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ORIGINAL

ALPINE SKI TECHNIQUE OBSERVATION INSTRUMENT: RELIABILITY AND VALIDITY

INSTRUMENTO DE OBSERVACIÓN DE LA TÉCNICA EN ESQUÍ ALPINO: FIABILIDAD Y VALIDEZ

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ABSTRACT

The aim of the study was to design an accurate and useful observational instrument for evaluating basic turn techniques in alpine skiing, and to determine its validity and reliability. A multi-step approach was used to design and validate the instrument: a literature revision; an expert meeting; a pilot test; the assessment of intra- and inter-observer reliability; a convergent validity test; and the responsiveness calculation with a pre- post-test. Results showed adequate values of intra-rater (P=0.80-0.83) and inter-rater reliability (P=0.86-0.97). For the convergent validity, a moderate statistically significant correlation for the speed and trajectory control dimensions were achieved ($r$ho=0.58-0.65, p<0.001), but not for the balance position dimension ($r$ho=0.24, p=0.166). The responsiveness was also acceptable (p<0.05, r=0.46-0.60). In conclusion, the

Alpine Ski Technique Observation Instrument is a useful, reliable, valid, and responsive observational tool.

KEY WORDS: skiing abilities; checklist; instrument development; intra-rater reliability; inter-rater agreement; convergent validity evidence.

RESUMEN

El objetivo del estudio fue diseñar un instrumento de observación preciso y útil para evaluar la técnica de cambios de dirección básicos en el esquí alpino, y determinar su validez y fiabilidad. Para diseñar y validar el instrumento se siguieron los siguientes pasos: revisión de la literatura, valoración por comité de expertos, prueba piloto, evaluación de la fiabilidad intra e inter-evaluador, prueba de validez convergente, y cálculo de sensibilidad con una prueba pre y post-intervención. Los resultados mostraron valores adecuados de fiabilidad intra-evaluador (P=0,80-0,83) e inter-evaluador (P=0,86-0,97). Respecto a la validez convergente se obtuvo una correlación moderada para las dimensiones de control de la velocidad y de la trayectoria ($r$ho=0,58-0,65, p<0,001), pero no para la dimensión de posición de equilibrio ($r$ho=0,24, p=0,166). La sensibilidad fue aceptable (p<0,05, r=0,46-0,60). En conclusión, el Instrumento de Observación de la Técnica en Esquí Alpino es una herramienta útil, fiable, válida y sensible.

PALABRAS CLAVE: Habilidades para esquiar, lista de verificación, desarrollo de instrumentos, fiabilidad intra-evaluador, fiabilidad inter-evaluador, validez convergente.

INTRODUCTION

As in every modality of individual sport, techniques of specific motor skills are essential in order to reach optimal results. This is true in the beginners' learning process (Cigrovski et al., 2017) as well as in the performance of high-level practitioners (Müller et al., 2017). Specifically, it is additionally important when the sport modality is alpine skiing, where the level of security in its practice depends on the technique performed by skiers together with the uncertainty of the environmental domain (Román, 2008).

Alpine skiing, as a risk sport activity, requires an emphasis on motor capabilities, as they affect the level of proficiency at any level of execution (Lakota et al., 2019). Snow-plough and other basic turns are specific fundamental skills in alpine ski when beginners start skiing, mainly because they are crucial skills for controlling the slide velocity, slow turns, and consequently to maintain security while downhill skiing (Bon et al., 2021; Supej & Holmberg, 2019). That is why the most methods of learning skiing for beginners are centered on these specific performance techniques (Bogdan & Lazar, 2015; Cigrovski et al., 2014). However, there are other methods that try to avoid snow-plough turns and stemming because they do not directly lead to parallel skiing (e.g., the One-Ski-Method, Kassat, 2009), or even combining snow-plough with parallel methods in order to increase the effectiveness in beginner alpine skiers (Cigrovski et al., 2010).

However, evaluating these specific skills in alpine skiing is not an easy task for teachers that want to chronicle the progress of a group of beginner skiers. In the field context, measurement instruments have to be characterized as being feasible (the instrument needs to be easily applied in the field of alpine skiing and for beginner skiers), reliable (i.e., the degree to which the measurement is free from measurement error), valid (i.e., the degree to which the content and the scores of an instrument are an adequate reflection of the construct and its dimensionality to be measured), and responsive (i.e., the ability of the instrument to detect change over time in the construct to be measured, entailing two scores and the validity of its change) (Mokkink et al., 2010).

