ISSN: 2148-1148

IntJSCS

International Journal of Sport Culture and Science (IntJSCS)

International Refereed Scientific Journal

Volume 9 Issue 3

September 2021

cross ref <enabled>

doi

International Refereed Scientific Journal

International Journal of Sport Culture and Science
September 2021 : 9(3)
ISSN : 2148-1148
Doi : 10.14486/IntJSCS

INTERNATIONAL
SCIENCE CULTURE AND
SPORT ASSOCIATION
www.iscs-a.org

IntJSCS is an International Refereed Scientific Journal published quarterly by ISCSA.

IntJSCS is indexed/included in CrossRef, DOAJ, Google Scholar, Cite Factor, J-Gate, Research Bible, Mendeley, Open Access Journals, Academic Keys, Scientific Indexing Services, DRJI, Journal Index, ASOS, İSAM, Dergipark, Arastirmax; and it is also under evaluation by many other primary indexing services.

Call for papers

We invite high-quality articles, review papers, case studies of theoretical, and empirical, conceptual, and experimental research solely on sport-related themes in a properly formatted file as per the author guidelines. We do our best to have evaluated all the submissions through a fast double-blind review process by our international scientific board and publish them in the following issue. Articles submitted in IntJSCS for consideration should not have been published elsewhere and should not be submitted for review elsewhere during the duration of evaluation. As mentioned in the general scope of the journal, we value submissions from different regions of the world in order to reach a real international coverage. Las, but not the least, we promote researchers to use our open access articles in their researches and to contribute to the development of our journal through their citations.

International Advisory Board

International Journal of Sport Culture and Science
September 2021 : 9(3)
ISSN : 2148-1148
Doi : 10.14486/IntJSCS

TABLE OF CONTENTS

REFEREES OF THIS ISSUE

Dr. Ali ÖZKAN
Dr. Andriy VOVKANYCH
Dr. Ayşegül YAPICI ÖKSÜZOĞLU
Dr. Ender ŞENEL
Dr. Fatih YAŞARTÜRK
Dr. Mahmut ALP
Dr. Mine TURGUT
Dr. Serdar KOCAEKŞİ

International Journal of Sport Culture and Science
September 2021 : 9(3)
ISSN : 2148-1148
Doi : 10.14486/IntJSCS.2021.646

Comparative Analysis of Ski Jumping In-run Hill Models Profile*

Ihor ZANEVSKYY[1], Lyudmyla ZANEVSKA[2]
[1] Lviv State University of Physical Culture, Lviv, Ukraine
https://orcid.org/ 0000-0002-3276-6057
[2] Lviv State University of Physical Culture, Lviv, Ukraine
https://orcid.org/ 0000-0001-9279-2373
Email: izanevsky@ukr.net, lzanevska@ukr.net

Type: Research Article (Received:16.07.2021– Accepted: 18.11.2021)

Abstract

Background. The aim of this research was done to create calculating methods for virtual replacing of a circle arc segment on the in-run hill. This replacement should not change the angle of the in-run hill inclination, but could change the length of the straight-line segment to such an extent that it can follow geometrical parameters of the in-runs in vogue.

Materials and Methods. 38 in-runs hills certificated by International Ski Federation; mechanical and mathematical modelling of the in-run hill profile modelled with cycloid, hyperbola, or inclined quadratic parabola with decreased ratio of vertical to horizontal dimensions.

Results and Discussion. The decreased ratio of the vertical to horizontal dimensions was in the range of 2.71–0.73% when cycloid was used, 16.33–8.60% when hyperbola was used, and 4.58–0.90% when inclined quadratic parabola was used. When the circle arc was replaced with a quadratic parabola or an inclined cubic parabola, the ratio of the dimensions increased. If the difference between the angles of inclination of straight-line segments increased, this ratio increased too. For the certificated in-runs, the ratio varied in the range of 2.21–8.61% when a quadratic parabola was used and 14.64–19.04% when inclined cubic parabola was used.

Keywords: Ski jumping; In-run hill profile; Mathematical Modeling

Introduction

Ski jumping from an in-run has four phases: in-run, taking off, flight, and landing. For judging the competition results, the judges follow the Ski Jumping Rules and consider only the third and the fourth phases (International ski competition rules, 2008). They evaluate the technique of the flight and landing, and measure the distance of the jump. The effect of in-run and take-off (first and second phases) on the finishing phases, therefore, plays a decisive role in determining, to a great extent, the quantitative and qualitative parameters of the jump (Schwameder, 2008; Muller, 2009; Jung et al., 2014).

The ski jumper executes the in-run and take-off sliding down the in-run hill which ends with a take-off table. The most widely used in-runs are solid units consisting of the in-run hill and the take-off table (Figure 1). The profile of the in-run track includes three segments: two straight-line ones and a curvilinear one. The first straight-line segment, together with the curvilinear segment, serves as the in-run track, and the second straight-line segment as the take-off table. In terms of actual usage, the inclined part of the take-off table serves, to some extent, as the in-run track too. The inclination of the curvilinear segment at its highest point equals the inclination of the first straight-line segment, and the inclination at its lowest point equals that of the take-off table.

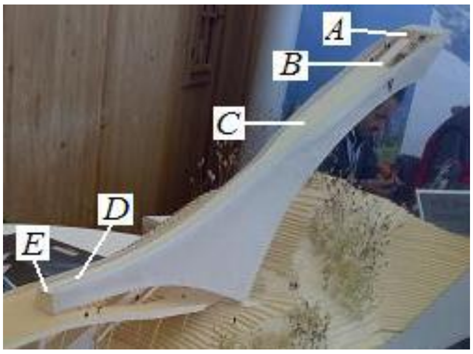

Figure 1. A model of an in-run hill (K-125) in Garmisch-Partenkirchen, Germany: *AC* is a straight-line in-run segment; *AB* is a segment of a start gate position; *CD* is a curvilinear in-run segment; *DE* is a straight-line take-off table (The new Olympiaschanze of Garmisch-Partenkirchen, 2017).

Sliding down the curvilinear segment can be considered a sub-phase of the in-run. The in-run curve starts when the ski jumper enters the radius, and ends as he reaches the take-off table. When the ski jumper enters the curvilinear segment the normal reaction force increases because of the centrifugal force. The take-off phase begins when the ski jumper initiates his take-off movement, and ends just as he leaves the take-off table (Banakh & Zanevskyy, 2010).

