authorities invest around €3 billion a year in sport facilities. In spite of this economically very significant approach, it is still unclear to what extent sport infrastructure influences sport activity throughout the course of life and, thus, the sport activity of different age groups.

This paper's objective is to investigate further the influence of infrastructural resources on the sport activity of *different age groups* (instead of sport activity *throughout the course of life*) because there is only cross-sectional data available. The paper is divided into five parts: (1) a discussion of the state of research; (2) subsequently, a theoretical model will be presented; (3) as a third step, the methodical approach will be described; (4) results will be presented and interpreted; (5) and, finally, implications for public sport management conclude the paper.

State of Research

While the influence of individual factors on sport participation can be described now as well investigated (e.g. Farrell & Shields, 2002; Stamm & Lamprecht, 2005; Stratton, Conn, Liaw, & Conolly, 2005; Breuer, 2006; Lera-López & Rapún-Gárate, 2007), the state of research regarding the influence of sport infrastructure on sport activity of different age groups is incomplete. Findings with respect to sport infrastructure suggest that a (perceived) lack of adequate sport infrastructure is one important barrier to sport participation. Hence, the distance to the sport facility is of great importance. Other barriers, such as lack of interest, time or money, poor health or exhaustion after work are typically mentioned as well in surveys concerning why people do not engage in sport (e.g. Slep & Duffy, 1982; Bodenmann, Ackermann-Liebrich, Ehrensam, & Marti, 1990; Hirvensalo, Lampinen, & Rantanen, 1998; Sallis & Owen, 1999). Sporting infrastructure is important because an adequate infrastructure is needed to practise virtually any sport. In particular, in order to exercise indoor, sports gymnasiums are needed. It is even argued that people prefer jogging in green areas rather than jogging through the streets of the city. Thus, green areas can also be seen as a part of a sport infrastructure.

Regarding the influence of infrastructure on sport activity, it should be emphasised that even the wide-ranging research efforts in behaviour-orientated strategies of sport development have not led to definitive conclusions. This is due to a lack of analytic approaches that focus on cause-effect relationships and correlations. This, in turn, can be traced back to the fact that the theoretical foundation of behaviour-orientated strategies

of sport development—in spite of numerous applications—is still in its early stages. One of the few German and, indeed, European investigations seeking to shed light on the importance of infrastructure for sport activity, is the MAREPS-study (Rütten, Lüschen, von Lengerke, Abel, Kannas, Diaz, Vinck, & van der Zee, 2000). This study analyses health behaviour and its determinants for inhabitants ($n=3,343$) of seven European states on the basis of Wright's (1974, 1977) theory of action. According to Wright, actions, skills, desires, obligations and situational eventualities influence the intentions of an individual and consequently his/her sport activity. As for sport participation, bivariate analyses show that physically active people assess the sport opportunities in their neighbourhood significantly better than physically inactive people. Especially for female sport activity, the availability of sport facilities seems to be of high significance. However, multivariate data analyses show no significant influence of infrastructure (Rütten et al., 2000). Thus, the bivariate results could be traced back to correlations with intervening variables at the individual level. Nevertheless, the factors of age, income and education, it is suggested, influence sport participation, as well as the assessment of sport availability. While the study of Rütten et al. (2000) revealed important details, it eliminated the lifelong perspective because of other research objectives. However, international studies seem to provide additional information regarding the influence of infrastructure on sport participation of different age groups. Although any comparisons between age groups have not been realised yet, the synopsis of diverse investigations and populations reveals the following picture. For children, there is a positive correlation between physical activity and the way they feel about the availability of sport facilities (for an overview, see Sallis, Prochaska, & Taylor, 2000). As for adolescents, there is a positive correlation between physical activity and the perceived exercise and training possibilities (for an overview, see Sallis et al., 2000). Regarding adults, the perceived local infrastructure seems to have a positive influence on an active lifestyle (for an overview, see Seefeldt, Malina, & Clark, 2002). The sport activity of seniors correlates positively with the perceived availability of near-natural sport environments, swimming pools and classical sport facilities, such as tennis courts (e.g. Chad, Reeder, Harrison, Ashworth, Shephard, Schultz, Bruner, Fisher, & Lawson, 2005). In addition, there are many studies dealing with sport development planning in various cities. Within these studies, sport infrastructure is measured objectively (e.g. Kirschbaum, 2003; Wetterich & Schrader, 2007), but data concerning people's sport participation and data concerning sport infrastructure are not connected in terms of statistical analysis. Usually, the data sets are analysed only in isolation or a method of 'balancing' is applied. Summing up, the influence of sport infrastructure on age-related sport activity is still an important topic, which has not been investigated adequately to date, in scientific (e.g. Chad et al., 2005; Sallis et al., 2000) or in practical policy terms (Gratton, Shibli, & Coleman, 2005).