After reviewing the literature, to our knowledge, there are no economic, easy to apply, reliable and validated instruments for evaluating these specific alpine skiing abilities in a teaching context. The main evaluation method observed in previous literature has been the consensus or the average of several independent experts who observed the technique according to one observation scale that evaluates the technique performance. An example would be the Austrian school grading scale, which is a 1 to 5 Likert scale from “perfect” to “failed execution” of the curve performed by participants (Müller et al., 2017). Summarizing, several problems have been detected in previous research that have used systematic observation sheets for evaluating the technique ability in alpine skiing abilities:

(a) There was no accurate definition of the items to observe or the items were defined in a very qualitative manner. For example, Cigrovski et al. (2010) used a 1 “unacceptable performance” to 5 “superb performance” scale applied on several selected basic alpine skiing abilities observed by five experts in order to measure the learning progress after a 7-day ski course for beginners. It is also the case of Kurpiers et al. (2017), who used a 1-10 scale rated from “very poor” to “excellent” in relation to seven aspects of the technique: skis parallel, canting, position of the ski, tight upper body, pole planting, tilting the knees, and smooth-fluent turns. However, similar to the Müller et al. (2017) research, the scale of Kurpiers et al. (2017) did not have any definitions of each of the scale items, making the evaluation process more inaccurate and subjective.

(b) Global evaluations, in which the criteria of all the components of the technique were mixed in the same item, so that the resulting number of an evaluation did not allow for distinguishing exactly where the technical problem was allocated in the skier assessed (e.g., Lakota et al., 2019).

(c) Excessively simple observations that make impossible to measure the different levels of performance in the skiers observed. For example, a checklist: yes/no, or 1/2, regarding to several positions or movements, which do not allow to distinguish between different learning achievement levels in observed skiers during a teaching process (Román, 2008).

(d) The use of single instruments that observe an isolated technique such as snow-plough turns in a particular research, not allowing for the observation of more than one technique with the same instrument, such as fundamental turns or parallel turns (e.g., Martínez-Álvarez et al., 2016).

(e) Overly complex computational analyses that use biomechanical techniques with kinematic parameters. For example, angles measurement and biomechanical analyses performed frame by frame and compared with a technical ability model (Supej, et al., 2015; Taek et al., 2016).

(f) Expensive methods with new technologies like the use of force platforms with electronic sensors (Inglés et al., 2017).

In these two last cases, despite its validity and accuracy, due to the complexity of the analyses and the equipment needed to carry out the evaluation process, the method to evaluate the performance in skiing is not feasible to be applied by teachers, for instance, in a short-term beginner learning course with less resources.

Consequently, the purposes of the present study were the following: (a) to design an accurate and useful new observational instrument for the evaluation of basic turn techniques (i.e., snow-plough, fundamental, and parallel turns) in alpine skiing; (b) to examine the intra-rater and inter-rater reliability of the scores of the observational instrument for the evaluation of basic turn techniques in alpine skiing, and (c) to study the convergent validity evidence of the scores, and the responsiveness of the observational instrument designed for the evaluation of basic turn techniques in alpine skiing.

MATERIAL AND METHODS

The present study is defined as a reliability and agreement study, and it was reported according to the GRRAS guidelines (Kottner et al., 2011). The protocol conforms to the Declaration of Helsinki statements (64th WMA, Brazil, October 2013) and it was first approved by the Ethical Committee for Human Studies at the University of Granada.

PARTICIPANTS

A total of 209 young adults were invited to participate in the present study. All of whom were university students that were attending winter sports classes at the Faculty of Sport Sciences at the University of Granada, and they had the opportunity of being evaluated in the alpine skiing technique while receiving a short-term ski course for beginners. The main reason for selecting this kind of sample was that beginner alpine skiers could provide the present study a high variability of performances and scores, allowing the researcher to check the observational instrument in a better way than with an expert alpine skier sample. After giving information about the characteristics of the project, all the signed written consents and permissions were obtained.