According to the norms of architecture, the curvilinear segment was being constructed, till date, as a circular arc (Neufert, 2004). Because of the sharp increase in the trajectory curvature at the junction of the first straight-line segment and the arc, the ski jumper's body will be affected by a centripetal force that equals about 87% of the normal reaction force value (Ettema et al., 2005). As the ski jumper slides along the arc, his body will be affected by a centripetal force that gradually increases in proportion to the squared speed of sliding, and dies down abruptly at the end of the take-off table. The normal force increased from 0.88 of the gravity on the first straight-line segment up to 1.65 on the arc. The exact value depends on the slope, speed, and radius of the arc. During the motion on straight-line segment, the normal force will be less than gravity because the ski jumper moves on the slope (Zanevskyy & Banakh, 2010).

For controlling the reaction force when the ski jumper moves along the curvilinear segment, researchers propose to use profiles with variable curvature: cycloid, parabola, hyperbola (Palej & Struk, 2003), and cubic parabola (Gasser, 2008). The last one was presented by International Ski Federation (ISF) as the standard profile for the in-run design. One in-run with cubic parabola profile of the in-run hill in Bischofshofen, Austria was certificated by ISF (Certificate of jumping hill, 2003).

Different profiles are proposed for different purposes: to reduce the reaction force at the end of the curvilinear segment, to stabilize its value or to reduce it to zero, to gradually increase the centripetal force at the very beginning of the curvilinear track, and so on. However, replacement of the circular arc with another profile causes major changes in some of the in-run hill parameters: the inclination of the straight-line segment, or horizontal and vertical dimensions of the curvilinear segment (Palej & Filipowska, 2009).

For reducing the value of the normal reaction force just near the take-off table, Palej & Struk (2004) proposed cycloid, parabolic, and hyperbolic profiles and considered cycloid profile the best. They formulated and solved an initial value problem for a nonlinear second order equation. They considered this approach as the simplest one, but cautioned that the normal reaction does not usually appear at the border with the take-off table.

Some researches tried to decrease the normal reaction force at the end of the curvilinear segment by using a family of even polynomial functions which possess the determined properties of the normal reaction (Filipowska, 2008; Jung et al., 2019). Considering the popular K125 power in-run Wielka Krokiew in Zakopane, Poland, they proposed to replace its straight-line and circle arc segments of the in-run hill with one polynomial curve. But, the implication of such replacement is the need to increase the inclination angle of the in-run hill to avoid the appearance of inflexion points. Unfortunately, the value of the increased incline should be greater than the maximum inclination of the in-run hills of the in-runs in vogue.

A weak point of these models is taking into account the air drag force and the force of friction between the skis and the in-run hill track. The corresponding models include empirical coefficients which are dependent on the ski jumper's body pose, speed, normal reaction force, temperature, dampness and other factors. Because the analytical functions used in modelling these factors do not ensure precision, it is considered better to create the profile model without necessarily taking into consideration the drag and friction forces. Therefore, from a practical point of view, using a geometrical model, which satisfies two fundamental conditions, was considered: smooth borders between the curvilinear and the straight-line segments of the in-run hill and the concave profile of the curvilinear segment (Zanevskyy & Banakh, 2010). With the frames of such a model, it would be possible to solve the problem with reasonable precision.

The objective of this research was to create calculating methods for virtual replacing of a circle arc segment on the in-run of the ski-jumping in-run with profiles of changeable curvature, based on the functions of cycloid, parabola, hyperbola, and cubic parabola. In the process of replacing, the angle of in-run hill inclination should not be changed, but the length of the straight-line segment could be changed to such an extent that it conforms to the geometrical parameters of the in-runs in vogue.

Materials and Methods

38 in-runs hills certificated by International Ski Federation; mechanical and mathematical modelling of the in-run hill profile modelled with a cycloid, a hyperbola, or an inclined quadratic parabola with decreased ratio of vertical to horizontal dimensions. Seven functions of a curvilinear segment profile of the in-run hill were investigated: arc, cycloid, quadratic parabola, cubic parabola, inclined quadratic parabola, inclined cubic parabola, and hyperbola (Gasser, 2018).

For smooth junctions between the arc and straight-line segments, their angles of inclination should be dependent on horizontal $(l = x_C - x_D)$ and vertical $(h = y_C - y_D)$ dimensions of the curvilinear segment defined by the following equations (Figure 2):

$$l = r(\sin\gamma - \sin\alpha); \qquad h = r(\cos\alpha - \cos\gamma), \tag{Eq.1}$$

where r is the radius of the arc, α the inclination angle of the second straight-line segment, i.e. take-off table, and γ the inclination angle of the first one, i.e. the in-run hill straight-line segment.

From equation (Eq.1), one gets the ratio between the circle arc dimensions by the following equation:

$$\left(\frac{h}{l}\right)_{circle} = tg\frac{\alpha+\gamma}{2}. \tag{Eq.2}$$

The length of the circle arc is:

$$S = r(\gamma - \alpha). \tag{Eq.3}$$

Using equations (1–3) and the inclination angles of straight-line segments (α,γ), one can calculate three of the four parameters of the arc segment (l,h,r,S), whereas the fourth one should be determined a priori.

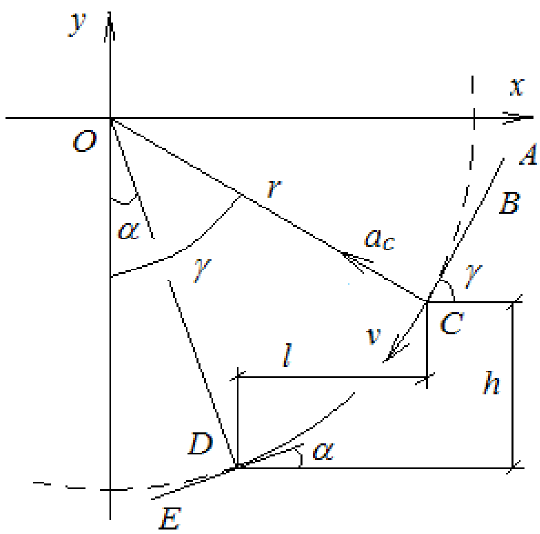

Figure 2. An in-run hill scheme model with a circle arc curvilinear segment.

The circle arc profile has one deficiency. Because of abrupt increase in the trajectory curvature at its junction with the first straight-line segment, the ski jumper's body is affected by a centripetal force whose magnitude is proportional to the body weight. The corresponding centripetal acceleration at the moment of entering the circle arc (point *C* on Figures 1, 2) is given by the following equation:

$$a_C = \frac{v_C^2}{r}, \quad \text{(Eq.4)}$$

where v_C is the speed of sliding at point *C*.

