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Effect of learning to ski with an indoor skiing carpet compared to the real snow setting on alpine skiing technique, anxiety levels, and autotelic experience in university students. A pilot randomized controlled trial

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The aim was to compare the effects of an alpine skiing learning intervention initiated in an indoor carpet setting (ICS) with the snow setting (SS) on the alpine skiing turn technique, state of anxiety, and autotelic experience. Thirty-four students (4 females) aged 18-37 years were randomly divided into indoor carpet skiing (ICSG; first two classes in an ICS, and the two last classes in the SS) or snow (all classes in the SS) groups. Statistically significant differences were only detected in the cognitive anxiety levels between both groups for the second day of the program and in the alpine skiing turn technique at the first day of practice in the SS for both groups, in favor of the ICSG in both cases ($p < 0.05$). The ICS seems to be a useful and effective setting for learning to ski in relation to motor learning and anxiety than THE SS.

KEY WORDS: Skiing abilities; Alpine skiing turn technique; Anxiety levels; Beginner skiers; Young people

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Alpine skiing is composed of a complex set of sport skills that have to be performed in an uncertain environment, which depends on the quantity

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and quality of the snow, winter climate conditions, mountain surroundings, and all the personal factors of each skier. The performance and technical factors being just as important as the psychological ones (Cigrovski, Franjki, Rupčić, Baković, & Matković, 2017; Mann & Narula, 2017). The technical executions of these specific skills and psychological factors are crucial at the beginning when learning alpine skiing (Cigrovski, Matković, & Ivanec, 2008; Cigrovski, Radman, Konter, Očić, & Ružić, 2018) due to their influence on motivation, success of learning, and risk of injury, probabilities that determine the continuity of practicing this complex but enjoyable sport modality (Lee et al., 2019). In contrast, any sport experience without enjoyment and successful performance is likely to result in discomfort, dissatisfaction, and anxiety (Borkovec, Robinson, Pruzinsky, & DePree, 1983).

Despite there being disadvantages of alpine skiing in relation to other indoor sports modalities due to the weather conditions, risks related to security while practicing, time spent to arrive at the ski resort, and other constraint factors, alpine skiing offers a natural environment, friendly social relationships, and enjoyment as the main characteristics in its favor making it recommendable for tourists, or schoolchildren, and adolescents in the Physical Education setting (Sutherland & Legge, 2016). Nowadays, technology and some developed sport facilities allow people to access alpine skiing in modified conditions such as with indoor carpet skiing (ICS) (Hofmann, 2012). ICS has been used recently to recover and rehabilitate high-level injured alpine skiers (Spörri, Kröll, Fasel, Aminian, & Müller, 2016) and capturing the skier positions, angles, and center of mass kinematics in competitive skiers (Fasel, Spörri, Schütz, Lorenzetti, & Aminian, 2017). However, there is a lack of knowledge on how this new technology can help beginner skiers, by providing a more controlled environment for their first experiences.

The specific uncertainty of the environment of alpine skiing together with all the above-mentioned factors generate anxiety, stress, fear, and insecurity that could take a toll on the intrinsic motivation and psychological well-being of a beginner skier (Gillet, Berjot, Vallerand, & Amoura, 2012), and even causing them to drop out of practicing alpine skiing when starting this activity (Aletta, Oberman, & Kang, 2018). However, once they overcome the difficulties of the first days of a short learning program for beginner skiers, alpine skiing may become a highly enjoyable experience for them (Lee et al., 2019). For example, Jurečka (2020) found that starting learning alpine skiing with short skis is less stressful for novice adult skiers compared to using standard length skis. Similarly, Künzell and Müller (2008) found that after a nine-day program, novice adolescent skiers who started the first four days with shorter skis called "Bigfoot", had

reduced their anxiety. These results are common to other sport practices like judo or basketball in which novice practitioners showed lower anxiety levels after practicing them for the first time (Dali & Parnabas, 2018; Yogi & Kyan, 2021). Specifically, Yogi and Kyan (2021) observed that performing an eight-hour program of progressively more difficult judo contents (e.g., basic motions, break fall, basic osaekomi-waza, and offense and defense with osaekomi-waza) helped high school students without prior judo experience to reduce their pre-intervention anxiety levels. In a similar way, Dali and Parnabas (2018) found that after performing self-talk techniques novice basketball players reduced their anxiety levels on free throw performance. Moreover, Giles, Fryer, Dickson, Moore, and Draper, (2020) analyzed the psychological response of climbers and non-climbers to a 20-meter wire ladder climbing task. These authors observed that when there is no previous experience performing a skill such as rock climbing, the manifested anxiety levels are higher. Related to this, the autotelic experience is part of the flow state of a sport practitioner, which refers to experiences strongly associated to intrinsic motivation, that is to say, the level of satisfaction and grade of enjoyment that a particular sport experience presents to its practitioners (Vieira, Balbim, Pimentel, Hassumi, & Garcia, 2011). It is well known that alpine skiing practice is an enjoyable experience for the one who practices it, due to it being carried out in an outdoor environment, reporting high grades of satisfaction (Mayorga-Vega, Ocaña-Wilhelmi, Gómez-López, & Viciana, 2017). In this line, previous studies carried out in other sport modalities (i.e., judo and whitewater kayaking; Dahlstrom, 2008; Yogi & Kyan, 2021) have shown that when novice practitioners without prior experience perform an initiation program of these sport modalities, they finalized them with higher levels of autotelic experience and satisfaction. Dahlstrom (2008) analyzed if a two-day instructional program in whitewater kayakers without prior experience, could influence their autotelic experience after it. This author found that before the program, participants manifested insecurity regarding the practice. However, after performing the program, they acknowledge that they would repeat the sport because when they know how to act in the different situations of the kayak practice, they perceived the experience as enjoyable (Dahlstrom, 2008). Similarly, Yoki and Kyan (2021) found that beginner judo practitioners enjoyed the judo practice more after performing a program specifically designed for people without prior experience in this sport modality. Therefore, considering all the exposed arguments regarding the presence of anxiety in novice practitioners of a sport modality, as well as of autotelic experience experienced, it is interesting to know how all these above-mentioned variables (i.e., psychological constrains such as the levels

of anxiety and the positive ones such as the autotelic experience) are influenced by the use of ICS in the process of learning to ski.

