The More Physically Active, the Healthier? The Relationship Between Physical Activity and Health-Related Quality of Life in Adolescents: The MoMo Study

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Background: Little is known about the relationship between physical activity and health-related quality of life (HRQOL) in adolescents. The purpose of this study was 1) to quantify the predictive power of greater physical activity on higher HRQOL in adolescents and 2) to analyze whether the prediction is better for the sports club setting than for the leisure time setting. Methods: Within the framework of the German Health Interview and Examination Survey for Children and Adolescents and the “Motorik-Modul,” 1828 German adolescents aged 11–17 years completed a questionnaire concerning the amount of weekly physical activity at school, in sports clubs, and during leisure time. The KINDL-R questionnaire was used to assess HRQOL. Linear and multiple regression analyses were used to analyze the effects of physical activity on HRQOL. Results: In regression analyses controlling for sociostructural variables, greater general physical activity was a significant predictor of higher HRQOL (P < .001). While greater physical activity in sports clubs significantly predicted higher HRQOL, greater physical activity during leisure time predicted higher HRQOL only to a certain level. Overall, the level of explained variance was low. Conclusions: Being physically active especially in sports clubs is positively linked to higher HRQOL of adolescents.

Keywords: Motorik-Modul, subjective health, sports club, leisure time, KINDL questionnaire

Physical activity has been recognized as an important factor for a person’s health. Examples of the benefits of physical activity include skeletal health, reduced risk of obesity and associated health exposure, and prevention of cardiovascular disease risk factors as well as the enhancement of psychological health.1–6 Furthermore, there is an ongoing debate about the association between physical activity levels and health-related quality of life (HRQOL). The conceptualization of HRQOL encompasses physical, mental, and social components. These are for instance the sense of well-being, the ability to maintain good physical, emotional, and intellectual functions and the ability to satisfactorily take part in social activities.7 In contrast to medical criteria, HRQOL includes the subjective view of the individual on their own health status. In addition, Ravens-Sieberer et al8 stated that HRQOL is a valid criterion to describe health status.

HRQOL is especially important in children and adolescents because they are relatively healthy, and hence limiting health parameters to the physical dimension of health may not detect differences in the health status between individuals. Indeed, HRQOL comprises several dimensions of health presumably allowing the identification of subgroups that are at higher risk of health problems.9 The components of HRQOL which are relevant for adolescents are physical health, self-esteem or self-perception, the perceived quality of the relationship to parents and peers as well as well-being in the school setting.8 In addition, HRQOL in adolescents is especially important because HRQOL during these developmental stages forms the foundation for HRQOL during adulthood. However, existing research on the association between physical activity and HRQOL has predominately focused on older populations with chronic diseases7,10,11 or on the general population, where a consistently positive association between physical activity level and HRQOL was shown. The systematic review by Bize et al7 comprised 14 analyzed studies and in most of these studies, the instruments used to measure HRQOL were related to the SF-3612 questionnaire.

To date little is known about the association between physical activity and HRQOL in the adolescent population in general. While several studies focused on only 1 of the components of HRQOL and its relationship with physical activity, 2 studies applied a questionnaire that measured 2 or more aspects. For instance, Moesch et al13 used the Berne questionnaire of subjective well-being (BFW)14 and reported moderate positive effects of physical activity on the underlying health construct, which is similar to HRQOL. In addition, Boyle et al15 used the PedsQL16 and the EQ-5D-Y QoL17 both questionnaires measuring quality of life. The results of the latter study...
reported little or no relationship between self-reported quality of life and moderate to vigorous physical activity. Finally, to date it is unclear if there are differences in the relationship of physical activity and HRQOL in adolescents dependent on the setting of physical activity. For instance, Sygusch\(^\text{18}\) investigated the relationship between subjective health (measured using a 1-item scale) and physical activity in sports clubs and during leisure time, and reported a better subjective health in those adolescents who exercised in a sports club \((P < .001\) for both sexes). In addition, Gogoll\(^\text{19}\) found a better subjective health in sports club members than in nonmembers.

The aim of this study was to analyze the predictive power of physical activity for HRQOL in German adolescents. We tested the hypotheses that 1) greater physical activity is a significant predictor for higher HRQOL and 2) the predictive power of greater physical activity on higher HRQOL is stronger for physical activity in sports clubs than for physical activity during leisure time outside of sports clubs.