Results

Dimensionless values of the circle arc curvature and the profile of a rather horizontal dimension of the in-run hill curvilinear segment with inclination angles of $\alpha = 11°$ and $\gamma = 35°$ are presented in the graph (Figure 3). These parameters were used, because among the 38 in-runs certificated by the ISF (Certificate of jumping hill, 2003) the in-run hill of seven in-runs had the same inclination angles and another five also had more or less the same inclination angle but for a difference $\pm 0.2°$ (Table 1: Numbers 20, 21, 25, 30, 31, 33, 34, and 9, 14, 15, 18, 32). These 12 in-runs present a full range in terms of power (K = 90–185) for high level competitions in ski jumping. The ratio of the circle arc dimensions (Eq.2) is $(h/l)_{circle} = 0.424$ and that of the dimensionless values of the curvature $(l/r)_{circle} = 0.383$.

Table 1. In-run hills which are certificated by ISF (Certificate of jumping hill, 2003)

No	Locality (country)	Size, K	γ	α	ρ
			Degree		m
1	Villach (AUT)	60	29.0	10.5	65
2	Wernigerode (GER)	63	35.0	9.5	59
3	Bischofsgrün (GER)	64	35.0	10.5	67
4	Namsos (NOR)	65	34.0	10.0	57
5	Bischofshofen (AUT)	65	35.0	10.0	65
6	Høydalsmo (NOR)	85	32.0	10.5	80
7	Villach (AUT)	90	35.0	10.5	64
8	Stryn (NOR)	90	30.0	10.5	85
9	Trondheim (NOR)	90	34.0	11.0	90
10	Örnsköldsvik (SWE)	90	36.0	10.5	90
11	Gällivare (SWE)	90	34.0	10.5	95
12	Heddal (NOR)	90	32.5	10.5	80
13	Mo I Rana (NOR)	90	36.5	10.5	80
14	Lillehammer (NOR)	90	35.0	11.2	90
15	Seefeld (AUT)	90	34.9	11.0	72
16	Lauscha (GER)	92	37.0	10.5	83
17	Oberwiesenthal (GER)	95	37.0	10.0	85
18	Hinterzarten (GER)	95	35.2	11.2	75
19	Gallio/Asiago (ITA)	95	30.0	11.0	90
20	Pragelato (ITA)	95	35.0	11.0	92
21	Sollefteå (SWE)	107	35.0	11.0	95
22	Ruhpolding (GER)	115	34.0	10.5	92
23	Zakopane (POL)	120	35.0	10.5	100

24	Engelberg (SUI)	120	35.0	10.5	110
25	Kuopio (FIN)	120	35.0	11.0	95
26	Kuusamo (FIN)	120	35.0	11.5	103
27	Trondheim (NOR)	120	34.0	11.0	105
28	Lillehammer (NOR)	120	34.0	11.0	107
29	Bischofshofen (AUT)	125	27.0	11.0	*
30	Klingenthal (GER)	125	35.0	11.0	105
31	Pragelato (ITA)	125	35.0	11.0	105
32	Whistler (CAN)	125	35.0	11.2	100
33	Garmisch-Partenkirchen (GER)	125	35.0	11.0	103
34	Willingen (GER)	130	35.0	11.0	105
35	Bad Mitterndorf (AUT)	185	35.0	10.7	147
36	Oberstdorf (GER)	185	39.0	10.5	120
37	Planica (SLO)	185	38.5	10.3	100
38	Vikersund (NOR)	185	40.4	11.0	105
	Max	185	40.4	11.5	147.0
	Min	60	27.0	9.5	57.0
	M	108.4	34.6	10.7	90.8
	SD	33.2	2.5	0.4	18.3

*Inclined cubic parabola

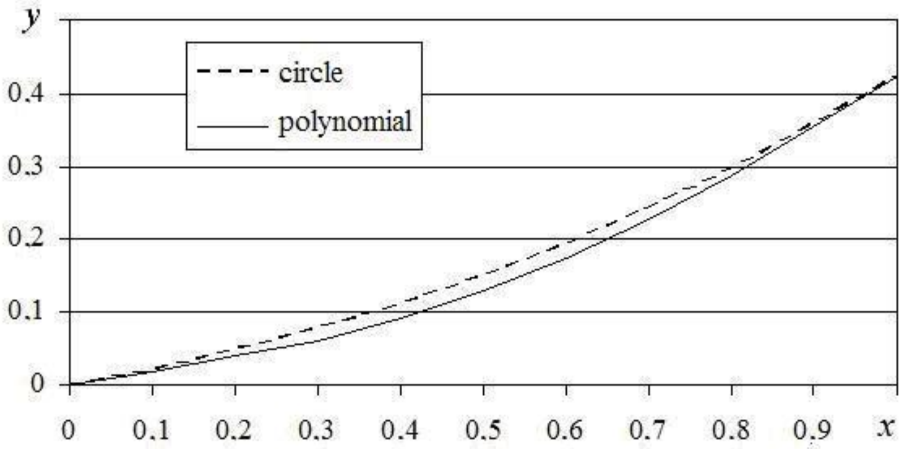

Figure 3. Dimensionless values of an arc curvature (---) and the profile (—) vs. a dimensionless distance of a skier to a take-off table relatively a horizontal dimension of the curvilinear segment of the hill.

Using the cubic parabola profile for the in-run with parameters of the in-run hill (α =11°, γ =35°), one can get almost the same ratio of curvilinear segment dimensions (h/l) as that of the arc profile, but for a difference of –0.7% (Table 2). After the cubic parabola, the nearest (based on the modulus of difference of the ratio with a circle profile) were the cycloid, inclined quadratic parabola, quadratic parabola, hyperbola, and inclined cubic parabola (Gasser, 2018). The maximum ratio of a curvilinear segment had an in-run hill profiled with an inclined cubic parabola and a minimum – hyperbola.

Table 2. Parameters of a curvilinear segment of an in-run hill

Curvilinear profile*	Curvature	Ratio between the vertical and horizontal

	dimensions			
	l/ρ_C	ρ_D/ρ_C	h/l	Difference from a circle arc, %
Circle	0.383	1	0.424	0
Cubic parabola	0.364	1.103	0.421	–0.7
Cycloid	0.428	1.198	0.417	–1.7
Inclined parabola	0.422	1.312	0.413	–2.7
Parabola	0.278	0.581	0.447	5.1
Hyperbola	0.691	3.973	0.369	–14.9
Incl.cub.parabola	0.614	1.312	0.500	15.2

*Angles of inclination of a take-off table (α =11°) and a top straight-line segment (γ =35°).

Only the circle arc profile has a constant curvature, whereas the other six functions, considered here as hypothetical profiles, have a variable curvature. The curvature increased down the hill when the curvilinear segment was profiled as a quadratic or cubic parabola, and decreased when profiled as an inclined quadratic parabola, hyperbola, cycloid, or cubic parabola.

