

# Psychological traits regarding competitiveness are related to the incidence of anterior cruciate ligament injury in high school female athletes



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## ABSTRACT

**Background:** The purpose of this study was to investigate the relationship between psychological competitive ability and the incidence of noncontact ACL injuries among high school female athletes.

**Methods:** A three-year prospective cohort study was conducted using 300 15-year-old high school female athletes with no previous injuries or symptoms in their lower limbs (106 handball players and 194 basketball players). At baseline, their psychological competitive abilities were assessed using a self-administered questionnaire—the Diagnostic Inventory of Psychological Competitive Ability (DIPCA.3). After the baseline examination was performed at high school entry, all players were prospectively followed for 36 months to document any subsequent incidence of ACL injury, according to their coaches. An unpaired t-test with Welch's correction was performed to compare the differences in the psychological competitive abilities between the injured and uninjured players.

**Results:** Of the 300 players, 25 (8.3%) experienced a noncontact ACL injury during the three-year observation period. The injured players had significantly higher total DIPCA.3 scores for psychological competitive ability than the uninjured players ( $169.9 \pm 18.8$  vs.  $159.2 \pm 21.6$ ,  $P = .036$ ). Additionally, the injured players had significantly higher scores than the uninjured players in the following categories: aggressiveness, volition for self-realization, volition for winning, judgment, and cooperation. However, no significant differences were observed in patience, self-control, ability to relax, concentration, confidence, decision, and predictive ability.

**Conclusions:** High psychological competitive ability was associated with the incidence of noncontact ACL injuries in high school female athletes.

**Level of evidence:** Level II (prospective cohort study).

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## 1. Introduction

Although reconstruction surgery for anterior cruciate ligament (ACL) injuries has improved and shown stable results, many challenges still remain for this sports injury (e.g., it still requires a long recovery time and is associated with meniscal tears) [1,2]. In addition, an ACL injury is one of the most costly sports injuries [3,4]. A noncontact ACL injury is prevalent among high school female athletes, especially in those who play ball sports such as handball, basketball, soccer, and volleyball [5,6], and it is a very serious issue since it not only interferes with

their sports activities but also puts them at risk for the early development of osteoarthritic changes in the future [7–9]. Therefore, the prevention of ACL injuries as well as an accurate diagnosis and proper treatment have significant importance in maintaining the future quality of life in these patients.

Identifying and understanding the risk factors of this injury are essential for developing an effective prevention program, and many researchers have conducted studies that focus on multilateral aspects, such as anatomical, neuromuscular, hormonal, biomechanical, and environmental factors [5,10–13]. However, psychological factors have been rarely reported on, and no consistent findings have been reported, although psychological factors along with strength and technical skills are known to have a significant influence on athletes [14,15]. In a competitive sport situation, the exertions of performance and also the incidence of injury can be influenced by psychological factors [16].

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Therefore, in addition to physical characteristics, the mental and psychological characteristics of athletes can become risk factors for ACL injuries.

The purpose of this prospective study was to evaluate the relationship between the psychological competitive ability and the incidence of ACL injuries in high school female handball and basketball players who are known to have a high incidence of ACL injuries.