### Methods

**Data Collection**

Data were collected between May 2003 and May 2006 as part of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS)\(^\text{20}\) and the "Motorik-Modul" (MoMo).\(^\text{21}\) Both studies were approved by the institutional review board and have been performed according to the Declaration of Helsinki. The KiGGS survey was conducted by the Robert Koch-Institute (RKI) in Berlin and represents a nationwide representative cross-sectional study on the health status of children and adolescents from 0–17 years of age.\(^\text{20,22}\) A detailed description of the survey has previously been published.\(^\text{23}\)

17,641 children and adolescents from all over Germany participated in the survey. In the subsample of the MoMo-Study, which is also representative for Germany, data on physical fitness and motor performance was collected for 4529 children and adolescents between 4–17 years-old. Participants were recruited from the KiGGS population allowing for the inclusion of data obtained in the KiGGS survey. A detailed description of the sample, materials, and methods of the MoMo study can be found in Woll et al.\(^\text{21}\)

**Participants**

In this study at hand, data obtained in the MoMo sample for adolescents age 11–17 years were included. In total, 1828 adolescents participated in this study [average (SD) age: 14.2 years (1.9); 48.7% female]. At the time of data collection, 53.6% of the subjects were a member in 1 or more sports clubs, while 63.4% of all participants declared that they were physically active during leisure time outside of sports clubs. To singularize physical activity in sports clubs to verify the second hypothesis, only those adolescents who were member of a sports club but physically inactive during leisure time were considered \((n = 349)\). To singularize physical activity during leisure time outside of sports clubs, only adolescents who were physically active during leisure time, but not a member of a sports club were considered \((n = 527)\).

### Measures

**Physical Activity.** To measure physical activity levels in adolescents the MoMo physical activity questionnaire (MoMo-PAQ) was used. The questionnaire was proofed in relation to reliability (between 0.78–0.87) and validity (correlations between questionnaire and accelerometer Sense ware Pro 2 bracelet were between \(r = .56–.66\)).\(^\text{24}\) Participants were asked about the amount of their weekly physical activity in sports clubs and during their leisure time outside of sports clubs. The questionnaire included questions on the frequency (how many times per week) and duration (in minutes) of their physical activity. Further, the number of physical education lessons at school per week was recorded. The questions originated from established questionnaires.\(^\text{25–29}\) An activity index was defined containing general physical exercise, including exercise in sports clubs, during leisure time outside of sports clubs, and at school:

\[
\text{Index}_{\text{activity}} = \#\text{PA}_{\text{club}} \times \text{duration}_{\text{club}} + \#\text{PA}_{\text{leisure}} \times \text{duration}_{\text{leisure}} + \#\text{PA}_{\text{school}} \times 30 \text{min}
\]

where \#PA relates to the number of times each week when physical activity was performed in different settings (sports club, leisure time, school) and duration corresponds to the number of minutes spent on each activity. The overall index and subsindices for each setting were used for further analysis. To illustrate the adolescents’ physical activity level in the figures, subjects were grouped into 4 groups by quartiles of the activity index.

**Health-Related Quality of Life.** HRQOL was assessed using the KINDL-R-Kiddo questionnaire,\(^\text{30}\) which has been developed especially for adolescents and contains 24 items concerning physical and psychological well-being, self-esteem, well-being in the family context, peer context, and in daily life (school). Each of the items offers 5 answer categories (never, seldom, sometimes, often, always) from which the participant can choose an answer. For all 6 dimensions, a score can be calculated, resulting in a profile of HRQOL. Furthermore, a total score can be calculated from all 24 items, which includes all dimensions of HRQOL and represents overall HRQOL. All scores were transformed to values between 0–100, where a larger score indicates better quality of life.\(^\text{30}\) A detailed description of the psychometric properties of this questionnaire can be found in Erhart et al.\(^\text{31}\) For evaluations in this study the KINDL-R Total Score was used, because this study focused on overall HRQOL.

**Socioeconomic Status.** Based on parental information (educational and professional status, and household net income), the adolescents were classified into 3 groups (low, intermediate, upper) in relation to their...
Socioeconomic status (Winkler-Index) was calculated from each of the 3 components, and the sum of the 3 scores represents the socioeconomic status. Scores were computed for each parent separately, children’s status was defined by the higher parent’s score.