The existing research can be criticised on a number of grounds. (1) The designs of the investigations are problematic. There are few investigations

that measure infrastructure objectively (for an overview, see McCormack, Giles-Corti, Lange, Smith, Martin, & Pikora, 2004). Instead, subjective estimations regarding an adequate infrastructure have been used as a basis for data. Thus, selective perceptions of infrastructure cannot be excluded, and persons with an affinity for sport could perceive their sport-related environment differently (as a rule, more positively). With sport activity being socially desirable, inactive people may blame the lack of infrastructure for their inactiveness, without this being the case from an objective point of view. Consequently, inactive people may subjectively perceive a worse infrastructure. In this case, the perception of sport infrastructure would affect sport participation. (2) Since most of the investigations have an epidemiological origin, not an origin in the fields of sport sociology or sport economics, the data on infrastructure on sport facilities is often considered only in undifferentiated form. Often, people were interrogated about general concepts such as *exercise opportunities*. Results on this undifferentiated level, however, cannot generate profound knowledge for the sport management of public authorities. (3) In many cases there is a lack of multivariate analyses. As a consequence, pseudo-correlations or pseudo-effects cannot be detected fully and may result in false conclusions being drawn, particularly since the correlations between individual factors and environmental factors, as well as sport activity, are extremely complex.

These problems can be solved only with the help of multivariate hierarchical linear approaches, in which the data for individuals is combined with differentiated and objective data on sport infrastructure. Other research areas already benefit from hierarchical linear models, for instance, sport psychology (Tate, Tenenbaum, & Delpish, 2006), sport economics (Todd, Crook, & Barilla, 2005) and behavioural research (Kulinna, 2000). None the less, there is still a research gap in the field of sports development planning.

Theoretical Model

Different behaviour models are available to serve as a theoretical foundation concerning the influence of infrastructural resources on the sport activity of different age groups: most notably from the disciplines of sociology and economics. The strength of the sociological approach is the explanation of existing standards. In contrast, the strength of the economics approach lies in the explanation for the alteration of human behaviour (Frey, 1990).

This investigation adopts the economics approach and, therefore, an 'individual' perspective for seven reasons. (1) The investigation's primary target is the analysis of changes in human behaviour; after all, the question is how sport activity of different age groups can be supported by the supply of infrastructure. (2) Human behaviour change preferably refers to observable and measurable changes in action rather than to changed preferences. Economic and infrastructural changes present such operational measures of change. (3) The economics model has the merit of simplicity, not requiring many variables. (4) An explanation for changed sport participation because

of changed preferences could be supported only if data of sport relevant preferences were collected continuously. This is not the case in Germany. In other countries (Switzerland, Flanders, the Netherlands and the UK) the situation is slightly better. (5) Additionally, the few sociological structural models that have been empirically tested and serve as an explanation for sport participation have tended to show a dominant influence of classical variables, which can themselves be interpreted as economic values at the same time (income, education). (6) A prediction of the effects based on the concept of changed preferences would also not be suitable in practice, because the change of preferences and values can hardly be explained, predicted or created. As the sociological focus deals with individual preferences it is difficult to give political advice based on this approach. In contrast, economic and infrastructural measures of change can be created comparatively easier in the majority of cases (infrastructure through new sport facilities, income through raises and pension adjustments, labour time through work-hour reduction or addition) and are perhaps intuitively clearer. (7) Findings from models based on methodological individualism can also be analysed on an aggregate level, while the converse could lead to ecological false conclusions.