Despite the importance of all these psychological variables at the beginning of the ski learning process, and also the crucial behavioral variable of the technical ability dominance in the alpine skiing discipline, to the best of our knowledge, there is a lack of research in previous literature regarding these factors combined with the ICS setting. To our knowledge, previous studies carried out in an ICS have been addressed with different aims to the ones related to improving technical abilities or overcoming psychological alpine skiing learning constraint factors (Fasel et al., 2017; Spörri et al., 2016). Consequently, the purpose of the present study was to compare the effects of an alpine skiing learning intervention initiated in an indoor carpet setting with the snow setting on the alpine skiing turn technique, state of anxiety, and autotelic experience in university students.

Methods

Study design

The present study is reported according to the current CONSORT guidelines for randomized pilot trials (Eldridge et al., 2016). The protocol of the present study conforms to the Declaration of Helsinki statements (64th WMA, Brazil, October 2013). The Ethical Committee for Human Studies of the University of Granada approved the present study protocol. Recruitment of participants was carried out in November of 2017, and the intervention was done on December of 2017. A pilot randomized controlled trial design was used. This study was non-blinded (treatments were not masked from the participants), parallel-grouped (study with two different treatments) (Spieth et al., 2016), and had four evaluation phases.

Participants

All the 209 students belonging to the second academic course at the Sports Science Faculty of the University of Granada (Granada, Spain) (first course of the degree in which they have the ski subject) were contacted. After informing students about the aim of the present study, they were invited to participate voluntarily in a 4-day alpine skiing learning program for beginners. All potential participants were attending winter sports classes at the Faculty of Sport Sciences for the first time during their initial formation and none of them had previous experience in alpine skiing. A total of 36 students, 31 males and 5 females, agreed voluntarily to participate in the present study (M_{age} = 21.4 ± 4.2, 18-37 years). Participants' signed written informed consent was obtained before taking part in the study. The inclusion criteria were: (a) not having any previous experience in skiing; (b) being enrolled in the second year of the Degree in Physical Activity and Sport Sciences, as those students were attending classes of winter sport at this faculty; (c) presenting the signed informed consent, and d) not having any pathology that prevented the practice of skiing. The exclusion criteria were: (a) not attending 100% of the interventional sessions, and (b) not correctly completing the questionnaires or performing the alpine skiing turn technique test.

Sample Size

A sample size calculation was estimated for the Wilcoxon-Mann-Whitney test (two groups) by the G*Power Version 3.1.9.4 for Windows. A minimum final sample size for the main randomized controlled trial of 106 participants (53 in each group) was estimated. According to Cocks and Torgerson (Cocks & Torgerson, 2013), the sample size for a pilot randomized controlled trial should be at least around 10% of what would be needed in the main study. Therefore, at least 11 participants should be recruited.

Randomization

Randomization was conducted before the intervention at the individual-level using a computerized random number generator. Participants were randomly assigned by an independent researcher, blinded to the study aim, to the snow group (i.e., SG; n = 14, 13 males and 1 female) and the indoor carpet skiing group (i.e., ICSG; n = 20, 17 males and 3 females).

Intervention

Figure 1 shows the general scheme of the procedure of the present study. Both the SG and the ICSG received the 4-day alpine skiing learning program with the same contents and learning progression as specified in Table I. The SG developed all classes in the snow setting, specifically at the beginners' tracks situated at the Ski Station Resort of Sierra Nevada (Granada, Spain). On the contrary, participants of the ICSG developed the first two ski sessions at the ICS setting of Mixed University for Sport and Health Institute (SkiingLab IMUDS, in Spanish, Granada) and the last two sessions at the above-mentioned Ski Resort, same as the SG.

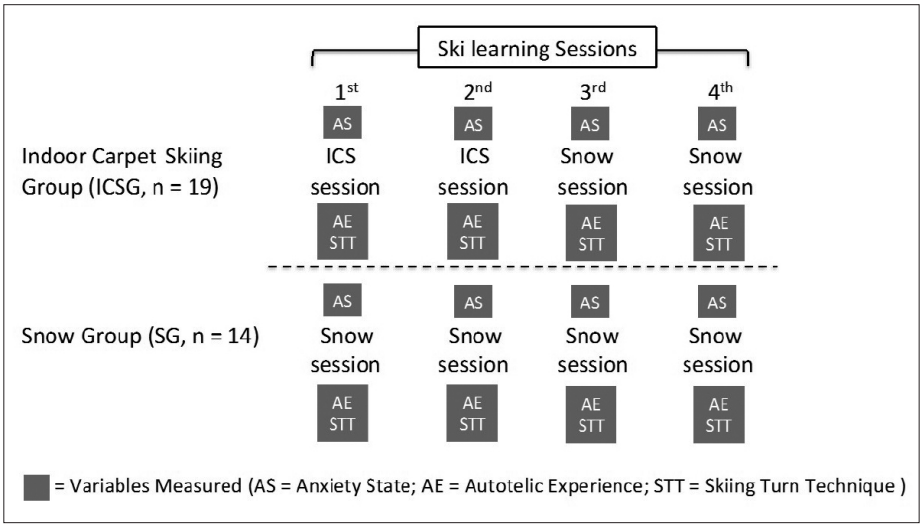

Fig. 1. - General scheme of the study.

TABLE I
Characteristics of the 4-Day Alpine Skiing Learning Program for Both the Snow and Indoor Carpet Skiing Groups.

1st day	**2nd day**	**3rd day**	**4th day**
Warm up (15 minutes): – Joint mobility and stretches (mainly of the lower body) – Reminder of the main tasks performed the day before (from the 2nd day and after)			
Main part of the session (4 hours and 30 minutes):			
SG – Environment and ski material familiarization (i.e., walk, jump, slide, balance seeking) – Fundamental position – Direct descent – Velocity control and braking through snow-plough *ICSG* – Start sliding from stopped carpet with ski poles – Sliding tasks holding a fixed external bar with moving carpet	*SG* – Trying different ski tracks – Using ski lifts (e.g., chairlift and carpet lift) *SG and ICSG* – Braking and sliding snow-plough (ascending at the carpet in the case of ICSG) – Snow-plough direction changes – Performing different turning radius with snow-plough – Velocity and incline changes	*SG and ICSG* – Snow-plough turns improvement – Initiation to stem turn	*SG and ICSG* – Stem turn improvement (changes in direction, velocity, incline, and turning radius)
Cool-down (15 minutes): – Different tasks of stretches of the lower body (10 minutes) and upper body (5 minutes)			

Note. ICSG = Indoor Carpet Skiing Group; SG = Snow Group

MEASURES

Data collection was carried out by the same tester, instruments, and protocols. Prior to carrying out the intervention, a socio-demographic questionnaire was applied and the anthropometric measures were registered to all the participants at the above-mentioned Faculty facilities.

