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Association between self-reported empathy and level of physical activity in healthy young adults

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Abstract Empathy, which consists of cognitive and affective empathy, is one of the vital skills in humans for creating and maintaining relationships with others, now, there are many empathy-deficient people, possibly deriving from an increase in harassment-related issues. Although there is a possibility that physical activity improves empathy, the association of physical activity with cognitive and affective empathy in healthy humans remains unclear. Thus, the present study aims to clarify the relationship between levels of physical activity and self-reported empathy. Eight hundred and ninety-three responses for two questionnaires, the short version of the International Physical Activity Questionnaire (SV-IPAQ) and Questionnaire of Cognitive and Affective Empathy (QCAE), were analyzed. Levels of physical activity in a usual week were measured based on the SV-IPAQ, and participants were divided into three groups: low, moderate and high physical activity. The scores for cognitive and affective empathy were measured based on QCAE. We found that people with a moderate or high physical activity level show significantly higher self-reported cognitive empathy compared to people with a low physical activity level. The score for self-reported affective empathy wasn’t affected by physical activity level. Physical activity level in a usual week showed a significant positive correlation with self-reported cognitive empathy scores, but not with self-reported affective empathy scores. Our findings imply that an increase in physical activity contributes to better cognitive empathy in healthy young adults.

Keywords: cognitive empathy, affective empathy, self-administered physical activity, young adults

Introduction

Empathy, which is defined as a skill to recognize emotions that others experience1,2, is an essential skill in humans for creating and maintaining relationships with others. Low empathy is associated with aggressive behavior in humans3-5, and it appears, due to the increase in harassment issues in several life stages, that there are an increasing number of people who are empathy-deficient6-9. An empathy-deficient person could impair a healthy life both for themself and others. Therefore, maintaining a higher level of empathy would be a crucial factor for better quality of life in humans, making it vital to come up with innovative strategies for improving empathy.

It is assumed that empathy consists of two components, cognitive and affective empathy1,2,3,4. Cognitive empathy is related to the ability to understand the emotional or mental states of others; while affective empathy is the ability to share the feelings of others without any direct emotional stimulation to oneself. Thus, to innovate strategies for treating empathy, it is necessary to consider these component differences.

Previous studies have reported that physical activity improves empathy in mammals, such as healthy rodents9 and people with multiple sclerosis10. Furthermore, a previous report has indicated the possibility that a lack of physical activity leads to bullying in adolescents11. Thus, an increase in physical activity seems to be a potential strategy for treating empathy. However, the relationship between the level of physical activity in a usual week and each component of empathy in healthy young adults remains unclear. Accordingly, this study aimed to clarify this relationship using two questionnaires: (1) the short version of the International Physical Activity Questionnaire (SV-IPAQ)2,12 and (2) Questionnaire of Cognitive and Affective Empathy (QCAE)4. *Correspondence: ta-shima@gunma-u.ac.jp
Materials and Methods

Participants. There were 1028 college student volunteers in Gunma University who answered two questionnaires: the SV-IPAQ\(^{12,13}\) and QCAE\(^{14}\) on a school day, and the results of 893 respondents (18.4 ± 0.9 years [range 18-30 years]; 520 males and 373 females) were analyzed. The questionnaire data of 78 out of 1028 participants were excluded due to being incomplete; and 57 out of 1028 participants were excluded due to a history of neurological, psychiatric or respiratory disorders, diabetes, anemia or other medical problem. The present investigation was approved by Gunma University Ethical Review Board for Medical Research Involving Human Subjects (ethical number: HS2019-304).

Questionnaires. The SV-IPAQ was used in the present study to assess self-administered physical activity in a usual week of the participant\(^{12,13}\). The amount of physical activity (MET-minutes/week) was calculated for each participant, and the participants were divided into three groups, low, moderate and high physical activity, according to the guidelines provided on the IPAQ website (http://www.ipaq.ki.se).

The self-reported scores of cognitive and affective empathy were measured by QCAE\(^{14}\) (https://sites.google.com/site/okadaxakihiro/, in Japanese). Higher scores in QCAE for each component mean higher empathy in the individuals.

Statistical analysis. Here we expressed the data as mean ± standard deviation (SD) and analyzed using IBM SPSS Statistics version 26.0. (SPSS Inc., Chicago, IL). Group comparisons were conducted by Chi-square test, one-way ANOVA or ANCOVA with gender as covariates. ANCOVA, followed by Fisher’s least significant difference post-hoc test, was used. Correlations were analyzed by partial correlation adjusted for gender. The statistical significance level was set at \(p < 0.05\).