**Statistical Analysis.** All statistical tests were performed in PASW statistical software (Predictive Analysis Software; release 18.0; SPSS, Inc. Chicago, IL, USA). Linear regression models were used to test the postulated hypotheses. The assumptions of linear regression were tested and confirmed. The significance level for all statistical tests was set a priori to \( \alpha = .05 \). To test for a possible effect modification by gender on the relationship between physical activity and HRQOL, an interaction term of gender and physical activity was included in the regression model. Because for each physical activity setting interaction term was not significant, all further analysis was performed for both sexes combined. The hypothesis that greater physical activity is a predictor for higher HRQOL in German adolescents was tested using linear regression analysis. In a second step, hierarchical multiple regression analysis was conducted to detect if the effects of physical activity are influenced by sociostructural variables. The hypothesis that the predictive power of physical activity for HRQOL is stronger for physical activity in sports clubs than for physical activity during leisure time outside of sports clubs was tested using the same statistical procedure. First, linear regression was used to determine if greater physical activity in sports clubs predicts higher HRQOL. A second linear regression was used to determine if greater physical activity during leisure time outside of sports clubs predicts higher HRQOL. In both models, potential moderation effects by sociostructural variables were tested comparable to the examination of hypothesis I.

**Results**

The mean total score of HRQOL measured by the KINDL-R questionnaire was 72.6 (SD = 10.3). While participants aged 11–13 years had a KINDL-R Total Score of 74.6 (SD = 9.4), those aged 14–17 years had a score of 70.6 (SD = 10.6; \( P < .001 \)). The mean total score in girls was lower than that in boys (71.4 (SD = 11.0) versus 73.8 (SD = 9.6); \( P < .001 \)). Residential environment (urban versus rural) and socioeconomic status did not influence the KINDL-R Total Score. On average, participants reported to be physically active for 4 h 54 min (SD = 3 h 48 min) per week, including physical activity in sports clubs, during leisure time, and at school. Of all participants, 21.6% were physically active for less than 2 hours per week, which mainly represents physical education at school. The mean physical activity time in the sports clubs group was 3 h 33 min (SD = 2 h 36 min). The group of adolescents who is only active during leisure time reported to be physically active outside of sports clubs on average for 2 h 49 min (SD = 3 h) per week.

**Overall Physical Activity and HRQOL**

Figure 1 shows the relationship between overall physical activity (including physical activity at school, sports

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**Figure 1** — Relationship between overall activity index and Kindl-R Total Score (n = 1828).
Physical Activity and HRQOL in Adolescents

Adolescents who were less physically active achieved lower scores in KINDL-R Total Score representing lower HRQOL, and vice versa. Using physical activity as predictor, 2.4% of variance of HRQOL for adolescents was explained by a linear regression ($P < .001$). The results are presented in Table 1. The regression analysis revealed that physically inactive adolescents on average rated their HRQOL at 70.5 points. $\beta = .007$ indicates an increased KINDL-R Total Score of 0.007 points with every additional minute of being physically active. Consequently, 1 hour of physical activity raises the KINDL-R Total Score by 0.42 points. The multiple regression analysis showed that even if age, gender, socioeconomic status, and residential environment were included into the regression model, the effect of physical activity on HRQOL remained significant. In addition, the results revealed the significant influence of age and gender ($P < .001$) on HRQOL. $\beta = -.95$ for age indicates that older adolescents reached a lower KINDL-R Total Score. $\beta = 1.90$ for gender indicates that boys rated their HRQOL about 1.9 points higher than girls.

### Table 1 Results of the Linear Regression Analysis With KINDL-R Total Score as Dependent Variable (n = 1735)

<table>
<thead>
<tr>
<th>Variables</th>
<th>$\beta$</th>
<th>Std. Error</th>
<th>$\beta$</th>
<th>t</th>
<th>Sig.</th>
<th>Adj. $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>70.537</td>
<td>0.400</td>
<td>176.517</td>
<td>&lt; 0.001</td>
<td></td>
<td>0.024</td>
</tr>
<tr>
<td>Overall activity index</td>
<td>0.007</td>
<td>0.001</td>
<td>0.155</td>
<td>6.538</td>
<td>&lt; 0.001</td>
<td>0.024</td>
</tr>
</tbody>
</table>

Physical Activity in Sports Clubs, During Leisure Time Outside of Sports Clubs and HRQOL

The hypothesis—that the predictive power of greater physical activity on higher HRQOL is stronger for physical activity in sports clubs than for physical activity during leisure time (hypothesis 2)—was confirmed. As presented in Figure 2, adolescents tended to rate their HRQOL higher if they were more physically active in sports clubs. The linear regression analysis revealed a significant positive effect of physical activity in sports clubs on HRQOL ($P = .039$; Table 2). Similar to the findings for overall physical activity, the effect, and the portion of explained variance were low ($\beta = .111$; $R^2 = .012$). Age significantly influenced HRQOL as shown by the results of the multiple regression analysis ($\beta = -.182$; $P < .001$). Nevertheless, physical activity in sports clubs significantly predicted HRQOL ($\beta = .110$; $P = .008$) when considering sociostructural variables.