Before starting each of the alpine skiing learning sessions, all the participants self-reported their state of anxiety, registering an evolution of this variable during the four days of the program by responding to the same anxiety questionnaire every day before each program session. Moreover, at the end of each session of the program, all the participants self-reported their autotelic experience, and then the ski turn technique was measured, registering day to day the progression of their satisfaction of the experience they were living and their learning in alpine skiing ability. The test protocol for measuring the learning in alpine skiing ability was composed of a previous warm-up of five minutes of mobility and muscle strengthening and five minutes practicing the turn technique (snow-plough or stem turns, depending on the level of skiers in that moment). Initial measurement of the turn technique in alpine skiing was not necessary as none of the participants had taken any ski classes before and, consequently, their level was established at zero. The measurement protocol followed with each variable is detailed below.

Demographic and sports antecedents' data. A demographic and sports antecedent survey regarding gender, age, sport habits (days per week and time they spend practicing sport), and of any other sliding sports experience (e.g., skateboarding or skating) was applied.

Anthropometric characteristics. Participants' body mass and height were measured in shorts, T-shirts, and barefoot. For the body mass measure, the student stood in the center of the scale (Seca, Ltd., Hamburg, Germany; accuracy = 0.1 kg) without support and with the weight distributed evenly on both feet. For the body height assessment, participants stood with their feet together with the heels, buttocks, and upper part of the back touching the stadiometer (Holtain Ltd., Crymmych, Pembs, United Kingdom; accuracy = 0.1 cm), and with the head placed in the Frankfort plane. Two measurements of both body mass and height were performed and the average of each was calculated (Stewart, Marfell-Jones, Olds, & De Ridder, 2011). Then, the body mass index was calculated as body mass divided by body height squared (kg/m^2).

Alpine skiing turn technique. The technical ability variable was measured observing the performance of two turns in a defined test situation (described below). The registration was carried out by the Basic Alpine Ski Turns Technique Observation Sheet (BASTTOS) (Viciana, Ocaña-Wilhelmi, Gómez-López, Casado-Robles, & Mayorga-Vega, 2023). This instrument was composed of three technical components: (a) balanced position (referring to the adaptation of the body segments, head, and ankle, knee and hip joints to the situation while turning); (b) velocity control (referring to maintain a continuous velocity during the turn performed), and (c) trajectory control (referring to the ski's direction, rotation of the body, independence of leg movements, and flex-extension and rotation of knees, in order to control the trajectory). All dimensions are divided into four degrees of learning (from 1 to 4), where "1" is the lower level of mastery performance and "4" represents the maximum level of mastery performance. These levels have symbols and pictures to facilitate the identification of the skiers' level of execution with the degrees of learning achieved. The BASTTOS has shown adequate reliability, validity, and responsiveness among young adult skiers [intra-rater (P = 0.80-0.83; k = 0.61-0.68) and inter-rater reliability (P = 0.86-0.97; k = 0.68-0.93); convergent validity (r_{ho} = 0.58-0.65, $p < 0.001$); and responsiveness ($p < 0.05$, r = 0.46-0.60)] (Viciana et al., 2023).

The test consisted of the performance of two turns consecutively (i.e., toward the left and right sides), and marked on the snow by ski poles or hanging from the celling in the case of the ICS setting. A six-meter wide and 10-meter long space was designed for this testing situation on the snow slope in order to have the same space as the ISC. The two turns were separated by a width of one and a half meters and a length of three meters, and the starting point was set at the opposite side (in diagonal) from the first marked turn. The ski track should be in the range of 10-15% of inclination, catalogued as a green color track or beginners' level. A camera was situated after the second competition pole in order to capture all movements of the skiers (see Figure 2). Tests were carried out in a MaxxTracks™ ISB2000 ski simulator (©MaxxTracks Indoor Skislopes, Beverwijk, The Netherland) designed for training, research, and teaching purposes, the dimensions of which are 12.50 × 6.55 m (ski surface area: 48 m^2). Its surface speed can be varied between 1 and 21 km/h, and the slope ranges from 10° to 19°. Surface wetting is required for achieving suitable skier sliding.

State of anxiety. The adapted and validated Spanish short version of the Competitive State Anxiety Inventory 2 (CSAI-2RE) (Arruza Gabilondo et al., 2012) was used to assess the participants' state of anxiety. This questionnaire is composed of 15 items belonging to three dimensions (five items each) that measure cognitive anxiety (e.g., "I am concerned about performing poorly"); self-confidence (e.g., "I feel secure"); and somatic anxiety (e.g., "My body feels tight"). A 10-point Liker-type scale (from 0 = "Nothing" to 10 = "A lot") was used in order to adapt the scale to the Spanish students' school marks (Guijarro-Romero, Mayorga-Vega, Casado-Robles, & Viciana, 2020). The Spanish version of CSAI-2RE has shown adequate psychometric values among young adults (CFI = 0.98; NFI = 0.95; RMSEA = 0.048; Cronbach's alpha = 0.87-0.93) (Arruza Gabilondo et al., 2012).

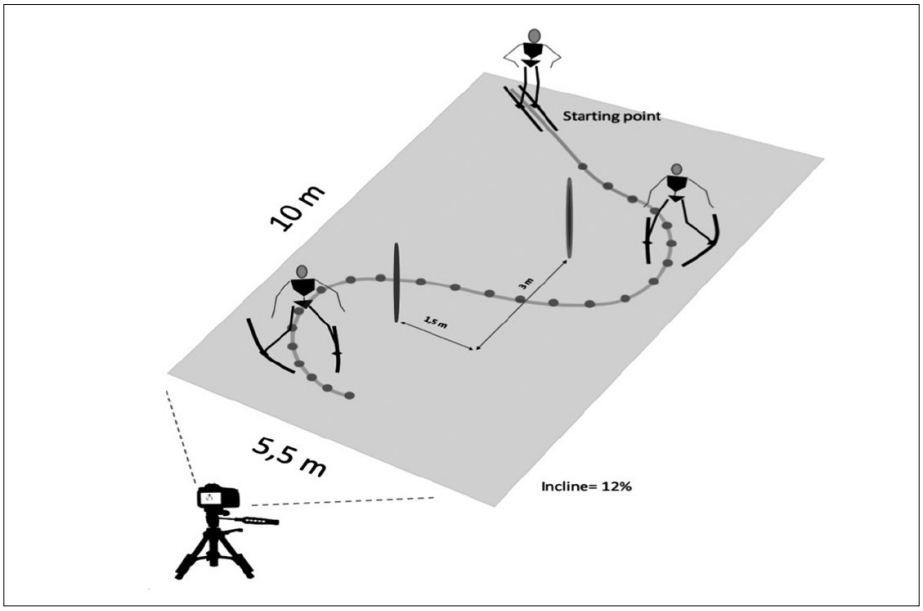

Fig. 2. - Scheme of the test for measuring the alpine skiing turn technique.