Results

Although there was no difference in age (\(F_{2, 890} = 2.065, \text{main effect of group; } p = 0.128\)), in females, a significant difference among the groups of low, moderate and high physical activity was seen (\(p = 0.026\)). The amount of physical activity in a usual week was different among the three groups adjusted for gender (Table 1: \(F_{2, 889} = 411.4, \text{main effect of group; } p < 0.001\)); physical activity in the moderate and high groups was significantly higher compared to the low group (Table 1: both moderate and high; \(p < 0.001\) vs low group). There were significant differences in scores of self-reported cognitive empathy among the three groups adjusted for gender (Fig. 1a: \(F_{2, 889} = 5.830, \text{main effect of groups; } p = 0.003\)), and subjects in both the moderate and high groups exhibited significantly higher scores of self-reported cognitive empathy compared to subjects in the low group (Fig. 1a: moderate \([p = 0.049]\), high \([p = 0.001]\) vs low group, respectively). There was no difference in the self-reported affective empathy among each group based on level of physical activity (Fig. 1b: \(F_{2, 889} = 0.440, \text{main effect of groups; } p = 0.644\)). The level of physical activity indicated a significant positive correlation with the cognitive empathy score after controlling for gender (Fig. 2a: \(r = 0.095; p = 0.005\)), but not with the self-reported affective empathy scores (Fig. 2b: \(r = 0.030; p = 0.368\)).

Discussion

The present study found that young adults with moderate and high levels of regular physical activity have significantly higher cognitive empathy compared to those with low levels. Moreover, the physical activity levels correlated with the scores of self-reported cognitive empathy, but not with the scores of self-reported affective empathy.

A notable and crucial finding explored in the present study is that the level of physical activity in a usual week correlates with self-reported cognitive empathy (Fig. 1a and 2a). Although we should investigate in further detail

<table>
<thead>
<tr>
<th>Table 1. Characteristics of participants in each group divided by physical activity amounts</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td><strong>n (%)</strong></td>
</tr>
<tr>
<td>Low physical activity</td>
</tr>
<tr>
<td>----------------------</td>
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<tr>
<td>248 (27.7)</td>
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<tr>
<td><strong>Age</strong></td>
</tr>
<tr>
<td>mean ± SD</td>
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<tr>
<td>p, vs Low group</td>
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<tr>
<td>18.4 ± 0.9</td>
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<tr>
<td>n.s.</td>
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<tr>
<td><strong>Gender</strong></td>
</tr>
<tr>
<td>male/female</td>
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<tr>
<td>p, Chi-square test</td>
</tr>
<tr>
<td>147/101</td>
</tr>
<tr>
<td>0.026</td>
</tr>
<tr>
<td><strong>MET-minutes/week</strong></td>
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<tr>
<td>mean ± SD</td>
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<tr>
<td>p, vs Low group</td>
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<tr>
<td>284.0 ± 300.9</td>
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<td>&lt;0.001</td>
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</tbody>
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n.s. indicates there is non-significant differences. * ANCOVA with gender as covariates.
the influences of physical activity on individual cognitive empathy, because the effect size of correlation was small (Fig. 2a, $r = 0.095$), our present results imply that a sustained moderate level of physical activity, based on the SV-IPAQ, contributes to better cognitive empathy in healthy young adults. In the present study, we could not explore the mechanisms of differences in cognitive empathy. An earlier study proposed that self-reported cognitive empathy indicates a significant positive correlation with the local gray matter density in the cingulate cortex and dorsal medial prefrontal cortex. Since there is a possibility that an increase in physical activity enhances neuronal plasticity in the brain regions mentioned above, it is assumed that physical activity in healthy young adults is related to self-reported cognitive empathy. Also, there is a possibility that the genotype of the G protein coupled receptor family, including the arginine-vasopressin receptor 1a, modulates cognitive empathy, therefore, we should investigate whether the individual differences of genotype have an influence on the relationship of physical activity with cognitive empathy or not.

Although physical activity was shown to be associated with cognitive empathy, this study showed that affective empathy remained unchanged with a usual level of physical activity (Fig. 1b and 2b). In contrast, an earlier study reported that regular exercise in healthy rodents increased “helping behavior”, which is based on affective empathy. The present research just assessed the relationship between self-administered physical activity and self-reported empathy; the effects of exercise interventions were not looked at. Thus, future studies are needed to investigate exercise intervention-induced changes in affective empathy in healthy persons.

A limitation of the present study is that we could not consider other confounding factors of empathy, such as home environment, peer relationship and educational environment. Thus, we need to investigate the effects of physical activity on empathy adjusting for such potential
confounding factors in future studies. In addition, there is the possibility that the level of physical activity in college students changes with vacations\(^2\). Potential changes in empathy associated with alteration of the physical activity level through the year should be addressed in future work. Furthermore, the beneficial intensities of physical activity remain unclear. Future investigations are warranted in this regard.

In conclusion, according to our present findings, an increase in regular physical activity would contribute to maintaining better cognitive empathy in healthy young adults. Despite the remaining unknowns, it appears that exercise and sports activity can be a strategy for treating and developing empathy in healthy persons.

Acknowledgments

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Conflicts of Interest

The authors have no conflicts of interest relevant to this article.

Author Contributions

TS conceptualized the study design and protocol. TS, HN, KT, TS, YA, KK, YO collected the data. TS carried out the analysis and interpretation of data. TS and SJ drafted the manuscript. All authors have critically reviewed, revised and approved the manuscript.

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