The theoretical model for this analysis is based on economic behaviour theory (e.g. Becker, 1993, 1996; Frey, 1999), which broadens the applicability of economic choices in the non-market area in the context of household production theory. According to this, even sub-segment or non-market-orientated choices, such as sport participation, are subject to monetary and time restrictions. Thus, in addition to income, the economic situation of an individual is also determined by the availability of time. As a consequence, money and time enhance the opportunities of an individual's sport activity. Thereby, time and income might present substitutes in most cases. The opportunity costs of non-working time increase with an increasing income, which is why time might be increasingly substituted by money whenever a raise in salary takes place. As a consequence, time-saving but rather expensive leisure activities are purchased in this kind of situation. In contrast, money is increasingly substituted by time when salary decreases. In this case, inexpensive but time-consuming leisure activities are purchased. In addition to income and time, the economic situation is determined by a third dimension, human capital. Human capital (education, sport knowledge) influences the productivity of time as well as market goods, which are used for sport activity. As a result, higher sport competencies, which have been acquired through long-term physical education (higher school education), broaden the possibilities for sport participation under monetary and time restrictions. Thus, it can be concluded that human capital influences the efficiency of the respective household production.

The core of this model based on household theory is expanded by theoretical factors concerning demand, which have also to be taken into account in order to explain the sport activity of different age groups. These factors can serve as additional restrictions in an expanded household theoretical model of sport participation. This should apply to age, gender

and migration background. Thus, the demand for sport could also be subject to restrictions of the body, as perhaps reflected in a person's age, since individual health usually deteriorates with increasing age. As to the construct of social capital (Becker, 1996), the benefit of the consumption of certain goods depends on the prestige of the goods in their social environment.¹ Consequently, the question arises as to whether different cultures have an effect on sport participation. Following sport sociology literature, ethnic differences may be detected in this context (e.g. Bröskamp, 1994). According to Frey (1999), ethnically determined ipsative possibilities also have to be taken into consideration, which influence the sport activity of different age groups or even have a restrictive effect on it. Ipsative possibilities are those possibilities that persons consider important but are forbidden because of the person's social surroundings (i.e. a person would like to participate, but is not able to do so).

Moreover, it has to be considered that ipsative possibilities may be differentiated with respect to gender. For instance, the social valuation of sport activity can vary between men and women, especially in interaction with ethnic and religious variables.

In addition to the factors at an individual level (micro-level), factors on the macro-level, like the availability of sport infrastructure, may influence sport participation. After all, space is a sports-related scarcity parameter *par excellence* (Heinemann, 1998; Büch, 2005). At this point, a distinction has to be made between different types of sport infrastructure. Sport infrastructure implies sports programmes (clubs' programmes, sports courses), sport facilities (gymnasiums, sports fields, tennis courts, swimming pools, fitness centres, public playgrounds) and other sport infrastructure (forest and recreational areas). In Germany, 90,000 non-profit sport clubs offer all kinds of sports programmes. In addition to the non-profit sector, for-profit organisations offer sports courses as well. Fitness centres are largely commercial fitness centres, i.e. for-profit organisations. In Germany, there are virtually no public fitness centres. With regard to public playground areas, it should be noted that usually small sports fields are part of a playground. As already suggested, other sport infrastructural elements can be important for people who undertake self-organised sports, e.g. jogging or mountain biking.

Method

Data Source and Treatment

The influence of infrastructure on the sports activities of different age groups was examined in Stuttgart² in the year 2007. Within this project, data both at the micro-level (individual) and at the macro-level (infrastructure) were collected. The micro-level data concerning the sport participation of the inhabitants of the city of Stuttgart were obtained by means of a computer-assisted telephone interview (CATI). The random sample is based on the last-birthday approach described by Gabler and Häder (1999). Altogether,

3,026 interviews were carried out, in which parents also answered questions regarding the sport activity of their children, so that 699 cases of 3–17-year-old children were added ($n=3,725$). People were asked whether they engage in sports and, where this was the case, several questions concerning type of sport, frequency, duration, organisation etc. followed. Moreover, several personal factors, such as income, level of education, number of hours per week spent at work or caring for relatives, gender and age, were ascertained. For school pupils, the weekly work time was replaced by school time according to their age (6–10 years: 20 hours; 11–14 years: 25 hours; 15–17 years: 30 hours). In the case of children, their level of education was deemed to be that of their parents. Apart from that, time caring for children or relatives was not put into the models for 3–17-year-old persons. Further analyses (regression analyses, hierarchical linear models) require complete cases concerning the relevant variables. Therefore, only a reduced number of cases could be used ($n=2,054$) because of missing values (especially concerning income). As the proportion of foreigners in the sample was only 10.2%, different nationalities could not be taken into account because of a lack of cases. Table 1 shows the operationalisation of the factors of the theoretical model.