The inclined cubic parabola profile gave zero value for the centripetal force at the junction of straight-line and curvilinear segments (point *C* in Figures 1, 2). No other investigated function (circle, cycloid, hyperbola, quadratic parabola, inclined quadratic parabola, and cubic parabola) could give zero value because of the abrupt increase in the trajectory curvature at the junction (see Figure 3 and Table 2).

Ratios of the dimensions of the in-run hill curvilinear segment, profiled with different functions, are presented in Table 3. The circle arc hill of the in-run K185 (α = 10.5°, γ = 39°) in Oberstdorf (GER) could be replaced by a cubic parabola profile, almost with the same ratio of the dimensions of curvilinear segments (the difference being 0.04%).

Table 3. Ratio of dimensions (vertical / horizontal) of an in-run hill curvilinear segment profiled with different functions

In-run*	h/l						
	Circle	Cycloid	Hyper-bola	Parabola	Cubic parabola	Inclined parabola	Inclined cub. par.
1	0.359	0.356	0.321	0.370	0.353	0.354	0.417
2	0.409	0.401	0.342	0.434	0.403	0.396	0.487
×	0.419	0.412	0.360	0.443	0.415	0.407	0.496
4	0.404	0.397	0.345	0.425	0.399	0.393	0.478
5	0.414	0.406	0.351	0.438	0.409	0.402	0.491
6	0.389	0.384	0.340	0.405	0.384	0.381	0.456
8	0.369	0.365	0.327	0.381	0.363	0.363	0.430
9	0.414	0.408	0.362	0.434	0.410	0.404	0.487
10	0.430	0.421	0.367	0.456	0.426	0.416	0.509
11, 22	0.409	0.402	0.354	0.430	0.404	0.399	0.482
12	0.394	0.388	0.344	0.411	0.389	0.385	0.463
13	0.435	0.426	0.370	0.463	0.432	0.420	0.515
14	0.427	0.419	0.372	0.449	0.424	0.416	0.502
15	0.423	0.416	0.368	0.446	0.420	0.412	0.499

16	0.440	0.431	0.374	0.469	0.438	0.425	0.522
17	0.435	0.425	0.365	0.465	0.431	0.418	0.517
18	0.429	0.421	0.374	0.452	0.426	0.417	0.504
19	0.374	0.370	0.335	0.386	0.369	0.369	0.434
+	0.424	0.417	0.369	0.447	0.421	0.413	0.500
26	0.430	0.422	0.377	0.452	0.427	0.419	0.504
27, 28	0.414	0.408	0.362	0.434	0.410	0.404	0.487
29	0.344	0.342	0.315	0.352	0.340	0.341	0.395
32	0.427	0.419	0.372	0.449	0.424	0.416	0.502
33	0.424	0.417	0.369	0.447	0.421	0.413	0.500
35	0.421	0.414	0.364	0.445	0.418	0.410	0.497
36	0.461	0.449	0.387	0.498	0.461	0.441	0.548
37	0.454	0.443	0.380	0.489	0.452	0.435	0.540
38	0.481	0.468	0.407	0.523	0.484	0.459	0.572

* See Table 1: ˣ No 3, 7, 23, 24, + 20, 21, 30, 31, 33, 34

The curvilinear segment of the in-run hill of in-run K125 $(\gamma = 27^o,\ \alpha = 11^o)$ in Bischofshofen (AUT) was profiled with an inclined cubic parabola (see Table 1, No 29). The ratio of the dimensions of the in-run hill curvilinear segment would have been 0.340 if the segment was profiled with a simple cubic parabola, 0.395 if profiled with an inclined quadratic parabola, and 0.344 (Eq.2) if profiled with a circle arc (Table 4).

Table 4. Relative difference (%) of ratios dimensions of the in-run hill curvilinear segment profiled with a circle arc and six hypothetical functions (statistics of 38 trampolines listed in Table 1)

Hypothetic functions	Cycloid	Hyperbola	Parabola	Cub. parabola*	Inclined parabola	Inclined cubic parabola
Max	–0.73	–8.60	8.61	0.58	–0.90	19.04
Min	–2.71	–16.33	2.21	–1.57	–4.58	14.64
M	–1.73	–13.44	5.39	–0.89	–2.72	17.81
SD	0.38	1.63	1.24	0.41	0.74	0.88

* Statistics: *Max* = 1.57, *Min* = 0.04, *M* = 0.92, *SD* = 0.34

In-runs of similar size (K125), situated in Klingenthal (GER), Pragelato (ITA), and Garmisch-Partenkirchen (GER), had curvilinear segments which were profiled with circle arcs (see Table 3: No 30, 31, 33). The inclination angles of their take-off tables were the same $(\alpha = 11^o)$, but those of straight-line segments were greater $(\gamma = 35^o)$. And, their ratio of the dimensions of the in-run hill curvilinear segment was rather greater: 0.424 (Eq.2). If the curvilinear segment of the in-run hill of these in-runs was profiled with an inclined cubic parabola, the ratio would have been 0.500, and if profiled with a simple cubic parabola, it would have been h/l = 0.421 (Table 5).

Table 5. Angle of inclination of a strait-line for different profiles of a curvilinear segment of the in-run hill

In-run*	γ^o	$\frac{\gamma - \gamma_{circle}}{\gamma_{circle}} 100\%$
Circle	35.0	–
Cycloid	46.3	32.2
Parabola	49.2	40.5
Hyperbola	55.3	58.0

* Angle of inclination of a take-off table: α =10.5°

From a practical point of view, it is important to define the conditions when the ratio of curvilinear dimensions with hypothetical functions would equal the corresponding ratio with a circle arc profile of the in-run hill. These conditions were presented with equations constructed from the right parts of equations (Zanevskyy and Banakh, 2010) on the one hand, and the right part of equation (Eq.2) on the other. The conditions for hypothetical profile functions (cycloid, quadratic parabola, cubic parabola, inclined quadratic parabola, inclined cubic parabola, and hyperbola) were defined by the following equations (Table 6):

$$\text{Cycloid: } \frac{\cos 2\alpha - \cos 2\gamma}{2(\gamma - \alpha) + \sin 2\gamma - \sin 2\alpha} = tg\frac{\alpha + \gamma}{2}, \quad \text{(Eq.5)}$$

$$\text{Quadratic parabola: } \frac{tg\alpha + tg\gamma}{2} = tg\frac{\alpha + \gamma}{2}, \quad \text{(Eq.6)}$$