Autotelic experience. Participants' satisfaction of the experienced skiing classes was measured by the adapted into Spanish and validated version of the Flow State Scale (García-Calvo, Jiménez, Santos-Rosa, Reina, & Cervelló, 2008). From the nine dimensions (36 items) that the flow construct has, and due to the main aim of the present study, only four items belonging to the autotelic experience were used (e.g., "I really enjoyed what I was doing"). Participants responded to this questionnaire in a 10-point Likert scale, from 0 = "Totally false" to 10 = "Totally true". The Spanish version of Flow State Scale has shown adequate psychometric properties among young people (CGI = 0.92; TLI = 0.91; RMSEA = 0.052; SRMR = 0.048; Autotelic experience, Cronbach's alpha = 0.83) (García-Calvo et al., 2008).

Statistical Analysis

Data were reported as median (interquartile range) or percentage for the continous/ordinal and categorial variables, respectively. The Mann-Whitney U test (continous/ordinal variables) and the chi squared test (categorical variables) were used to compare the general characterictics of the participants. Then, the internal consistency of the dependent variables was estimated using the Cronbach's alpha (α) and Omega (Ω). Finally, the Mann-Whitney U test was used to compare the effect of starting to learn to ski in an ICS setting and in snow on autotelic experience, state of anxiety, and skiing technique (between the same session and the first snow session). Moreover, the Wilcoxon test was used to compare the beginning to the end of the 4-day skiing course on autotelic experience, state of anxiety, and skiing technique for each group separately. Effect sizes were estimated using the *r* (Field, 2017). All statistical

analyses were performed using the SPSS Version 25.0 for Windows (IBM® SPSS® Statistics). The statistical significance level was set at $p < 0.05$.

Results

Final Sample And General Characteristics

From the 36 students who agreed to participate in the study, 34 participants met the inclusion criteria (30 males and 4 females), and two did not because of the inclusion criterion (a) (1 male and 1 female). Of the 34 participants who started the alpine skiing learning program, one male was eliminated for not satisfactorily passing the exclusion criteria (a). The final sample of the study was 33 participants, of whom 29 were males and four females (See flow chart in Figure 3).

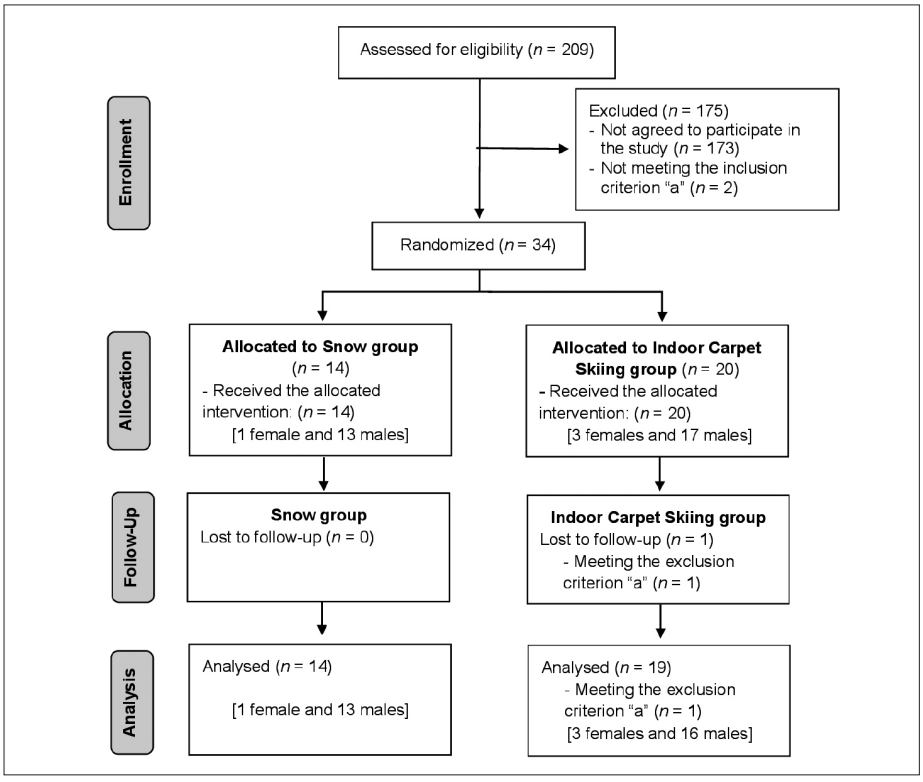

Fig. 3. - Flow chart of the design and participants of the present study.

Table II shows the general characteristics of the participants and the differences between the ICSG and SG. The results of the Mann-Whitney U test showed that the participants in the ICSG were statistically significantly older than those from the SG ($p < 0.01$). However, for the rest of the general characteristics statistically significant differences between the participants from the ICSG and SG were not found ($p > 0.05$). The internal consistency of all the dependent variables was adequate (autotelic experience, $\alpha = 0.92$, $\Omega = 0.96$; cognitive anxiety, $\alpha = 0.80$, $\Omega = 0.85$; somatic anxiety, $\alpha = 0.78$, $\Omega = 0.82$; self-confidence, $\alpha = 0.92$, $\Omega = 0.93$).

TABLE II
General Characteristics of the Included Participants and Differences Between the Indoor Carpet Skiing Group and Snow Group

	Total (*N* = 33)	**SG (*n* = 14)**	**ICSG (*n* = 19)**	**p[a]**
Demographic				
Age (years)	19.0 (3.0)	19.0 (0.3)	21.0 (6.0)	0.006
Gender (females/males)	12.1/87.9	7.1/92.9	15.8/84.2	0.452
Anthropometric				
Body mass (kg)	73.5 (11.9)	73.2 (12.7)	73.5 (12.4)	0.948
Body height (cm)	178.0 (13.1)	178.1 (13.0)	174.6 (12.6)	0.616
Body mass index (kg/m^2)	23.4 (2.9)	23.0 (4.9)	23.7 (2.4)	0.616
Sport habits				
Sport participation (days/week)	5.0 (2.0)	5.0 (1.0)	5.0 (2.0)	0.397
Sport participation (min/week)	120.0 (60.0)	105.0 (75.0)	120.0 (60.0)	0.788
Sliding sports experience (no/yes)	84.8/15.2	85.7/14.3	84.2/15.8	0.905

Note. Data are reported as median (interquartile range) or percentage for the continous and categorial variables, respectively. ICSG = Indoor skiing carpet group; SG = Snow group.
[a] Significance level from the Mann-Whitney U test and the chi squared test for the continous and categorial variables, respectively.