In addition to this telephone survey, another survey regarding the available sport infrastructure was carried out in all 23 urban districts of Stuttgart. In this case, sport infrastructure incorporated sports programmes (clubs' programmes, sports courses), sport facilities (gymnasias, sports fields, tennis courts, swimming pools, fitness centres), and other sport infrastructure (public playground area, forest area and recreational area). These macro-level data on sport infrastructure were obtained by means of the analysis of secondary data (see Table 2). Table 2 shows that the city of Stuttgart already has a good sport infrastructure, but this varies between urban districts. Indeed, it is evident that some urban districts have no supply of some types of infrastructure. For example, in downtown Stuttgart, there are no sports fields, tennis courts, swimming pools, and forests, whereas some *rural* urban districts have no fitness centres.

Statistical Analyses

Hierarchical linear models are generally deemed to be an adequate procedure for testing the influence of factors of different levels on a dependent variable (e.g. Bryk & Raudenbush, 1992). Here, a regression model (sub-model), as well as an interdependent regression model, was calculated at every level in order to identify relations that remain undetected with regular regression analyses (Raudenbush, Bryk, Cheong, Congdon, & Du Toit, 2004). Within this procedure, individual false conclusions are minimised and relations that remain undetected in normal regression analyses can be revealed (Todd et al., 2005). Therefore, at first, hierarchical linear models were carried out for regular sporting activity, personal factors (Table 1) and urban district factors (Table 2, but values per person) of the theoretical model. Strictly speaking, if the dependent variable is a dummy, hierarchical *non*-linear models are

Table 1. Operationalisation of the variables

Variable	Operationalisation	Scale
Dependent variable		
Demand for sports	Regular sport activity (1 = at least once per week)	Dummy
Personal factors (micro-level)		
Personal income	Household net income (Euros per month)/ number of persons in the household	Metric
Time	a) Work time resp. school time (hours per week)	a) Metric
	b) Time for care of children/relatives (hours per week)	b) Metric
Human capital	Level of education (1 = A-levels and higher)	Dummy
Age	Age (years)	Metric
Nationality	1 = German, 0 = other nationality	Dummy
Gender	1 = Female	Dummy
Factors of urban districts (macro-level)		
Bad supply of gymnasia, sports fields, public playgrounds	1 = Area counts to the least supplied 20% of urban districts regarding: gymnasium area per person + sports field area per person + public playground area per person (m ²)	Dummy
Bad supply of swimming pools	1 = Area counts to the least supplied 20% of urban districts regarding: water area in swimming pools per person (m ²)	Dummy
Bad supply of fitness centres	1 = Area counts to the least supplied 20% of urban districts regarding: number of fitness centres per person	Dummy
Bad supply of forest area	1 = Area counts to the least supplied 20% of urban districts regarding: forest area per person (hectares)	Dummy

estimated. In short, these models were calculated for age-specific target groups and for the whole sample (Table 3; only two age-specific models are presented). Although the models reveal interesting results, the models' fit is relatively poor for different reasons. Admittedly, the application of hierarchical linear models requires specific conditions. Thus, 50 cases are regarded as important at the macro-level in order to secure a stable application of the hierarchical linear model. However, Stuttgart consists of only 23 urban districts and, consequently, this number cannot be changed. Another reason is that the number of factors at the macro-level was too high and had to be reduced. Thirdly, problems of multi-collinearity appear, which may confound conclusions. In order to avoid these problems, the relations between macro-variables were investigated applying correlation analyses.

Table 2. Sport infrastructure in the city of Stuttgart

Type of sport infrastructure	Sport infrastructure per 1,000 inhabitants		
	Stuttgart (Total)	Minimum (least supplied urban district)	Maximum (best supplied urban district)
Clubs' programmes	4.9474	1.3274	15.7813
Sports courses	2.4070	0.6169	5.6832
Gymnasia (m ²)	165.3579	78.6726	439.5313
Sports fields (m ²)	1,473.8823	0.0000	8,311.4565
Tennis courts	0.8361	0.0000	4.0420
Swimming pools (water area in m ²)	29.9174	0.0000	206.0790
Public playground area (m ²)	1,406.2693	417.7253	20,034.7059
Fitness centres	0.0963	0.0000	0.5310
Recreational area (ha)	1.9227	0.3733	5.9531
Forest area (ha)	8.3879	0.0000	25.3344