The inclusion criteria were: (a) presenting the signed written informed consent; (b) participating voluntarily in the offered ski learning course for beginners and to attend the three first days of the ski learning program; (c) not having previous ski experience; and (d) not having any pathology that would prevent the participant from skiing. The exclusion criteria were: (a) not attending the short-term learning course completely; (b) not performing the post-intervention evaluation, and (c) not performing the pre-intervention evaluation (for subsample only). Finally, a total of 35 participants were recruited (30 males and 5 females, age = 21.4 ± 4.3 years; body height = 176.6 ± 8.9 cm; body mass = 73.8 ± 10.0 kg; body mass index = 23.6 ± 2.0 kg/m2; current sport participation = 4.8 ± 1.1 days a week and 112.9 ± 36.9 minutes a week; previous sliding sport experience = 5 participants; previous skiing experience = 0 participants). Then in order to calculate the responsiveness of the instrument, a subsample of 15 participants (13 males and 2 females, age = 19.3 ± 0.8 years) was selected. A priori sample size calculation was estimated as follows: kappa, 4 x 4 categories, alpha = 0.05, power = 0.80, k = 0.50 (minimum sample size, n = 12) (Bujang & Baharum, 2017); Spearman's rank correlation coefficient, alpha = 0.05, rho = 0.50 (minimum sample size, n = 17) (Sheskin, 2011); and Wilcoxon signed-rank test, tails = 2, alpha = 0.05, power = 0.80, and dz = 0.80 (minimum sample size, n = 15) (G*Power version 3.1.9.4).

Two qualified and experienced male ski teachers participated in this study as observers at the different phases of the observation sheet's validation (mean age = 51.5 years old; average ski experience = 44.5 years; average teaching experience = 30.5 years). The criteria considered to be selected as expert teachers were based on those proposed by García-Martín et al. (2016) adapted to the skiing context. They both: (a) have national and regional ski certifications for teaching and training skiers; (b) have been responsible for several ski teaching schools at the Ski Resort of Sierra Nevada, Spain, for more than 30 years, and have directed ski technician training programs for the last five years; (c) have participated as researchers in a formal research group registered in the Scientific Information System of Andalucía (Spain) for eighteen years; (d) have doctorate degrees from the University of Granada; and (e) have publications about analysis of sport performance in skiing.

Finally, four experts also participated in this study in several phases of the validation process. They all have bachelor degrees in Physical Activity and Sports Sciences and doctorate degrees in Sport Sciences by the University of Granada. Three of the four experts had ski experience and a high level of ski mastery aside from being experts in physical activity research methodology. Moreover, the fourth participant was an expert in evaluation and measurement (mean age = 41.38 years old; average methodology in research experience = 13.25 years).

MEASURES

At the beginning of the study, a demographic and sport antecedent survey was delivered to all participants, collecting data regarding sex and age of the participants, sport habits (days per week), time they spend practicing sport, and if they had any previous experience in other sliding sports (e.g., skateboarding or skating). Before delivering the ski program for all the participants, the anthropometric characteristics were also collected in accordance with the International Standards for Anthropometric Assessment (Stewart et al., 2011). Then, body mass index was calculated as body mass divided by the square of body height (kg/m2).

Two instruments were used in this research to evaluate the specific alpine ski ability technique. The first one was designed and validated in the present study. The second one was an observation sheet currently used by the Andalusian Winter Sports Federation to assess the level of performance of alpine ski technicians in training courses.

The first instrument is the Alpine Ski Technique Observation Instrument (IOTEA) [*Instrumento de Observación de la Técnica en Esquí Alpino*, in Spanish], which is focused on evaluating, in a general manner, the three main turns in alpine skiing (snow-plough, fundamental, and parallel turns). This instrument is composed of three dimensions: (a) balanced position, (b) velocity control, and (c) trajectory control. Balanced position is referred to the adaptation of the body segments (including head) and the main skier joints (i.e., those from the lower limb joints: ankle, knee, and hip) to the situation and with balance dominance. Velocity control refers to the maintenance of a continuous velocity during turning, adapted to the level of the skier, with proficiency. Trajectory control refers to the skis' direction and turns performed, the existence of body rotation, the independence of leg movements, and flex-extension and rotation of knees, letting the skiers control the trajectory. All dimensions were scaled into four degrees of learning depending on the ski turning performance, and they were defined in an unequivocal and unambiguous manner. Moreover, this instrument also incorporates symbols and pictures in order to clarify the position and actions of the skier observed in each of the degrees of learning (see degrees of learning definition and symbols/pictures in Appendix 1).

The *Andalusian Winter Sport Federation Observation Sheet* is the second instrument applied to participants in this research. It has been used for the last four years by the Andalusian Winter Sports Federation (Andalucía, Spain) to assess the alpine ski level of technicians during their training process. It is composed of three categories: position (body centered all the way down), velocity (velocity control) and trajectory (turn trajectory control and rhythm changes). Each of the three categories are divided into five levels of mastery, which can be assessed by the scale: "1" "it is not achieved" ["*no lo consigue*", in Spanish], "3" "mid-point" ["*término medio*", in Spanish], and "5" "it is performed perfectly" ["*lo realiza perfectamente*", in Spanish].