Table 6. Parameters of a real circle arc profile of an in-run hill and results of a virtual transformation to an inclined cubic parabola profile

In-run*	$tg\gamma$	$\frac{h_{circle}}{l_{circle}}$	$\frac{h}{l}$	$\frac{l - l_{circle}}{l_{circle}}$	$\frac{h - h_{circle}}{h_{circle}}$	$\frac{\Delta s}{l_{circle}}$
1	0.554	0.359	0.417	0.422	0.652	-0.483
2	0.700	0.409	0.487	0.365	0.625	-0.446
×	0.700	0.419	0.496	0.373	0.622	-0.455
4	0.675	0.404	0.478	0.378	0.631	-0.456
5	0.700	0.414	0.491	0.369	0.624	-0.450
6	0.625	0.389	0.456	0.399	0.641	-0.470
8	0.577	0.369	0.430	0.415	0.649	-0.479
9	0.675	0.414	0.487	0.385	0.627	-0.464
10	0.727	0.430	0.509	0.363	0.615	-0.449
11, 22	0.675	0.409	0.482	0.382	0.629	-0.460
12	0.637	0.394	0.463	0.394	0.638	-0.468
13	0.740	0.435	0.515	0.359	0.611	-0.446
14	0.700	0.427	0.502	0.378	0.620	-0.461
15	0.698	0.423	0.499	0.377	0.621	-0.460
16	0.754	0.440	0.522	0.354	0.606	-0.443
17	0.754	0.435	0.517	0.350	0.607	-0.438

18	0.705	0.429	0.504	0.376	0.619	-0.460
19	0.577	0.374	0.434	0.418	0.645	-0.482
+	0.700	0.424	0.500	0.376	0.621	-0.459
26	0.700	0.424	0.500	0.376	0.621	-0.459
27, 28	0.700	0.430	0.504	0.380	0.619	-0.464
29	0.675	0.414	0.487	Inclined cubic parabola		
32	0.510	0.344	0.395	0.439	0.650	-0.493
33	0.700	0.427	0.502	0.378	0.620	-0.461
35	0.700	0.421	0.497	0.374	0.622	-0.457
36	0.810	0.461	0.548	0.334	0.588	-0.430
37	0.795	0.454	0.540	0.338	0.592	-0.432
38	0.851	0.481	0.572	0.324	0.574	-0.426

* See Table 1: [×] 3, 7, 23, 24, [+] 20, 21, 30, 31, 33, 34

Cubic parabola: $$\frac{tg\alpha + tg\gamma + \sqrt{tg\alpha \times tg\gamma}}{3} = tg\frac{\alpha+\gamma}{2}, \qquad \text{(Eq.7)}$$

Inclined quadratic parabola: $$\frac{tg\alpha + tg\gamma + 2tg\alpha\ tg^2\gamma}{2 + tg\gamma(tg\alpha + tg\gamma)} = tg\frac{\alpha+\gamma}{2}, \qquad \text{(Eq.8)}$$

Inclined cubic parabola: $$\frac{tg\gamma - \frac{tg(\gamma-\alpha)}{3}}{1 + \frac{tg(\gamma-\alpha)}{3}tg\gamma} = tg\frac{\alpha+\gamma}{2}, \qquad \text{(Eq.9)}$$

Hyperbola: $$\sqrt{tg\alpha \times tg\gamma} = tg\frac{\alpha+\gamma}{2}. \qquad \text{(Eq.10)}$$

Discursions

According to the aim of this research, a calculating method for virtual replacing of a circle arc segment on the in-run hill has been created. Palej and Struk (2003) proposed to replace the straight-line (*BC*) and circle arc (*CD*) segments of the in-run hill with one curvilinear segment (*BD*) profiled as a polynomial of the second, fourth, sixth, and eighth power. The function was constructed on the condition that the effect of normal reaction on a ski jumper's body on the curvilinear segment had non-zero value. A form of the function was calculated as a solution to a nonlinear differential equation of the second order. The authors observed a positive consequence to this reconstruction: reduction in curvature as a result of decrease in normal reaction on a ski jumper's body. In general, as a result of this reconstruction, the straight-line segment of the in-run hill did not disappear; it only became shorter up to the straight-line segment *AB,* where the start gate was situated. Sometimes, although very seldom, the start gate can be placed at point *A*, and in such cases, the in-run should start at the very beginning of this curvilinear segment.

Some combinations of the inclination angles of a straight-line segment and take-off table (α, γ), and the ratio of dimensions of a curvilinear segment (h/l) can result in convexity that enables ski jumpers pull off the track. Because the values of three of these four parameters

(h, l, α) were restricted by the in-run size, Palej and Struk (2004) proposed to obtain the concave curvilinear segment by increasing the angle of inclination γ. Therefore, the implication of these functions was that it was necessary to increase of the inclination angle to avoid the inflexion points.

This model of in-run hill construction had a few defects which rendered this approach useless, in practical terms. First, according to this method, the angle of the increased incline should be greater than the maximum inclination of the in-run hills of the in-runs in vogue: γ = 29.0 – 40.4° (see Table 1). Second, it is doubtful if the curvature of the in-run hill can be decreased at its junction with the take-off table. Corresponding decrease in centripetal force causes similar decrease in take-off impulse at the very beginning of the phase. Third, although the problem under consideration was a dynamic one, air drag and ski jumper's friction were not taken into account in the frames of the model. These forces have significant influence on the dynamics of the ski jumper's in-run (Ettema et al., 2005).

Taking into account unequal $(h/l)_{parabola} < (h/l)_{circle}$, one can define that a difference between the ratios of a circle and a cubic parabola dimensions can be equal, less or greater a unit. Correlation between the angles of inclination of the in-run hill straight-line segment and the take-off table, when the ratios of the dimensions of a circle profile and a cubic parabola profile are equal, was calculated as a solution to equation. In the majority of the in-runs considered, the replacing of a circle arc with cubic parabola gave a greater ratio of vertical to horizontal dimensions, the difference being around 1.6%. (see Table 4). Following is the correlation equation between the angles of inclination:

$$\gamma = 52.3 - 1.26\alpha .$$

If the difference between the angles of inclination of straight-line segments $(\gamma - \alpha)$ is below 28.5° where $\alpha = 10.5°$, the ratio decreases, and when the difference is over 28.5°, the ratio decreases. For example, for the ski fly in-run K185 (see Table 1: No 36) in Vikersund (NOR), the difference in the ratios was 0.04% ($\gamma = 39.0°$, $\alpha = 10.5°$).