Alpine skiing turn technique

Table III shows the comparison of the effect of starting to learn to ski through indoor carpet skiing and in the snow setting on alpine skiing turn technique. Results of the Mann-Whitney U test showed that the participants in the ICSG had a statistically significant better balance position ($Z = 3.513$; $p = 0.002$; $r = 0.61$), speed control ($Z = 3.131$; $p = 0.002$; $r = 0.54$), and tra-

TABLE III
Comparison of the Effect of Start Learning Skiing in an Indoor Carpet Skiing and on Snow Settings on Alpine Skiing Turn Technique

Variables	Day	SG (n = 14)	ICSG (n = 19)	Mann-Whitney U test		Effect size
				Z	*p*	*r*
Balance position	1st	2.0 (0.3)	2.0 (0.3)	2.579	0.065	0.45
	2nd	2.0 (1.0)	2.0 (1.0)	0.284	0.837	0.05
	3rd	2.0 (1.0)	3.0 (1.0)	0.950	0.418	0.17
	4th	3.0 (1.3)	3.0 (0.0)	0.617	0.597	0.11
Speed control	1st	2.0 (1.0)	2.0 (0.0)	1.382	0.283	0.24
	2nd	2.5 (1.3)	2.0 (1.0)	0.186	0.866	0.03
	3rd	3.0 (1.0)	3.0 (1.0)	0.480	0.679	0.08
	4th	3.0 (0.3)	3.0 (0.5)	0.774	0.544	0.13
Trajectory control	1st	1.0 (1.0)	2.0 (1.0)	1.403	0.235	0.24
	2nd	2.0 (0.0)	2.0 (0.3)	0.047	0.985	0.01
	3rd	2.0 (1.0)	2.0 (0.0)	1.753	0.199	0.31
	4th	3.0 (1.0)	3.0 (0.0)	0.682	0.625	0.12

Note. Data are reported as median (interquartile range). SG = Snow group; ICSG = Indoor carpet skiing group.

jectory control levels (Z = 3.587; p = 0.002; r = 0.62) during the first snow session (i.e., the third day of intervention) than those from the SG (i.e., the first day of intervention). However, for the other pairwise comparisons statistically significant differences between the students from ICSG and SG were not found in any day of the program ($p > 0.05$).

Moreover, the results of the Wilcoxon test showed that both the SG and ICSG participants statistically significantly improved the three dimensions of the alpine skiing turn technique from the beginning to the end of the 4-day skiing course (SG, balance position: Z = 2.879, p = 0.004, r = 0.54; velocity control: Z = 3.256, p = 0.001, r = 0.62; trajectory control: Z = 3.397, p = 0.001, r = 0.64; and ICSG, balance position: Z = 3.276, p = 0.001, r = 0.53; velocity control: Z = 3.630, $p < 0.001$, r = 0.59; trajectory control: Z = 3.704, $p < 0.001$, r = 0.60).

AUTOTELIC EXPERIENCE AND ANXIETY STATE

Table IV shows the comparison of the effect of starting to learn skiing with ICS and the snow setting on autotelic experience and state of anxiety. The results of the Mann-Whitney U test showed that the participants in the

TABLE IV
Comparison of the Effect of Starting to Learn Skiing in an Indoor Carpet Skiing and in Snow Settings on Participants' Autotelic Experience and Anxiety State

Variables	Day	SG (n = 14)	ICSG (n = 19)	Mann-Whitney U test		Effect size
				Z	p	r
Autotelic experience	1st	8.4 (0.9)	9.0 (1.5)	1.706	0.091	0.30
	2nd	9.0 (2.4)	9.0 (1.5)	0.908	0.377	0.16
	3rd	9.9 (2.3)	9.5 (2.0)	0.399	0.706	0.07
	4th	10.0 (1.3)	10.0 (1.8)	0.438	0.706	0.08
Cognitive anxiety	1st	2.6 (2.4)	3.0 (3.6)	0.109	0.928	0.02
	2nd	2.7 (3.0)	2.0 (2.4)	2.047	0.042	0.36
	3rd	2.1 (5.0)	2.8 (4.2)	0.238	0.815	0.04
	4th	2.3 (5.2)	1.0 (3.6)	1.685	0.098	0.29
Somatic anxiety	1st	2.0 (2.4)	1.8 (2.0)	0.493	0.627	0.09
	2nd	1.1 (2.2)	0.0 (1.2)	1.862	0.071	0.32
	3rd	0.3 (1.8)	1.4 (2.0)	1.381	0.174	0.24
	4th	0.2 (1.9)	0.4 (1.2)	0.154	0.900	0.03
Self-confidence	1st	6.9 (2.9)	7.0 (2.6)	0.146	0.900	0.03
	2nd	8.5 (3.0)	8.2 (3.8)	0.091	0.928	0.02
	3rd	8.8 (2.6)	7.6 (3.2)	1.021	0.321	0.18
	4th	9.0 (1.9)	8.6 (1.2)	0.770	0.461	0.13

Note. Data are reported as median (interquartile range). SG = Snow group; ICSG = Indoor carpet skiing group.

ICSG reported statistically significantly lower cognitive anxiety levels during the second session than those from the SG ($Z = 2.047$; $p = 0.042$; $r = 0.36$). Additionally, the results showed that the participants in the ICSG reported statistically significantly higher autotelic experience levels during the first snow session (i.e., the third day of intervention) than those from the SG (i.e., the first day of intervention) ($Z = 2.133$; $p = 0.035$; $r = 0.37$). However, for the other pairwise comparisons statistically significant differences between the students from ICSG and SG were not found ($p > 0.05$).

Moreover, the results of the Wilcoxon test showed that both the SG and ICSG participants statistically significantly improved their punctuations diminishing the somatic anxiety ($Z = 2.200$, $p = 0.028$, $r = 0.42$ and $Z = 3.554$, $p < 0.001$, $r = 0.58$, respectively) and increasing their self-confidence ($Z = 2.387$, $p = 0.017$, $r = 0.45$ and $Z = 3.578$, $p < 0.001$, $r = 0.58$, respectively) from the beginning to the end of the 4-day skiing course.