PROCEDURE

LITERATURE REVIEW. MAIN TECHNICAL COMPONENTS OF THE BASIC ALPINE SKI TURN IN BEGINNERS AND PREVIOUS OBSERVATION SHEETS

The literature revision was carried out through the main bibliographic research databases (i.e., Scopus and Web of Science) using terms regarding the action of assessing (e.g., to evaluate or to assess, among others); the instrument (e.g., sheet or form, among others); the methodology (e.g., observation or observational, and similar terms); the content to observe (e.g., alpine ski, alpine skiing, among others); and the technique of the skiing actions (turn technique, curve technique, among others, including the name of the specific abilities such as snow-plough, fundamental, or parallel turns).

Several problems were detected in trying to provide a valid and useful observation sheet for teachers focused on the main turns performed in alpine ski. These problems have been referenced and described in the Introduction section, being related to the ambiguity/absence of the definitions of the items or overly simple observations, global evaluations, the use of single instruments that observe an isolated technique (not allowing for the observation of more than one technique with the same instrument), or complex and expensive methods.

As required in this type of studies, and based on the revision of literature regarding the observation sheets, the technical elements of an effective basic alpine ski turning technique were also discussed, synthetized, and defined before designing the new observational instrument. In this process, all constitutive elements that define the proficiency of an alpine ski turning performance were selected and analyzed from previous studies and four components of the skier were deduced: balanced position, velocity control, trajectory control, and coordination of movements while turning. The observation sheets of the Professional Ski Instructors of America (2014), the Canadian Ski Instructors' Alliance (2017), and the ones used by Martínez-Álvarez et al. (2016), by Román (2008), and by Rodríguez (2013, 2014) were taken into account for this synthesis of the technique components of basic turns in alpine ski.

A first observation sheet was created starting with the four aforementioned components, defining four dimensions of the skier while turning (i.e., balanced position, velocity and trajectory control, and coordination of movements). These components were specified into five skiers' levels of execution (i.e., from 1 to 5) in order to be able to register a considerable range of mastery performances.

EXPERT MEETING AND DISCUSSION

Definition of the test situation for evaluating basic turn techniques in alpine skiing. During the first experts meeting, a test situation was also defined in order to have the reference for applying the observation sheet that was being created. This learning/test situation or protocol took into account a previous warm-up of five minutes of mobility and muscle strengthening and five minutes practicing the snow-plough technique (or fundamental or parallel turns, depending on the level of skiers), braking, in an isolated turn or in consecutive turns. The test consists of the entry and the exit of the skier into two curves performed consecutively, one on each side (i.e., left and right turns), and marked on the snow by ski poles. A six meter wide and 10 meter length space was designed for this testing situation on the snow slope. 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 1).

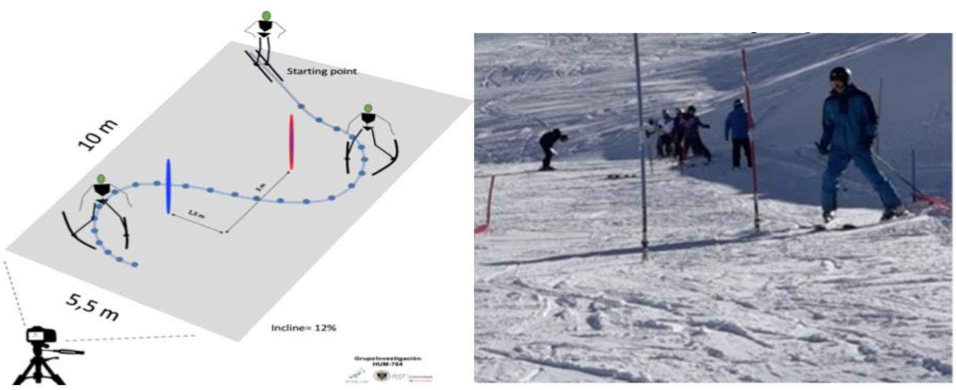

Figure 1. Test situation scheme and picture of the test in the ski track from the camera point of view

Definition of the dimensions and levels of performance (degrees of learning). During the second session of the process, and after the experts' revision of the first sheet, some modifications were performed. First, experts detected a methodological problem that the levels of execution in each of the dimensions were overlapped due to their definitions being based on the same criteria in more than one dimension (e.g., in order to define the levels of performance in the coordination dimension, the position of the upper body was used at the same time as in the balanced position dimension). Consequently, the coordination of movements of the skier was eliminated, and all the criteria of the three remaining dimensions were defined. The balanced position was defined by the following criteria: position of the ankle, knee, and hip joints; and also, by the position of the upper body [shoulders and arms, and head position (or gaze direction)]. The velocity control dimension was defined by the continuity of the movement (stops), the necessity of extra impulses, and the existence of skidding criteria. Finally, trajectory control was defined by the performance of the two planned turns, rotation, leg movement independence, knee flex-extension, and knee rotation criteria (body weight transfer).