Considering the unequal parts of the model equations one can generalize that a circle arc profile can be replaced with a cycloid, a hyperbola, or an inclined quadratic parabola with decreased ratio of vertical to horizontal dimensions. If the difference between the angles of inclination of the straight-line segments increases, the ratio decreases. For example, for the 38 in-runs certificated by ISF (see Table 1), the ratio varied in the range of (2.71–0.73)% when cycloid was used, (16.33–8.60)% when hyperbola was used, and (4.58–0.90)% when inclined quadratic parabola was used (see Tables 3, 4). When the circle arc was replaced with a quadratic parabola or an inclined cubic parabola, the ratio of vertical to horizontal dimensions increased. If the difference between the angles of inclination of the straight-line segments increased, the ratio increased too. For the in-runs mentioned above, the ratio varied in the range of 2.21–8.61% when a quadratic parabola was used and 14.64–19.04% when an inclined cubic was used.

To control the force of inertia acting on a ski jumper's body during sliding Palej and Filipowska (2009) proposed to replace the first straight-line segment and the circle arc segment with one curvilinear segment of a hypothetical profile as a polynomial function. To avoid appearance of inflexion points, they were forced to increase the angle of inclination of the starting segment. For example, in K 120 in-run (see Table 1: No 23) at Zakopane (Poland), the angle of inclination in the circle arc ($\gamma = 35°$) was increased up to 41°80′–49°68′ corresponding to the power of the polynome that equaled 2–8. Palej and Struk (2003) used a cycloid, a quadratic parabola, or a hyperbola. They would have had to increase the angle of inclination up to 46°16′–55°19′ (see Table 5). These values are considered significantly high against the standard value of the in-run hill inclination.

An analytical method is proposed here for calculating the hypothetical in-run hill profile parameters, instead of the circle arc profile. The method allows for maintaining the inclination angles of the straight-line segment of the in-run hill and of the take-off table. The horizontal dimension (l) and vertical dimension (h) of a hypothetical profile and the corresponding dimensions of a circle arc profile $(l_{circle},\ h_{circle})$ should be dependent on the inclination of the in-run hill (see Figure 2).

If a quadratic parabola or an inclined cubic parabola replaces the circle in-run hill profile, its horizontal and vertical dimensions should be greater than the corresponding dimensions of the circle profile. The corrected length of the straight-line segment of the in-run hill should be smaller. If a cycloid, an inclined quadratic parabola, or a hyperbola profile is applied, the dimensions should be smaller. The corresponding corrected length of the straight-line segment should be greater. If a cubic parabola profile is applied, its dimensions should be greater than, smaller than, or equal to the circle dimensions depending on the angles of inclination of the in-run hill and take-off table.

The difference between the dimensions of a circle arc segment and the corresponding dimensions of a quadratic parabola, an inclined quadratic parabola, or an inclined cubic parabola depends more on the inclination angle of the in-run hill than of the take-off table. Conversely, the difference between the dimensions of a circle arc segment and corresponding dimensions of a hyperbola depends more on the inclination angle of the take-off table than of the in-run hill. There is no significant distinction in the dependence of difference between a cycloid and a cubic parabola. The same type of dependence could be noticed for the difference between the lengths of the in-run hill and straight-line segments (Jung et al., 2018).

The only profile that obtains zero centripetal acceleration at the top point of the curvilinear segment is the inclined cubic parabola. Therefore, virtual replacing of a real circle arc profile of an in-run hill with an inclined cubic parabola profile was considered in a special way. For this, the parameters of the real circle arc profile of an in-run hill and the results of its virtual transformation to an inclined cubic parabola profile are presented in Table 6. As in-run K 125 in Bischofshofen (AUT) was originally designed with an inclined cubic parabola profile, the corresponding line No 29 in the table was not completed. To equip the in-runs under consideration with an inclined cubic parabola profile, the horizontal dimension should be increased by 32.4–43.9%, and the vertical one by 54.7–65.2%. The relative (to the horizontal dimension) length of the straight-line segment of the in-run hill should be decreased by 42.6–49.3%.

For example, in-run K 120 (see Tables 1 and 3: No 23) Wielka Krokiew in Zakopane (POL) could be reconstructed and equipped with an inclined cubic parabola profile, instead of a circle arc profile, by increasing horizontal and vertical dimensions correspondingly to 37.3%

(14.59 m) and 62.2% (10.22 m); the relative length of the straight-line segment should be decreased by 45.5% (17.81 m). According to Palej and Struk's method (2003), the dimensions should be increased correspondingly by 53.8% (21.07 m) and 89.9% (14.75 m); the relative length of the straight-line segment should be decreased by 65.7% (25.72 m).

The proposed method of reconstructing in-run hill has three advantages: First, the angle of inclination of hill remains the same; second, there is no inflection of the curvilinear segment; third, only a significantly small part of the straight-line segment (69.2%) should be replaced by a curvilinear segment.

Palej and Struk (2004) tried to decrease the normal reaction force at the end of the curvilinear segment by using a family of even polynomial functions which possess the determined properties of the normal reaction. However, there are grounds to suppose that it is not reasonable to reduce a curvature of the curvilinear segment at the bottom point because a centripetal force acted a skier's body fall down to zero just entering to the table. On the contrary of negative influence on a skier's body of a momentary appearance of the in-run curvature, a momentary disappearance of the in-run curvature at the bottom is positive a sport result. On the curved area of the in-run hill, the weight of skier's body consists of sum of two forces. One of them is a normal (to the hill surface) component of a gravitation force, which equals a production of body mass and gravity acceleration and cosine of incline angle of the hill slope. The second one is a centrifugal force which equals production of body mass and centrifugal acceleration. The greater a body weight – more compact a body pose, then a jump length is greater. At the instant of running on the table, a centrifugal acceleration disappears, that in terms of dynamics means instantaneous reduction of the skier's body weight. This makes a motion of taking off more rapid and a jump length greater (Zanevskyy & Banakh, 2010).

So, it is reasonable to obtain a zero curvature only from the very beginning of the curvilinear track. An inclined cubic parabola is a simplest polynomial function of the in-run profile obtained zero centripetal acceleration at the top point of the curvilinear segment. This helps to avoid instantaneous increasing of the trajectory's curvature and make in-run more comfortable.

Conclusions

The calculating methods of virtual replacing of the in-run hill circle arc segment on a ski jumping in-run with profiles of changeable curvature, based on the functions of cycloid, parabola, hyperbola, and cubic parabola, allows for retaining the original angles of inclination. The length of the straight-line segment can be diminished to such an extent that it becomes suitable to the geometrical parameters of the in-runs in vogue.