Figure 3 shows the relationship between physical activity during leisure time and HRQOL. Less-active
adolescents had lower HRQOL scores and medium-active adolescents achieved higher scores. However, the most-active adolescents during leisure time only showed a slight and nonsignificant increase in their HRQOL. Linear regression analysis did not reveal any significant effect of physical activity during leisure time outside of sports clubs on HRQOL ($\beta = .028; P = .522$). The portion of explained variance was $R^2 = .000$. By taking nonlinear components (square and cubic terms) into consideration, there was a significant effect on physical activity during leisure time outside of sports clubs on HRQOL (Table 3) where a negative effect of the square term on HRQOL was

Table 2 Results of the Linear Regression Analysis With KINDL-R Total Score as Dependent Variable (n = 347)

<table>
<thead>
<tr>
<th>Variables</th>
<th>$\beta$</th>
<th>Std. Error</th>
<th>$\beta$</th>
<th>$t$</th>
<th>Sig.</th>
<th>Adj. $R^2$</th>
</tr>
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<tr>
<td>Constant</td>
<td>71.504</td>
<td>0.911</td>
<td>78.498</td>
<td>&lt;.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sports club activity index</td>
<td>0.007</td>
<td>0.003</td>
<td>0.111</td>
<td>2.073</td>
<td>0.039</td>
<td>0.012</td>
</tr>
</tbody>
</table>

Figure 3 — Relationship between leisure time activity index and Kindl-R Total Score (n = 527).

Table 3 Results of the Hierarchical Regression Incorporating Square and Cubic Terms With KINDL-R Total Score as Dependent Variable (n = 527)

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables</th>
<th>$\beta$</th>
<th>Std. Error</th>
<th>$\beta$</th>
<th>$t$</th>
<th>Sig.</th>
<th>Adj. $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Constant</td>
<td>71.276</td>
<td>0.632</td>
<td>112.853</td>
<td>&lt;.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Leisure time AI</td>
<td>0.002</td>
<td>0.003</td>
<td>0.028</td>
<td>.641</td>
<td>.522</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td>Constant</td>
<td>69.566</td>
<td>0.835</td>
<td>83.320</td>
<td>&lt;.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Leisure time AI</td>
<td>0.022</td>
<td>0.007</td>
<td>0.362</td>
<td>3.114</td>
<td>.002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Leisure time AI square term</td>
<td>0.000</td>
<td>0.000</td>
<td>-0.360</td>
<td>-3.098</td>
<td>.002</td>
<td>0.015</td>
</tr>
<tr>
<td>3</td>
<td>Constant</td>
<td>68.538</td>
<td>1.071</td>
<td>64.012</td>
<td>&lt;.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Leisure time AI</td>
<td>0.041</td>
<td>0.014</td>
<td>0.681</td>
<td>2.855</td>
<td>.004</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Leisure time AI square term</td>
<td>0.000</td>
<td>0.000</td>
<td>-1.188</td>
<td>-2.149</td>
<td>.032</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Leisure time AI cubic term</td>
<td>0.000</td>
<td>0.000</td>
<td>0.549</td>
<td>1.531</td>
<td>.126</td>
<td>0.018</td>
</tr>
</tbody>
</table>

Abbreviations: AI, activity index.
observed ($\beta = -0.360; P = .032$). The portion of explained variance was $R^2 = .015$. When adding the square term, the effect of the linear term became significant ($P = .002$) and raised to $\beta = 0.362$. This indicates that the square term has a suppression effect on the linear term, and HRQOL raised up to a certain level and then flattened. The cubic term did not significantly contribute to the explanation of variance ($\Delta R^2 = .003; P = .126$).

**Discussion**

The purpose of this study was to examine the predictive power of physical activity on HRQOL in German adolescents in different settings. The results of this study confirmed that greater overall physical activity predicts higher HRQOL, and these findings also held true when sociostructural variables were considered. In addition, it appears that physical activity in sports clubs predicts HRQOL better than physical activity during leisure time outside of sports clubs. In multiple regression analyses, sex and age were significant confounders.