Afterwards, considering the difficulties in distinguishing five levels of performance, as was established initially, and in order to define mutually exclusive skiers' executions for each of the dimensions, four levels of performance were defined (see Table 1, and Appendix 1 in Spanish).

Table 1. Four levels of performance of the three dimensions of the Alpine Ski Technique Observation Instrument

	Level 1	**Level 2**	**Level 3**	**Level 4**
Balanced position	The skier is in a seated and unbalanced position. Downward gaze. High possibility of a fall	Extended legs or slightly flexed, also with a light hip delay regarding the feet (a bit seated). Extended arms. Downward gaze	Flexed ankles and knees, slight hip flexion, and upright trunk. Strait arms and looking forward	Flexed ankles-knees-hips, with a slight trunk flexion. Strait arms with semi-flexed elbows. Looking forward
Speed control	The skier stops at some part of the test. He has to impulse himself with his arms or with skiing skate steps	Speed quickly changes (skidding, pushing with ski poles or lateral skate steps). Velocity is not controlled by the skier	Slight accelerations or decelerations (skidding) at some point of the trajectory	Velocity is constant from the beginning to the end of the curve, and all the way down
Trajectory control	The skier does not control the trajectory, does not complete the test. There is no coordination of movements	The skier turns but with trunk-hip rotation at the end of the curve, as a block. There is no clear independence of leg movements. Awkward coordination	The skier turns but with trunk-hip rotation at the beginning of the curve. Some independence of leg flex-extension movements. Knees and hips rotate toward the inside of the curve. One turn is better coordinated than the other one	Skis are directed with control. Flex-extension of the two legs independently. Notable coordination of knee rotation and hip displacement toward the inside of the curve (body weight transfer flow with normality)

PILOT TEST

A pilot test was performed by applying the observation sheet to 34 observations after two days of learning of the ski program for beginners in which they were involved. This pilot sample was selected according to the Fontes et al.'s (2007) recommendation of using at least 25-50 participants for pilot studies.

During the application of the observation sheet the observer had some problems identifying the description of the criterion with the image of the skier during the test, in order to associate the skier's execution according to the established levels of performance. Then, after consulting the group of experts, the research group decided on including: (a) some pictures in the first dimension of balanced position showing the particular positions defined in the levels of performance; and (b) symbols in order to facilitate the identification of the skier's execution with the level of performance definition in the dimensions of trajectory control and velocity control (see pictures and symbols in Appendix 1). After adding the pictures and symbols to the observation sheet, the pilot test was repeated by the same observer and the observation sheet was applied without any incident.

INTRA- AND INTER-OBSERVER RELIABILITY

The two observers defined in the participants' section of this manuscript participated in the following processes of reliability: (a) with a four-week interval between the first and second assessment, the same observer carried out 35 observations two times for a sample of beginner skiers, after the third day of a learning course, in order to determine the reliability of the measurement (see Table 2 in the results section); (b) in order to compare the agreement of the instrument while being used by different observers, a second observer also carried out the same observations of the same sample used for the intra-observer reliability made by the first observer (see Table 2 in the results section).

VALIDITY

Finally, the second observer, who made the second wave of observations in the inter-observer reliability process, also carried out a new observation of the same sample (i.e., N = 35 skiers after the third day of the ski learning course) but with a second observational instrument. In this case, the instrument applied was the one that the Andalusian Winter Sport Federation usually applies in the selection process for alpine ski technicians. This instrument was defined in the instruments section, and it is composed of three dimensions [i.e., position (centered in all the way down), velocity (velocity control) and trajectory (turn trajectory control and rhythm changes)], with five levels of performance each one (from 1 to 5) (see Table 3 in the results section). For the responsiveness measurement of the IOTEA, the first observer also carried out the observations of a subsample of 15 skiers before and after the ski learning program in which they were involved.