The results of the Wilcoxon test also revealed that only SG participants increased statistically significantly their autotelic experience ($Z = 3.190$, $p = 0.001$, $r = 0.60$; for the ICSG participants the values were $Z = 1.422$, $p = 0.155$, $r = 0.23$) and, on the contrary, only ICSG participants statistically significantly diminished the cognitive anxiety variable ($Z = 2.486$, $p = 0.013$, $r = 0.40$; for the SG participants the values of this variable were $Z = 0.140$, $p = 0.889$, $r = 0.03$).

Discussion

The purpose of the present study was to compare the effects of an alpine skiing learning intervention initiated in an indoor carpet setting with one in a snow setting on the alpine skiing turn technique, state of anxiety, and autotelic experience in university students. Overall, results show effects on cognitive anxiety by the second day of the program and some other signs of significance to this variable at the fourth day of the program, on the somatic anxiety variable at the second day, and as well as on the skiing turn technique at the end of the first day of the program (balance position dimension). Unfortunately, there is no previous similar research to compare these outcomes with.

In regard to the effects of comparing the beginning to the end of the 4-day skiing course the ICSG participants improved their state of anxiety (only the cognitive anxiety variable) and the SG participants improved their satisfaction regarding their ski-learning experience (i.e., autotelic experience). It is important to denote that both groups achieve the maximum punctuation in autotelic experience the fourth day (an average of 10 points in a 11-point scale), so the fact that only the SG participants improved their punctuation in a statistical way is due to the starting point, which was lower for the SG than the ICSG participants (i.e., 8.4 for the SG participants instead 9.0 for the ICSG participants). As states previous research obtained, these kinds of activities developed outdoors, in the middle of nature (i.e., enjoying the mountain and its environment) have resulted to be very pleasant (Mayorga-Vega et al., 2017).

Regarding the learning of the alpine skiing turn technique, it is important to point out that both study groups learnt it in a statistically significantly way from the first to the fourth day of the program. This outcome, being similar to results obtained in previous research of short-term programs in alpine skiing in the snow setting at ski-resorts, with children (Lakota, Turkovič, & Bilić, 2019) as well as young adults (Wojtyczek, Pasławska, & Raschner, 2014). Consequently, a first conclusion could be that the ICS setting is a good

environment to start skiing in regard to the overall effects of a short-term learning program on beginner skiers.

None of the groups had any advantage over the other comparing the day by day during the whole of the skiing learning program development in relation to alpine skiing turn technique. This is a remarkable issue due to the fact that starting to learn to ski in the ICS setting had no detrimental effects on the alpine turn technique when compared to the snow setting. Therefore, multiple applications are deduced from these results such as that starting to ski in the ICS setting is possible and it does not negatively affect the alpine skiing technique when environmental or logistical conditions do not allow to start skiing on snow tracks (e.g., students from schools that want to start skiing in a particular programmed week and the climate conditions do not allow for it normally on the ski-resort or, for instance, when schools are too far away from any ski-resort). However, statistically significant differences were found between the first day of skiing in the snow setting for both groups. It seems obvious that for the ICSG results were better than for the SG due to participants from the ICSG having had two previous sessions on the ICS that the SG participants had not. However, these results are important because it confirms that starting to ski in an ICS setting does not slow down the skiing turn technique learning, and using the ICS setting is a good solution for people who cannot access a ski-resort, or for people who want to reduce costs in regard to travelling to skiing in snow tracks, for instance. Besides, people in general and students from schools who want to start skiing will know that they can start practicing alpine skiing in the ICS setting in order to continue skiing in ski-resorts after they feel more secure and have acquired the first familiarization and basic movements in this sport modality. Furthermore, they will achieve consequently a better performance after attending a normal short-term ski program commonly delivered in ski resorts all over the world. Finally, it is also interesting to continue researching the results obtained at the end of the first day of the program, because there were signs of significance in the balance position in favor of the ICSG ($p = 0.065$), which could be confirmed with a higher number of participants in future samples, taking into account that at the present study the effect size was moderate ($r = 0.45$) (Cohen, 1992). Although it is a similar sensation to ski on snow and on an ICS (Panizzolo, Marcolin, & Petrone, 2013), there are some differences that could influence in this dimension of the alpine skiing turn technique (e.g., the surface of the carpet is sliding under our skies instead the skier sliding on the slope). It is therefore interesting to delve more into this issue in further research to contrast results of the present research.

Regarding the state of anxiety in the participants, it is remarkable that punctuations were low in general (i.e., under three points out of 10). Low punctuations could be registered perhaps due to this sample group (Sport Sciences university students) having experience with practicing sports of this kind, and perhaps further research should investigate this issue in recreational, adult, and school-aged beginner skiers (i.e., children and adolescents), who could respond in a different way facing this new risk of a sport learning program. Overall, results showed that cognitive anxiety was reduced by the second day of the alpine skiing learning program for the ICSG, and a tendency to the significance was also detected at the beginning of the second day for somatic anxiety and the fourth day of the program for cognitive anxiety in favor of ISCG ($p = 0.07$ and $p < 0.10$, respectively). Unfortunately, there are no previous experiences in ISC settings analyzing levels of anxiety in alpine skiers. It is possible that the familiarization of the ICS participants with alpine skiing practice was quicker than in the snow setting the first day, because of the stable conditions of the ICS setting, allowing practitioners to achieve greater confidence regarding the expectations about success, and reducing the anxiety toward facing the second day of the skiing learning program, which is an important outcome for designing future alpine skiing learning programs. Moreover, the ICS environment could have produced in ICS participants a higher familiarity and a lower perception of uncertainty than the SG participants, due to the state of the snow and weather climate at the mountain which could cause a lack of control over the environment, consequently increasing the anxiety levels associated to the practice of alpine skiing (Craft, Magyar, Becker, & Feltz, 2003). In relation of the rest of the days of the program and levels of anxiety, some explanations need to be added. Primarily, and despite that there were no differences between the ICSG and the SG, it is understandable that the values of the first day of the program were similar for both groups, due to it being a new risk situation for all the participants. It is important to denote that the third day of the program, which is the first one for the ICSG in the snow setting, the levels of anxiety were similar for both groups, despite the SG having had two previous days in the snow setting. Therefore, to start skiing in the ICS setting is useful for a positive management of the anxiety levels in beginner skiers before going to the snow setting, being comparable to starting to ski in the snow setting.