As postulated in Hypothesis 1, overall physical activity was a significant predictor of HRQOL. Being involved in physical activity is related to improved psychological and social functioning$^{33,34}$ which may lead to a more positive assessment of personal HRQOL and hence explain these positive effects of physical activity. In addition, it is possible that the positive effects of physical activity on mood$^{35}$ are responsible for a higher rating of the psychological aspects of HRQOL. Indeed, Thorlindsson et al$^{36}$ postulated that sport participation boosts adolescents’ self-esteem by increasing physical fitness and athletic performance. In turn, higher self-esteem might lead to a better rating of one’s health.

While a significant positive prediction was found of general physical activity on HRQOL, the effect sizes were weak. There are several potential explanations for this result. First, adolescents are comparatively healthy,$^{37}$ and risk factors may not have substantial effects on health until they reach adulthood. The small differences in perceived health might generate a ceiling effect. Further, the positive effects of physical activity on health may not arise in the short term but may become apparent in the mid to long term. Therefore, these effects may not yet be noticeable in adolescence. For instance, Wendel-Vos et al$^{38}$ found some longitudinal associations between physical activity and HRQOL in adults which indicates that there may be a positive effect of physical activity on HRQOL over a longer period of time. Finally, the complex structure of health and the “pluralism of perspectives”$^{39}$ suggest that health may be affected by a large number of variables. The low variance explanation supports this theory. In comparison with the results of the existing research concerning the effect of overall physical activity on HRQOL in adolescents, our results can be arranged intermediate. While in contrast to Boyle et al$^{15}$ predictive power was present in our study, the effects in our study were lower than those reported by Moesch et al.$^{13}$ A reason for the stronger effects in the latter study may be the use of a more differentiating survey of physical activity in that study.

The second hypothesis focused on the setting of physical activity. The setting appears to play a role regarding the predictive power of physical activity on HRQOL. While greater physical activity in sports clubs predicted higher HRQOL, being physically active during leisure time outside of sports clubs increased HRQOL only to a certain level. It is possible that being physically active in a sports club and being socially involved in the sports club team are related to well-being$^{40}$ and consequently also to HRQOL. Zambon et al$^{41}$ investigated the contribution of club participation to adolescent health and confirmed that the positive relationship between sports club participation and perceived health may originate in associated better social skills and social abilities, which are both known to augment health. The social involvement associated with sports club participation is a possible reason for the better prediction of physical activity in sports clubs on HRQOL than that of physical activity during leisure time.

The result that physical activity in sports club predicts HRQOL better than physical activity during leisure time is in agreement with the results reported by Sygusch.$^{18}$ However, in the leisure time setting, the square term in the regression equation suppressed the linear term. Hence, it appears that the relationship between physical activity during leisure time outside of sports clubs cannot be fully described by a linear function. This observation indicates that HRQOL increases with greater leisure time physical activity to a certain level and then flattens. This nonlinear relationship may be related to the unstructured training during physical activity during leisure time. Arrangements with friends to perform physical activities (eg, playing soccer, skating) are commonly made spontaneously and irregularly and depend on extrinsic factors such as, for instance, weather. Thus, it seems obvious that the improvement of HRQOL by leisure time physical activity is not as large. The results showed that leisure time physical activity can improve HRQOL but only to a certain level. Beyond this level, regularity of training and the focus on constant advancement, which is given in sports clubs by the presence of a coach, appear to be necessary for further improvement of HRQOL.

This study has some limitations that should be considered when interpreting these reported findings. For instance, all indices used in this study were based on self-reported questionnaires. Statements can be affected by the difficulty to recall time in young people and the rounding up of time. This may especially affect leisure time activity index, because physical activity during leisure time outside of sports clubs mostly takes place at different times and is of varying duration. Participants tend to overestimate their physical activity level. The choice of collecting data by questionnaire was predetermined by the size of the study population. In addition, this study relied on cross-sectional data, which does not necessarily indicate a causal relationship between engaging in physical activity and better HRQOL. It is unclear if adolescents’ engagement in physical activity depends on their overall state of health, or if health perception is
influenced by physical activity level. Both hypotheses may be correct and do not exclude each other. Nevertheless, the results of this study emphasize the importance of being physically active for adolescents.

**Conclusion**

The results of this study showed an overall prediction of higher HRQOL with greater physical activity. However, low variance explanation implicates that, aside from the aspects studied here, there are further aspects of health behavior that contribute to HRQOL. Multiple health behavior research is needed to study the interaction of different health-related lifestyle factors. Furthermore, longitudinal data are indispensable to answer the question of causality.

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