STATISTICAL ANALYSIS

Descriptive statistics for all the variables were first calculated. Then, to examine the intra-rater and inter-rater reliability of the scores of the observational instrument, the Proportion of agreement (P) and Kappa coefficient (*k*) were calculated (Kottner et al., 2011). Afterwards, as the two instruments did not have the same scale, to study the validity of the proposed observational instrument the Spearman's rank correlation coefficient (*r*ho) between its scores and the Andalusian Winter Sport Federation Observation Sheet was calculated (Hernaez, 2015). Finally, to examine the differences in the scores of the IOTEA before and after a learning program, the Wilcoxon signed-rank test and the *r* effects size were calculated (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

INTRA-RATER AND INTER-RATER RELIABILITY

Table 2 shows the intra-rater and inter-rater reliability of the scores of the IOTEA for the evaluation of the turn technique in alpine skiing. The results of the proportion of agreement and kappa coefficient showed adequate values of 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).

Table 2. Intra-rater and inter-rater reliability of scores of Alpine Ski Technique Observation Instrument

	Agreement		**Disagreement**			
	n	**%**	***n***	**%**	***P***	***k***
Intra-rater reliability (Rater A, evaluation 1 and 2)						
Balance position	28	80.0	7	20.0	0.80	0.61*
Speed control	29	82.9	6	17.1	0.83	0.62*
Trajectory control	29	82.9	6	17.1	0.83	0.68*
Inter-rater reliability (Rater A-evaluation 1 and rater B)						
Balance position	30	85.7	5	14.3	0.86	0.72*
Speed control	30	85.7	5	14.3	0.86	0.68*
Trajectory control	31	88.6	4	11.4	0.89	0.78*
Inter-rater reliability (Rater A-evaluation 2 and rater B)						
Balance position	33	94.3	2	5.7	0.94	0.89*
Speed control	34	97.1	1	2.9	0.97	0.93*
Trajectory control	33	94.3	2	5.7	0.94	0.89*

Note. Total number of participants, N = 35. P = Proportion of agreement; k = Kappa coefficient.
* $p < 0.001$

VALIDITY

Table 3 shows the convergent validity evidence of the scores of the IOTEA for the evaluation of the turn technique in alpine skiing. The results of the Spearman's rank correlation coefficient showed a statistically significant correlation for the speed control and trajectory control dimensions (*r*ho = 0.65 and 0.58, $p < 0.001$). However, for the balance position dimension a statistically significance correlation was not found (*r*ho = 0.24, p = 0.166).

Table 3. Convergent validity evidence of the scores of the Alpine Ski Technique Observation Instrument (IOTEA) for the evaluation of the curve technique in alpine skiing in respect to the Andalusian Winter Sport Federation Observation Sheet (HOFADI)

	IOTEA	HOFADI	*r*ho	*p*
Balanced position	2.0 (1.0)	3.0 (0.0)	0.24	0.166
Speed control	3.0 (0.0)	4 (1.0)	0.65	< 0.001
Trajectory control	3.0 (1.0)	3 (0.0)	0.58	< 0.001

Note. Data are reported as median (interquartile range). IOTEA (scale 1-4) and HOFADI (scale 1-5)

Table 4 shows differences in the scores of the IOTEA for the evaluation of the turn technique of a subsample of 15 beginner skiers before and after a short-term ski learning program (i.e., responsiveness). The results of the Wilcoxon signed-rank test showed that the participants' balance position, speed control, and trajectory control scores were statistically significant higher after the learning program ($p < 0.05$).

Table 4. Differences in the scores of the Alpine Ski Technique Observation Instrument for the evaluation of a subsample of 15 beginner skiers before and after a short-term ski learning program

	Pre-intervention	**Post-intervention**	***Z***	***p***	***r***
Balance position	2.0 (0.0)	2.0 (1.0)	2.530	0.011	0.46
Speed control	2.0 (1.0)	3.0 (1.0)	2.859	0.004	0.52
Trajectory control	1.0 (1.0)	2.0 (1.0)	3.276	0.001	0.60

Note. $n = 15$. Data are reported as median (interquartile range). IOTEA (scale 1-4).