Finally, overall results for the autotelic experience did not show any difference for any of the groups in this research. This is also an important outcome as we can deduce that the ICS setting is comparable to the snow setting regarding the enjoyment that both environments provide to participants. Results of the present research verified that experiences in both envi-

ronments have caused high levels of satisfaction in both groups, being always over 8.4 on a 10 points scale. Moreover, both groups were increasing their autotelic experience day by day. The SG registered punctuations from 8.4 to 10 points progressively from the first day to the fourth day of the program, and the ICSG registered values from 9 to 10 increasing day by day as well. Therefore, despite the snow setting representing a well-known enjoyable environmental experience, mainly due to it being an outdoor practice, the ICS setting is comparable from the enjoyment that these experiences provided to participants point of view. These results regarding the enjoyment of outdoor experiences had been registered previously in Physical Education programs[14] as well as in other populations (Houge Mackenzie & Brymer, 2020). Moreover, it is also important to point out that signs of significance were detected in the autotelic experience for the first day of the program between the participants of both groups in favor of the ICS participants ($p < 0.10$). Nevertheless, further research regarding this issue needs to be addressed in order to confirm any difference in the autotelic experience variable between both environments and its causes.

The main strength of the present study was that, to our knowledge, it is the first study that compares the psychological factors of the state of anxiety and autotelic experience, and the behavioural variable of the alpine skiing turn technique in a short-term alpine skiing learning program, between the snow and ICS settings. Results of this research should be verified in future studies complementing them with the manipulation of some factors and sample characteristics (e.g., using greater sample numbers or conducting comparative analyses according to gender or previous experience in skiing). Furthermore, future research studies in which the sampling distribution is normally distributed, could complement the outcomes of this study by measuring other related psychological variables like motivation or the satisfaction of basic psychological needs (together with those measured in this study) to perform a regression analysis in order to check the predictive values of them as independent variables on dependent variables (e.g., anxiety, autotelic experience, and skiing abilities). Regarding the limitations of the study, the sample size and characteristics did not allow for the generalization of results or for comparing analyses such us gender differences or any other contextual factor (e.g., previous skiing experience of participants). Although gender differences have not been found in previous alpine ski experiences for the state of anxiety (Koca, 2017) or for alpine skiing skills (Cigrovski, Prlenda, & Radman, 2014), future research with wider samples could analyze these important factors (i.e., gender and alpine skiing technique) regarding the variables studied in the present study.

Conclusions

The ICS setting seems to be a useful and motivating environment that can be used as a substitutive of the snow setting for the convenience of beginner skiers when they start skiing, for scholar programs as well as for recreational young adults who want to start learning skiing. Starting skiing in an ICS setting does not imply any prejudice, neither impeding the technical skiing learning nor having any other negative consequence on a psychological level (e.g., anxiety). On the contrary, starting to learn to ski in an ICS setting could help beginner skiers to overcome the first levels of anxiety that come with the instability of skiing in the snow setting and maintaining high levels of satisfaction that this recreational activity supposes for practitioners (in comparison to the snow setting).

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REFERENCES

Aletta, F., Oberman, T., & Kang, J. (2018). Associations between positive health-related effects and soundscapes perceptual constructs: A systematic review. *International Journal of Environmental Research and Public Health*, *15*(11), 1-15. doi:10.3390/ijerph15112392

Arruza Gabilondo, J. A., González Rodríguez, O., Palacios Moreno, M., Moreno, M., Arribas Galarraga, S., & Cecchini Estrada, J. A. (2012). Validation of the competitive state anxiety inventory 2 (CSAI-2 re) through a web application. *Revista Internacional de Medicina y Ciencias de la Actividad Física y del Deporte*, *12*(47), 539-556.

Borkovec, T., Robinson, E., Pruzinsky, T., & DePree, J. (1983). Preliminary exploration of worry: Some characteristics and processes. *Behaviour Research and Therapy*, *21*(1), 9-16. doi:10.1016/0005-7967(83)90121-3

Cigrovski, V., Franjki, I., Rupčić, T., Baković, M., & Matković, A. (2017). Comparison of standard and newer balance tests in recreational alpine skiers and ski novices. *Montenegrin Journal of Sports Science and Medicine*, *6*(1), 49-55.

Cigrovski, V., Matkovič, B., & Ivanec, D. (2008). The role of psychological factors in the alpine skiing learning process of novice skiers. *Croatian Sports Medicine Journal*, *23*(1), 45-50.

Cigrovski, V., Prlenda, N., & Radman, I. (2014). Future of alpine skiing schools-gender related programs. *Montenegrin Journal of Sports Science and Medicine*, *3*(1), 5-8.

Cigrovski, V., Radman, I., Konter, E., Očić, M., & Ružić, L. (2018). Sport courage, worry and fear in relation to success of alpine ski learning. *Sports*, *6*(3), 96. doi:10.3390/sports6030096

Cocks, K., & Torgerson, D. J. (2013). Sample size calculations for pilot randomized trials: A confidence interval approach. *Journal of Clinical Epidemiology*, *66*(2), 197-201. doi:10.1016/j.jclinepi.2012.09.002

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155-159.

Craft, L. L., Magyar, T. M., Becker, B. J., & Feltz, D. L. (2003). The relationship between the

competitive state anxiety inventory-2 and sport performance: A meta-analysis. *Journal of Sport and Exercise Psychology*, *25*(1), 44-65. doi:10.1123/jsep.25.1.44

Dahlstrom, E. A. (2008). *An examination of arousal states in novice whitewater kayakers during a weekend instructional experience* [Doctoral dissertation, Ohio University]. http://rave.ohiolink.edu/etdc/view?acc_num=ohiou1213027065

Dali, M. S. B., & Parnabas, V. A. (2018). The effects of self-talk on free throw performance and the level of anxiety among male novice basketball players. *Malaysian Journal of Movement, Health & Exercise*, *7*(1), 73-87.

Eldridge, S. M., Chan, C. L., Campbell, M. J., Bond, C. M., Hopewell, S., Thabane, L., … Tugwell, P. (2016). CONSORT 2010 statement: Extension to randomised pilot and feasibility trials. *The BMJ*, *355*, i5239. doi:10.1136/bmj.i5239

Fasel, B., Spörri, J., Schütz, P., Lorenzetti, S., & Aminian, K. (2017). An inertial sensor-based method for estimating the athlete's relative joint center positions and center of mass kinematics in alpine ski racing. *Frontiers in Physiology*, *8*, 850. doi:10.3389/fphys.2017.00850

Field, A. (2017). *Discovering statistics using IBM SPSS Statistics* (5th ed.). London: SAGE Publications.