## 2. Materials and methods

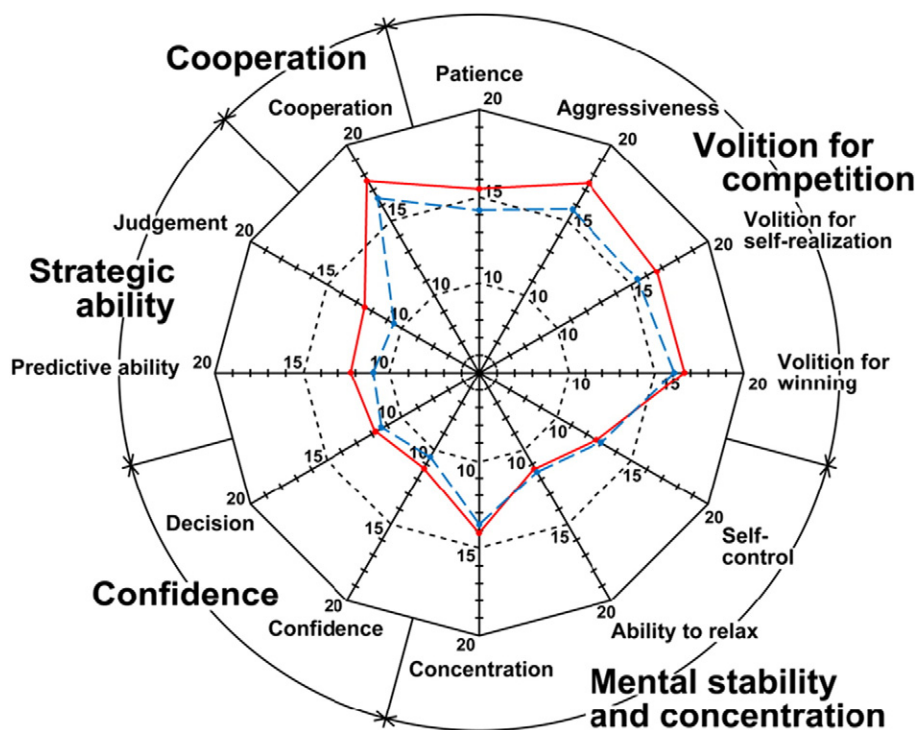
We prospectively investigated the risk factors for ACL injuries in high school female athletes (handball and basketball players) over a three-year period. We included 303 15-year-old participants with no previous injuries or symptoms in their lower limbs who joined the handball club (107 subjects) or basketball club (196 subjects) from April 2009 to April 2011. During the study period, the level of the competitions was standardized for the teams, which were ranked among the top four in each prefecture. Being ranked among the top four in each prefecture. Players who were injured at the start of the study were excluded and all players who were enrolled in basketball or handball at baseline continued to play these sports for the full duration of the three-year study. Demographic and anthropometric data (height and weight) were collected from all players during baseline testing. The psychological competitive ability was also assessed with a self-administrated questionnaire, the Diagnostic Inventory of Psychological-Competitive Ability for Athletes (DIPCA.3) (Figure 1) [17–19], which was administered at baseline when the subjects entered high school. The DIPCA.3 measures athletes' psychological traits to indicate their skills and talents during sports competitions, using 52 questions (e.g., "I can perseveringly compete even in difficult situations;" "I get nervous worrying too much about winning or losing;" and "During games, my teammates or partners and I cooperate well with each other."). These questions are answered by using five scales from "always so" to "not at all so" and the responses are sorted into the following 12 categories: patience, aggressiveness, volition for self-

realization, volition for winning, self-control, ability to relax, concentration, confidence, decision, predictive ability, judgment, and cooperation. Each category is given 20 points, totaling 240 points for the whole questionnaire.

After the baseline data were collected, the occurrence of ACL injuries was recorded prospectively for the subsequent three years. All coaches were instructed to maintain a continuous log of all data requested, and they were contacted by telephone and/or e-mail at least once a month to record new injuries as well as all playing activities in training and competitions. ACL injuries were diagnosed at a medical institution after physical and magnetic resonance imaging findings were interpreted, and direct arthroscopic visualization confirmed a complete ACL tear during the subsequent ACL reconstruction. The subjects were categorized into an ACL injured group and an uninjured group after the three-year survey was administered, and the psychological competitive ability of both groups was compared. All 303 players who provided complete data sets for the baseline screening tests were followed up for three years until they graduated from high school. During the follow-up period, 28 (9.2%) of the 303 players ruptured their ACL. Of these, 25 players (89.3%) experienced a noncontact injury, whereas three (10.7%) experienced a contact injury to their knee. Players with a contact ACL injury were excluded because of the accidental nature of the injury. Hence, this prospective cohort study included 300 players, and the 25 players (8.33%) who experienced a noncontact ACL injury were assigned to the ACL injured group.

This study was approved by the ethics committee of Kanazawa University. Participants were recruited for this study by distributing a letter about the study to the teams and coaches, and written informed consent was voluntarily obtained from the players and their parents after providing a thorough explanation on the content of this research prior to the intervention.

The data were analyzed by using the Statistical Package for the Social Sciences for Windows, version 19.0 (SPSS Inc., Chicago, IL, USA). Each item of the DIPCA.3 scores was first compared by using an unpaired t-test with Welch's correction, and then items with a P-value less than



**Figure 1.** The Diagnostic Inventory of Psychological-Competitive Ability for Athletes (DIPCA.3). DIPCA.3 measures athletes' psychological abilities during sports situations in 12 categories [17–19]. The red solid lines and the blue broken lines show the DIPCA.3 scores of the ACL injured group and the uninjured group, respectively.

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