For high correlations ($r > 0.7$), variables were transformed into new independent variables. The highly correlated variables gymnasium area per person, sports field area per person, and public playground area per person were thus transformed into a new factor. Moreover, several factors were deleted from the model. The factors clubs' programmes and sports courses were deleted because of their high correlation with gymnasia and sports fields. Usually, sports courses and clubs' programmes depend on gymnasia and sports fields. The factor recreational area was also deleted because of high correlations with these factors, while tennis courts were deleted because they were too sport specific. With this procedure, the number of factors was reduced to four. Unfortunately, the models' fit was still poor because the supply of sports facilities is quite homogeneous in Stuttgart. Therefore, extreme values were used—a dummy variable was given the value one if the urban district was in the lowest 20% in terms of sport supply (Table 1). These relative values were chosen in order to make comparisons between the urban districts possible. Absolute values would be problematic, because they would not take the specific sport participation of the inhabitants of the city of Stuttgart into account, which was a major problem in sports development planning. Moreover, since 50.9% of the inhabitants did not undertake their sport in their urban district, the values of the macro-level factors were weighted according to their bordering urban districts. Thus, the values from the urban districts where the persons lived and the bordering urban districts were weighted. The value of the bordering urban districts was estimated as follows: the sum of the values from the bordering urban districts was divided by the number of bordering urban districts. The values were then divided by the number of inhabitants in the urban district, which led to the respective operational figures per person (Table 1).

In the light of problems with hierarchical models, a modified strategy was applied. At first, classical logistic regression analyses with the dependent dichotomous variable *regular sport activity* and the independent micro-level

Table 3. Hierarchical non-linear models for regular sport activity (coefficients are displayed)

Age-specific target group (years)	3–18	29–35	Total
<i>n</i>	337	325	2,054
Personal factors			
Personal income	0.000	0.000	0.000****
Work resp. school time	0.043	0.008	–0.000
Time for the care of children/relatives		–0.005	–0.002****
Human capital	0.506	0.613**	0.098****
Age	–0.091*	–0.003	–0.002**
Gender	–0.583**	–0.314	–0.037*
Nationality	0.824***	0.438	0.125****
Factors of urban districts (per person)			
Clubs' programmes	–25.505	401.230***	26.044**
Sports courses	105.558	–364.884**	–26.669**
Gymnasiums (m ²)	1.771	–11.129**	–0.625**
Sports fields (m ²)	0.009	–0.070	–0.010
Tennis courts	–21.070	–25.016	–0.733
Swimming pools (water area in m ²)	5.010**	0.672	0.191
Public playground area (m ²)	0.357**	0.019	0.008***
Fitness centres	1,806.266	2,370.005***	141.543*
Recreational area (ha)	–209.061**	100.462	2.230
Forest area (ha)	–16.292	–2.018	0.417
R ²	0.5 n.s.	0.4 n.s.	14.5 n.s.

Note: levels of significance are * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$.

and macro-level variables were applied, as they seemed to be more stable at the macro-level. They served as test processes. Afterwards, in case of significant influences at the macro-level, additional hierarchical linear models were applied in order to preclude false conclusions. Findings regarding the influence of infrastructure on sport participation of different age groups were assessed only on reliability if they were confirmed by the hierarchical (non-) linear model.

Results

The results from the original hierarchical non-linear models for regular sport activity are presented in Table 3. The models indicate that, apart from typical personal factors, various types of infrastructure have an influence on regular sport activity. Concerning the total population of Stuttgart, clubs' programmes, public playground area and the number of fitness centres, in particular, have a significant positive influence on regular sport activity. The confounding effects already mentioned in terms of multi-collinearity were avoided in further models. A closer look at age-specific target-groups shows that, for 3–17-year-old persons in particular, the supply of swimming pools and public playground areas plays a central role. In contrast, recreational

areas seem to have a negative influence on the regular sport activity of young people. Regarding 29–35-year-old persons, fitness centres were especially important for their sport activity. It is very evident that all personal factors (except work/school time) significantly affect regular sport activity on the total level. Regarding age-specific target groups, the number of significant factors is significantly lower. Hence, 3–17-year-olds' regular sport activity is influenced only by age, gender, and nationality. Obviously, younger German boys are more likely to engage in sports. In contrast, in relation to the 29–35-year olds, only human capital plays a significant role.