García-Calvo, T., Jiménez, R., Santos-Rosa, F. J., Reina, R., & Cervelló, E. (2008). Psychometric properties of the spanish version of the Flow State Scale. *The Spanish Journal of Psychology*, *11*(2), 660-669. doi:10.1891/jnum.11.1.61.52067

Giles, D., Fryer, S., Dickson, T., Moore, L., & Draper, N. (2020). Effect of chronic exposure to height on the psychophysiological responses to a climbing task. *The Journal of Sport and Exercise Science*, *4*(2), 106-111. doi:10.36905/jses.2020.02.06

Gillet, N., Berjot, S., Vallerand, R. J., & Amoura, S. (2012). The role of autonomy support and motivation in the prediction of interest and dropout intentions in sport and education settings. *Basic and Applied Social Psychology*, *34*(3), 278-286. doi:10.1080/01973533.2012.674754

Guijarro-Romero, S., Mayorga-Vega, D., Casado-Robles, C., & Viciana, J. (2020). Does students' self-determined motivation toward Physical Education influence the effectiveness of a fitness teaching unit? A cluster-randomized controlled trial and cluster analysis. *Psychology of Sport and Exercise*, *51*, 101768. doi:10.1016/j.psychsport.2020.101768

Hofmann, A. R. (2012). Bringing the alps to the city: Early indoor winter sports events in the modern city of the twentieth century. *International Journal of the History of Sport*, *29*(14), 2050-2066. doi:10.1080/09523367.2012.719882

Houge Mackenzie, S., & Brymer, E. (2020). Conceptualizing adventurous nature sport: A positive psychology perspective. *Annals of Leisure Research*, *23*(1), 79-91. doi:10.1080/11745398.2018.1483733

Jurečka, J. (2020). Effect of the different ski length on the level of anxiety at novice skiers. *Studia Sportiva*, *14*(2), 52-56.

Koca, F. (2017). Evaluation of state and trait anxiety levels among with students with no prior knowledge of skiing befor and after the implementation of a skiing course. *Anthropologist*, *20*(3), 485-491. doi:10.1080/09720073.2015.11891753

Künzell, S., & Müller, J. (2008). The use of bigfoots reduces state anxiety in novice skiers. *Journal of Applied Sport Psychology*, *20*(2), 253-260. doi:10.1080/10413200701871192

Lakota, R., Turković, B., & Bilić, Ž. (2019). The effects of alpine skiing training on the adoption of skiing elements in girls. *Sportski Logos*, *17*, 43–46.

Lee, H. W., Yoo, J., Cha, J. Y., Ji, C. H., Eun, D., Jang, J. H., … Jee, Y. S. (2019). Effects of winter skiing on stress, heart rate, apprehension, and enjoyment in collegiate students: A single randomized controlled trial. *Journal of Exercise Rehabilitation*, *15*(2), 235–241. doi:10.12965/jer.1938116.058

Mann, A., & Narula, B. (2017). Positive psychology in sports: An overview. *International Journal of Social Sciences*, *6*(2), 153-158. doi:10.5958/2321-5771.2017.00017.5

Mayorga-Vega, D., Ocaña-Wilhelmi, J., Gómez-López, P. J., & Viciana, J. (2017). Efecto de un programa extraescolar de esquí sobre la motivación hacia la educación física y la intención de ser activo en escolares de educación primaria. Resultados preliminares. In A. Baena-Extremera, A. Granero-Gallegos, A. Martínez Baena, & M. Ortíz-Camacho (Eds.), *Enseñanza de la Educación Física y las Actividades en el Medio Natural* (pp. 115-126). Sevilla: Wanceulen.

Panizzolo, F. A., Marcolin, G., & Petrone, N. (2013). Comparative evaluation of two skiing simulators as functional training devices for recreational skiers. *Journal of Sports Science and Medicine*, *12*(1), 151-158.

Spieth, P. M., Kubasch, A. S., Penzlin, A. I., Illigens, B. M. W., Barlinn, K., & Siepmann, T. (2016). Randomized controlled trials - a matter of design. *Neuropsychiatric Disease and Treatment*, *12*, 1341-1349. doi:10.2147/ndt.s101938

Spörri, J., Kröll, J., Fasel, B., Aminian, K., & Müller, E. (2016). Rehabilitation following ACL-Reconstruction in alpine ski racing - can indoor carpet skiing build the bridge between. In E. Muller, J. Kroll, S. Lindinger, J. Pfusterschmied, J. Spörri, & T. Stöggl (Eds.), *Book of Abstracts of the 7th International Congress on Science and Skiing* (pp. 197–207). St. Christoph Arlberg: Maidenhead Meyer & Meyer.

Stewart, A., Marfell-Jones, M., Olds, T., & De Ridder, J. (2011). *International standards for anthropometric assessment*. New Zealand: International Society for the Advancement of Kinanthropometry.

Sutherland, S., & Legge, M. (2016). The possibilities of "doing" outdoor and/or adventure education in physical education/teacher education. *Journal of Teaching in Physical Education*, *35*(4), 299-312. doi:10.1123/jtpe.2016-0161

Viciana, J., Ocaña-Wilhelmi, F. J., Gómez-López, P. J., Casado-Robles, C., & Mayorga-Vega, D. (2023). Alpine ski technique observation instrument: Reliability and validity. *Revista Internacional de Medicina y Ciencias de la Actividad Física y del Deporte*, *23*(90), 436-449. doi:10.15366/rimcafd2023.90.031

Vieira, L. F., Balbim, G. M., Pimentel, G. G. de A., Hassumi, M. Y. S. S., & Garcia, W. F. (2011). Estado de fluxo em praticantes de escalada e skate downhill. *Motriz: Revista de Educação Física*, *17*(4), 591-599. doi:10.1590/s1980-65742011000400003

Wojtyczek, B., Pasławska, M., & Raschner, C. (2014). Changes in the balance performance of polish recreational skiers after seven days of alpine skiing. *Journal of Human Kinetics*, *44*, 29-40. doi:10.2478/hukin-2014-0108

Yogi, Y., & Kyan, A. (2021). Psychological changes in anxiety, enjoyment, and value of learning in junior high school students learning judo. *Journal of Physical Education and Sport*, *21*(4), 1676-1681. doi: 10.7752/jpes.2021.04212

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