DISCUSSION

The first purpose of the present study was to design an accurate and useful new observational instrument for the evaluation of the basic turn techniques (i.e., snow-plough, fundamental, and parallel turns) in alpine skiing. The overall results of this study produced the IOTEA. This observational instrument is composed of three dimensions that define the quality in alpine ski basic turn performance (balanced position, velocity control, and trajectory control), and they are defined by mutually exclusive criteria. Each of the three dimensions have four levels of performance in order to classify the degree of execution mastery observed in the skier performance. The aforementioned IOTEA dimensions and levels of performance together with the help of symbols and pictures, let teachers and researchers perform a more faithful assessment, detecting different learning degrees of skiers by using this observation sheet without complex or expensive methods. Besides, this instrument may be used by ski teachers during the teaching-learning process with beginner skiers, to provide them with immediate feedback on those specific technical elements that they perform incorrectly, and therefore, improving their learning and motor performance in the basic turn techniques (Camacho-Lazarraga, 2018)

The second objective of this study was to examine the intra-rater and inter-rater reliability in the scores of the observational instrument for the evaluation of the basic turn techniques in alpine skiing. According to the Cicchetti and Sparrow (1981) criteria for the *k* value interpretation, overall results showed that the IOTEA was "excellent". Also, according to Landis and Koch (1977), all values obtained for the intra- and inter-rater reliability were between "substantial" and "almost perfect", concluding that all *k* values have shown a well ranked position regarding the quality of the reliability.

The third and last aim of the present study was to analyze the convergent validity evidence of the scores and the responsiveness of the observational instrument designed for the evaluation of the basic turn techniques in alpine skiing. In the case of the validity of the IOTEA, the analysis of the dimensions needed to be differentiated. For the velocity and trajectory control dimensions, values of the created observation sheet and the complementary sheet used for this analysis (the Andalusian Winter Sport Federation Observation sheet) were similar, as shown in Table 3. According to Cohen (1992), the value of the correlation is considered as “large”, with *r* values over 0.50. However, when the balanced position dimension is analyzed, the correlation value was low, as shown in Table 3. A possible reason for this discordance in correlation between the values of these two observation sheets may be due to the difference in the items (levels of performance) definitions. While the IOTEA defines its levels of performance in the balanced position dimension based on the lower body joints and position of the upper body extremities (including gaze direction), the Andalusian Winter Sport Federation Observation Sheet bases its levels of performance according to how much distance regarding the total the skier goes in a centered position during the test, that is, the criterion is global and focused on the global body position (center of gravity projection). Therefore, taking into account this difference it can be concluded that the validity indices were adequate, although this validity process should have subsequent analyses in further research. Moreover, the responsiveness of the IOTEA measured by the pre-post-intervention differences in a subsample of 15 beginner skiers before and after a short-term learning program, showed acceptable values of *r*, according to the consensus-based standards for the selection of health status Measurement Instruments (COSMIN, Mokkink, et al., 2010).

In the present study, another examination of construct validity could be to apply the known differences method, meaning, comparing the average scores of the observational instrument between an experienced skiing group and a non-experienced skiing group. Therefore, future research studies should compare the mean scores of the proposed observational instrument between a group with and without experience in alpine skiing.

CONCLUSIONS

In conclusion, the IOTEA is a reliable, valid, and responsive observational instrument for assessing basic turn techniques in alpine skiing, and it has been shown to be useful for beginner skiers in the context of learning alpine skiing.

REFERENCES

Bogdan, T. & Lazar, L. (2015). Comparative aspects of the main ski schools in the world. *Studia Universitatis Babes-Bolyai, Educatio Artis Gymnasticae*, *60*(2), 47-56.

Bon, I., Očić, M., Cigrovski, V., Rupčić, T., & Knjaz, D. (2021). What Are Kinematic and Kinetic Differences between Short and Parallel Turn in Alpine Skiing? *International Journal of Environmental Research and Public Health, 18*(6), 3029.

Bujang, M., & Baharum, N. (2017). Guidelines of the minimum sample size requirements for Cohen’s Kappa. *Epidemiology Biostatistics and Public Health, 14*(2), e12267.

Camacho-Lazarraga, P. (2018). Effect of attentional focus on the learning of individual sports skills. *Retos, 36*, 561-566.

Canadian Ski Instructors' Alliance (2017). Level 1 Certification Course Guide 2017-2018. Montreal (QC H2P 2MP). Montreal. Canadian Ski instructors’ Alliance. Retrieved from http://www.snowproab.com/skipro/alberta/wpcontent/uploads/2017/09/L1GUIDE-ENG-18-color.pdf

Cicchetti, D.V, & Sparrow, S. S. (1981). Developing criteria for establishing interrater reliability of specific items: Applications to assessment of adaptative behavior. *American Journal of Mental Deficiency, 86*, 127-137.