Because of the problems cited with hierarchical linear models, our focus lies with the models presented in Table 4. As the coefficients of determination show, the models explain between 11.5% and 18.8% of the variation in the regular sport activity of different age groups. The displayed odds ratios show the effect size of the factors, according to the beta-coefficients in an ordinary linear regression model. Moreover, they give information about the effect direction (odds ratio >1 means positive effect, odds ratio <1 means negative effect). In relation to personal factors, the results show that regular sport activity especially depends on human capital, nationality, gender, time for child care, care of relatives and personal income. As a consequence, the likelihood of a person being physically active is highest if the individual is young, male, well-educated, German, has a high income and spends little time caring for children or relatives. In terms of the theoretical model, the assumed influence of the new household theory is confirmed. Apart from these individual factors, the supply of sport infrastructure is important. Here, poor supply of gymnasias, sports fields and public playgrounds, as well as fitness centres, influences regular sport activity negatively ($p < 0.1$). The influence of the scarcity of space regarding the supply of gymnasias, sports fields, public playgrounds and fitness centres is confirmed by the hierarchical non-linear model. Consequently, the supply of gymnasias, sports fields, public playgrounds and fitness centres should not fall below a minimum value if the population is to participate in sport on a regular basis. A look at the group of children and adolescents (3–18 years of age), however, shows a change in the influencing factors. Altogether, socio-economic factors at the individual level are less important in this age group. Only gender (here with an even higher effect than in the overall model) and (with greater significance level) personal income, as well as nationality, influence the regularity of sport activity in 3–18-year olds. A poor supply of swimming pools represents a decisive dimension, in terms of influencing the regularity of their sport activity. As to the hierarchical non-linear model, the probability of error here is even less than one percent (Table 4). As a consequence, the supply of swimming pools clearly must not fall below a minimum value if children and adolescents are to engage in sport on a regular basis. In relation to gender, it is remarkable that the supply of swimming pools is especially relevant with respect to girls' regular sport activity. The 19–28 age group are more likely to participate in regular sport activity if they spend little time on childcare or care of relatives. At the same time, the supply of gymnasias, sports fields, public playgrounds and fitness

Table 4. Results of the logistic regression analyses and the hierarchical non-linear models for regular sport activity (the odds ratios are displayed)

Age-specific target group (years)	3–18	19–28	29–35	36–44	45–64	65 and older	Total
<i>n</i>	337	333	325	367	497	195	2,054
Personal factors							
Personal income	1.001*	1.000	1.000	1.000*		1.000	1.000***
Work resp. school time	1.046	0.996	1.007	1.012		1.086	0.998
Time for the care of children/relatives		0.983***	0.993	0.998		0.983	0.992****
Human capital	1.513	2.003**	1.910**	1.865**		1.005	1.601****
Age	0.914	0.966	0.996	1.076		0.947**	0.989****
Gender	0.566**	0.649	0.777	1.120		0.952	0.833*
Nationality	1.959*	1.500	1.526	1.356		4.644	1.792****
Factors of urban districts: Bad supply of ...							
Gymnasia, sports fields and public playgrounds	1.111	0.480***++	0.594*+	0.698		1.269	0.813*+
Swimming pools	0.536***++	0.637+++	0.883	1.008		2.894**+	0.870
Fitness centres	0.992	0.247***++	0.533	1.039		1.649	0.726*+
Forest area	1.009	1.656	0.891	0.896		0.310***++	1.001
R ²	11.8****	15.4****	13.7****	11.5****	n.s.	18.8****	7.8****

Note: levels of significance for the logistic regression are * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$; levels of significance for the hierarchical non-linear models are + $p < 0.1$; ++ $p < 0.05$; +++ $p < 0.01$; ++++ $p < 0.001$ (only displayed for macro-level variables).

centres is relevant. A poor supply of these types of infrastructure results in a significant decrease in regular sport activity, irrespective of individual factors. Furthermore, the findings of the hierarchical non-linear model reveal an additional negative effect of poor supply of swimming pools for this age group (Table 4).

Thus, a minimum supply of sport facilities is extremely relevant for the sport activity of 19–28-year olds. On an individual level, the regular sport activity of the 29–35-year olds is influenced merely by human capital. On the macro-level, however, a good supply of gymnasia, sports fields and public playgrounds plays a significant role, even if they do so in understated form. This is confirmed by the hierarchical non-linear model (Table 4). With regard to sport activity of the 36–44-year olds and the 45–64-year olds, the supply of sport infrastructure has no significant influence. In contrast, the sport activity of the ≥65-year olds is influenced by the supply of forest area. The respective hierarchical non-linear model actually indicates an even higher influence of a minimum supply of forest area on the regular sport activity of seniors (Table 4).