The circle arc profile could be replaced with a cycloid, a hyperbola, or an inclined quadratic parabola with decreased ratio of vertical to horizontal dimensions. If the difference between the angles of inclination of straight-line segments increases, the ratio decreases. For the 38 in-runs certificated by International Ski Federation, the ratio varied in the range of 2.71–0.73% when cycloid was used, 16.33–8.60% when hyperbola was used, and 4.58–0.90% when inclined quadratic parabola was used. When a circle arc was replaced with a quadratic parabola or an inclined cubic parabola, the ratio of vertical to horizontal dimensions increased. If the difference between the angles of inclination of straight-line segments increased, the ratio increased too. For the certificated in-runs, the ratio varied in the range of

2.21–8.61% when a quadratic parabola was used and 14.64–19.04% when inclined cubic was used.

The difference between the dimensions of a circle arc segment and the corresponding dimensions of a quadratic parabola, an inclined quadratic parabola, or an inclined cubic parabola depends more on the angle of inclination of the in-run hill than of the take-off table. Conversely, the difference between the dimensions of a circle arc segment and the corresponding dimensions of a hyperbola depends more on the angle of inclination of the take-off table than of the in-run hill. There is no significant distinction in the dependence of difference between a cycloid and a cubic parabola. The same type of dependence could be noticed for the difference in the length of the in-run hill straight-line segment.

The only profile which obtains zero centripetal acceleration at the top point of the curvilinear segment is the inclined cubic parabola. This helps to avoid instantaneous increasing of the trajectory curvature and make in-run more comfortable. To equip the certificated in-runs with inclined cubic parabola profile, the horizontal dimension should be increased by 32.4–43.9%, and the vertical dimension by 54.7–65.2%. The relative (to the horizontal dimension) length of the straight-line segment of the in-run hill should be decreased by 42.6–49.3%.

Acknowledgements

The research was partly supported by Ukrainian Ministry of Education and Science, Research Grant No 0116U06473.

Conflict of Interests

Authors declare no conflict of interests regarding this paper.

*The research was presented on the 5th International Eurasian Conference on Sports, Education and Society in Lviv, Ukraine (9-11 July 2021).

REFERENCES

Banakh V & Zanevskyy I (2010). The profile of the in-run hill and conditions of take off in ski jumping from a trampoline. Chapter 1. A comparative analysis of the in run hill profiles. Sport Science of Ukraine, 30(1): 10-24 (in Ukrainian, abstract in English).

Certificate of jumping hill (Bischofshofen) No.5 / AUT 5. (2003). International Ski Federation http://www.skisprungschanzen.com/e_index.htm?/e_profile.htm Retrieved 2 February 2020.

Eastern Ski Jumping & Nordic Combined Foundation (2011). Facts about Ski Jumping hills. Archived from the original on 17 March 2011. Retrieved 23 February 2020.

Ettema GJ, Braten S, Bobbert MF (2005). Dynamics of the In-Run in Ski Jumping: A Simulation Study. Journal of Applied Biomechanics, 21 (3): 247-259.

Filipowska R (2008). Optimization of ski jumping inrun profile. Czasopismo Techniczne. Mechanika. Wydawnictwo Politechniki Krakowskiej, 3-M Z: 57-64 (in Polish, abstract in English).

Gasser H (2018). Jumping hills construction norm. Implementing Provisions for Art. 411 of the ICR Ski Jumping. FIS, 11. https://assets.fis-ski.com/image/upload/v1592381507/fis-prod/assets/Construction-Norm_2018-2.pdf. Retrieved February 3, 2020.

Gasser H (2008). Skisprungschanzen Bau-Normen (Ausfuhrungsbestimmungen zu Art. 411 der IWO Band) Internationaler ski verband http://www.fis-ski.com/data/document/skisprungschanzen_bau-normen2008.pdf Retrieved 23 February, 2020 (in German, abstract in English).

International ski competition rules (2008). Ski jumping. International Ski Federation. http://www.fis-ski.com/data/document/icr_jp_2008.pdf Retrieved February 9, 2020.

Jung A, Muller W, Staat M (2019). Optimization of the flight technique in ski jumping: The influence of wind. Journal of Biomechanics, 88: 190-193. DOI: 10.1016/j.jbiomech.2019.03.023

Jung A, Staat M, Muller W (2014). Flight style optization in ski jumping on normal, large, and ski flying hills. Journal of Biomechanics, 71 (11): 716–722. DOI: 10.1016/j.jbiomech.2013.11.021

Jung A., Mueller W., Staat M (2018). Wind and fairness in ski jumping: A computer modelling analysis. Journal of Biomechanics, 75: 147-153.

Muller W (2009). Determinants of ski-jump performance and implications for health, safety and fairness. Sports Medicine, 39(2): 85-106.

Neufert E (2004). Bauentwurfslehre. Berlin: Vieweg Verlag (in German, abstract in English).

Palej R & Filipowska R (2009). Mathematical modelling of the inrun profile of a ski jumping hill with the controlled track reaction force. Journal of theoretical and applied mechanics, 47(1): 229-242.

Palej R & Struk R (2004). Optimization of ski jumping inrun profile. Czasopismo Techniczne. Mechanika. Wydawnictwo Politechniki Krakowskiej, Z. 5-M: 363-370 (in Polish, abstract in English).

Palej R & Struk R (2003). The inrun profile of a ski jumping hill with lowered normal reaction of the track. Czasopismo Techniczne. Mechanika. Wydawnictwo Politechniki Krakowskiej, Z 6-M: 127-136 (in Polish, abstract in English).

Schwameder H (2008). Biomechanics research in ski jumping, 1991-2006. Sports Biomechanics, 7(1): 114-136.

The new Olympiaschanze of Garmisch-Partenkirchen at the rising of the inrun tower (2007). www.skisprungschanzen.com/ger/gere_garmisch-s.htm Retrieved February 4, 2020 (in German, abstract in English).

Zanevskyy I & Banakh V (2010). Dependence of ski jump length on the skier's body pose at the beginning of take-off. Acta of Bioengineering and Biomechanics, 12(4): 77-85.