Cigrovski, V., Franjko, I., Rupcic, T., Baković, M., and 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*, 49–55

Cigrovski, V., Matković, B., & Matković, B. (2010). Can we make alpine ski learning more efficient by omitting the snow--plough technique? *SportLogia, 2*, 51-57.

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.

Cohen, J. (1992). A power primer. *Quantitative Methods in Psychology, 112*(1), 155–159.

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

Fontes, G.S., García-Gallego, C., Garriga-Trillo, A.J., Pérez-Llantada, M.C., & Sarriá, E. (2007). *Diseños de investigación en psicología.* Madrid: UNED.

García-Martín, A., Antúnez, A., & Ibáñez, S. (2016). Análisis del proceso formativo en jugadores expertos: validación de instrumento. *Revista Internacional de Medicina y Ciencias de la Actividad Física y del Deporte*, *16*(61), 157-182.

Hernaez, R. (2015). Reliability and agreement studies: A guide for clinical investigators. *Gut*, 64(7), 1018–1027.

Inglés, E., Villena, V., Padullés, J.M., Funollet, F., Labrador, V., & Gomila, J.B. (2017). Postural Evaluation and Balance Analysis in Nordic Skiing Beginners. *Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte, 17*(68), 651-665.

Kassat, G. (2009). Not the skier - but the slope turns the skis. In E. Müller, S. Lindinger, & T. Stöggl (Eds.). *Science and skiing* IV, 4, 292–303.

Kottner, J., Audige, L., Brorson, S., Donner, A., Gajewski, B., Hróbjartsson, A., … Streiner, D. (2011). Guidelines for Reporting Reliability and Agreement Studies (GRRAS) were proposed. *International Journal of Nursing Studies, 48*, 661–671.

Kurpiers, N., Kersting, U.G., & Girginov, V. (2017). The one-ski-method effects of an alternative teaching approach on selected movement patterns in alpine skiing. *Cogent Social Siences*, *3*(1), 1275958.

Lakota, R., Turkovic, B., & Bilic, Z. (2019). The effects of alpine skiing training on the adoption of skiing elements in girls. *Sportski Logos,* 43-46.

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33*, 159-174.

Martínez, J.C., Gómez-López, P.J., Femia, P., Mayorga-Vega, D., & Viciana, J. (2016). Effect of augmented verbal and visual feedback on efficiency in skiing teaching. *Kinesiology, 48*(1), 49-57.

Mokkink, L.B., Terwee, C.B., Patrick, D.L., Alonso, J., Stratford, P.W., Knol, D.L., Bouter, L.M., & de Vet, H.C.W. (2010). The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: an international Delphi study. *Quality of Life Research*, 19: 539–549

Müller, L., Hildebrandt, C., Müller, E., Fink, C., & Raschner, C. (2017). Long-term athletic development in youth alpine ski racing: The effect of physical fitness, ski racing technique, anthropometrics and biological maturity status on injuries. *Frontiers in Physiology, 8*, 656.

Professional Ski Instructors of America (2014). PSIA-C Scorecard 2014-15-2. PSIA Central División, Frankfort (Michigan 49635). Retrieved from https://www.psia-c.org/education/reference-materials-repository/

Román, B. (2008). *La transferencia del patinaje en línea al aprendizaje del esquí alpino en la educación física escolar*. Doctoral Thesis. Granada. University of Granada Publication Services.

Rodríguez, E. (2013). El alfabeto del esquí I. Nevasport.com. Retrieved fromhttps://www.nevasport.com/skines/art/40057/El-alfabeto-del-esqui-I/

Rodríguez, E. (2014). La capacidad de diferenciación. Nevasport.com. Retrieved from https://www.nevasport.com/skines/art/40057/El-alfabeto-del-esqui-I/

Sheskin, D. (2011). Handbook of parametric and nonparametric statistical procedures (5th editio). London: Chapman and Hall/CRC.

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

Supej, M., Hébert-Losier, K., Holmberg, H.C. (2015). Impact of the steepness of the slope on the biomechanics of World Cup slalom skiers. *International Journal of Sports Physiology Performance, 10*(3), 361-368.

Supej, M., & Holmberg, H.C. (2019). Recent kinematic and kinetic advances in olympic alpine skiing: pyeongchang and beyond. *Frontiers in physiology, 10*, 111.

Taek, H., Lyun, H., & Sang, Y. (2016). Kinematic characteristics of the lower extremity during a simulated skiing exercise in healthy participants. *Journal of Physical Therapy Science, 28*(2), 626-631.

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