Discussion

The state of international research regarding the general significance of sport infrastructure was confirmed and expanded at the same time with the help of the method of analysis adapted here, namely hierarchical linear models. The measurement of infrastructure was carried out in an objective, differentiated and multivariate mode. Thus, we have shown how local authorities are able to support the sport activity of different age groups with the help of a differentiated sport infrastructure. In this context, it has to be considered that personal factors are difficult to change for local authorities, whereas sports infrastructure can be made more accessible. It must be noted that nature-related sport opportunities and commercial infrastructure generally lie outside the usual field of responsibility of community sport departments. Partially, this can also be true for the supply of swimming pools. For this reason, intersectoral alliances may be necessary to create certain contexts of activity. In this manner, initiation and maintenance of sport activity throughout the course of life can be enhanced. It is important for the sport management of local authorities to realise that the disposition of sport infrastructure to support sport activity of different age groups is complex since different age groups prefer different types of sport infrastructure. A minimum supply of sport infrastructure is especially important for the youngest and oldest (3–35 years; 65 years and older), whereas it is not that important for the middle-aged (36–64 years). Concerning the youngest and oldest age group, there may be difficulties in accessing a sport facility. In contrast, young adults might suffer from a lack of time once they have begun work. The middle-aged are supposed to have a stable work and family life and, therefore, are less likely to be affected by the distance to a sport facility.

The main reason for the changing need for sport infrastructure is supposed to be the changing nature of sports favoured throughout the course of life. The data indicate that sports differ between age groups. For example, young people prefer team sports or more intense sports, whereas seniors prefer health-orientated sports. Moreover, in the light of flexible working hours, other factors are important for working people, like the opening hours of a sport facility. This may be one reason why young adults prefer fitness centres that usually have long and flexible opening hours. For these reasons, the types of sport infrastructure needed will change during the course of life. This needs to be considered when local authorities plan provision of sport infrastructure, especially in the context of demographic change in Germany. This demographic change will lead to a higher proportion of seniors, who will obviously require a different sport infrastructure from that required by younger people.

Further attention should be paid to the fact that the findings are valid only for the city of Stuttgart. Consequently, the external validity is limited, since the variance of the infrastructure in this analysis represents only the interior situation of the regional capital of Stuttgart. It has to be emphasised that the city of Stuttgart is one of the wealthiest cities in Germany. Therefore, Stuttgart can afford to provide a good range and quality of sport facilities and provision for its inhabitants. In order to increase the external validity, comparative studies of other cities would need to be made.

At first glance the coefficients of determination (R^2) seem relatively small. One reason for that may be the dichotomous dependent variable. Here, a differentiated dependent variable (e.g. sport frequency or sport minutes per week) may lead to higher coefficients of determination (e.g. Downward, 2005; Breuer, 2006). However, peoples' regular sport activity is supposed to be the primary objective of local authorities, and the concrete extent of sport activity might be said to be secondary; this justifies our use of the dummy variable. In addition, it should be noted that regression analyses in other studies dealing with the explanation of sports participation generally suffer from low coefficients of determination (e.g. Breuer, 2006; Humphreys & Ruseski, 2006), if they are displayed at all. One reason for this may be that sport is a heterogeneous good (e.g., Heinemann, 1995) and, therefore, it is difficult to explain sport activity. Moreover, from a statistical point of view, there are no minimum requirements concerning R^2 (e.g. Backhaus, Erichson, Plinke, & Weiber, 2006).

In contrast, another issue is more problematic. The transfer of assumed-age class findings of cross-sectional analysis to principles of the course of life can be affected only cautiously because of the possible influence of cohort and period effects. Hence, research regarding the life-course requires additional adequate methods of analysis, such as multi-point cross-sectional studies, longitudinal analyses and cohort sequence analyses. From an economic point of view, these methods are not recommended, particularly in the hierarchical linear model. Nevertheless, these methods may be applied in future research, allowing consideration to ways in which infrastructure

can be measured to allow information concerning conditions, opening times etc. of the sport facilities to be part of the analysis.

Notes

1. Psychologists would rather talk about norm-behaviour (Kahnemann & Miller, 1986), respectively social rationality (Gigerenzer, 2000).
2. Stuttgart is one of the largest cities in Germany, with about 600,000 inhabitants.

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