Appendix

Notation*

Symbol	Explanation
a	centripetal acceleration
f	transversal dimension of the inclined parabola profile
h	vertical dimension of an in-run hill curvilinear segment
k	coefficient of the quadratic and cubic parabolas
l	horizontal dimension of an in-run hill curvilinear segment
q	longitudinal dimension of the inclined parabola profile
r	radius of a circle arc in-run hill profile
v	sliding speed of a skier along an in-run hill
x	horizontal coordinate of the circle and parabolic profiles
y	vertical coordinate of the circle and parabolic profiles
H	coefficient of the hyperbola
K	In-run hill size
R	radius of the circumference circle of a cycloid
S	length of a circle arc in-run hill profile
α	angle of inclination of an in-run hill straight-line segment
β	angle parameter of the inclined parabolas
χ	horizontal coordinate of the cycloid profile
γ	angle of inclination of a take-off table
η	transversal coordinate of the inclined parabolas
φ	angle of inclination of a tangent line to the cycloid
κ	coefficient of the inclined quadratic and cubic parabola
ν	vertical coordinate of the hyperbolic profile
π	constant
ρ	in-run hill radius of curvature
τ	parameter of a cycloid
ξ	longitudinal coordinate of the inclined parabolas
ψ	horizontal coordinate of the hyperbolic profile
ζ	vertical coordinate of the cycloid profile
Δs	absolute difference in the length of the in-run straight-line segment

* Eastern Ski Jumping (2011)

International Journal of Sport Culture and Science
September 2021 : 9(3)
ISSN : 2148-1148
Doi : 10.14486/IntJSCS.2021.647

Exercise Motivation and Social Physique Anxiety In Adults

Buse SULU[1], Erdem ÇAKALOĞLU[2], Perican BAYAR[3]
[1]İstanbul Gedik Üniversitesi, İstanbul, Türkiye
https://orcid.org/0000-0003-3749-6129
[2] Ankara Üniversitesi, Ankara, Türkiye
https://orcid.org/0000-0003-1187-8276
[3] Ankara Üniversitesi, Ankara, Türkiye
https://orcid.org/0000-0002-5797-3300
Email: buse.sulu@gedik.edu.tr, erdemcakaloglu@gmail.com, pbayar@ankara.edu.tr

Type: Research Article (Received:23.08.2021– Accepted: 18.11.2021)

Abstract

This study investigated the relationship between basic psychological needs, motivational regulations in exercise, and social physique anxiety. The sample of the study was conducted 420 individuals, 193 males and 227 females (mean age 28.33±6.21), who regularly exercise (30 minutes, 3 days a week for at least 1 year) participated voluntarily. The Social Physique Anxiety Inventory, Behavioral Regulations in Exercise Scale, and Basic Psychological Needs in Exercise Scale were used as data collection tools. Pearson Correlation Analysis and Linear Regression Analysis were used to analyze the data. There was a negative relationship between basic psychological needs and intrinsic regulation and social physique anxiety; there was a positive relationship between introjected regulation, external regulation, amotivation, and social physique anxiety. While intrinsic regulation predicted social physique anxiety negatively, introjected regulation and external regulation positively predicted social physique anxiety. It was found that satisfaction of the need for competence and autonomy negatively predicted social physique anxiety. This research suggested that basic psychological needs and motivational regulations for exercise could play an important role in social physique anxiety.

Keywords: Exercise, Self-determination Theory, Social Physique Anxiety

Introduction

Over the last decades, an enormous amount of research has been done on regular physical activity and exercise participation. These studies were revealed the beneficial effects of physical activity and exercise on physiological and psychological health (Sicilia et al., 2014; Sisson and Katzmarzik, 2008; Teixeira et al., 2012; Thøgersen-Ntoumani and Ntoumanis, 2006; Wilson et al., 2003; World Health Organization, 2020). Although it was known that regular participation in physical activity and exercise was highly beneficial for health, physical and psychological well-being, very few adults in modern societies were reported to engage in physical activity or exercise regularly. Moreover, the findings were suggested that many people do not have enough motivation to participate in exercise or physical activity (Sisson and Katzmarzik, 2008).

Studies on exercise and physical activity have used Self-determination theory to analyze the motivation and psychological processes underlying well-being. Self-determination theory is a macro theory of motivation and personality that can be applied to different contexts and cultures (Deci and Ryan, 2002). The theory assumes that people have a natural growth tendency to actively manage their environment and interactions and integrate new experiences into their sense of self. Therefore, fulfilling their needs and their motivation to engage or participate in different activities depends on the component of the characteristics of intrinsic, external, and non-motivation (amotivation). This classification can make it easier to understand both the reasons that drive people to exercise and the reasons that can reduce their social physique anxiety (Sicilia et al., 2016).
The lack of interest, and not seeing any reason to exercise were associated with amotivation. It is defined as the absence of any desire, neither intrinsic nor external, to perform a behavior (Vlachopoulos et al., 2000). On the other side, intrinsic motivation refers to the reflection that exercise is done for its own sake, fun, and enjoyment. When an individual is internally motivated, he or she experiences feelings of enjoyment, use of skills, personal achievement, and excitement. In contrast to intrinsic motivation, external motivation refers to performing an activity for instrumental reasons or achieving a different outcome from the activity (Honeybourne, 2005). External motivation is divided into four different (external, introjected, identified, and integrated) regulations that vary according to their levels of self-determination.

External regulation is the least desirable type of motivation and is typically used to contrast with intrinsic motivation. Individuals only participate in the exercise to achieve the desired outcome or avoid a negative outcome, such as punishment. Introjected regulation means that individuals operate not to maintain self-esteem and pride or avoid any obligation but to avoid guilt or shame. The identified regulation represents a relatively self-determined arrangement because the action is performed due to its value, importance, or benefit for the individual. When the action takes place willingly, and without a sense of pressure, the regulatory process is fully integrated into the individual's sense of self. This regulation is purely a product of self-determination defined as integrated regulation. Integrated regulation is similar to intrinsic motivation, representing self-determined regulation (Deci and Ryan, 2000; Cox, 2007). Studies have consistently shown that self-determination forms of motivation and controlling forms of motivation were associated with initiating and maintaining an exercise behavior positively and negatively, respectively (Thøgersen-Ntoumani and Ntoumanis, 2006; Ersöz, 2016).

In the Basic Psychological Needs theory, it is mentioned that there are three innate psychological needs for autonomy, competence, and relationality. These needs are necessary for psychological, physical, and social health (Vansteenkiste et al., 2010). Basic psychological needs are defined as nutrients necessary for a person's growth, integrity, and well-being (Deci and Ryan, 2000). Autonomy refers to the internal focus of causality for what one does. The person's actions express the person himself, which are not affected by external factors (Ryan and Deci, 2002). The satisfaction of the need for autonomy reflects the sense of willpower and self-approval in one's behavior. When autonomy is satisfied, behavior is experienced authentically and appropriately, self-endorsing, conforming to interests and values (Vansteenkiste et al., 2010). Competence refers to the ability to perform tasks of varying complexity. When the need for competence is met, individuals feel that they interact effectively with their environment and experience opportunities to express or develop their capacities (Parfitt et al., 2009). Relatedness is the degree to which a person feels that he or she is safely part of a group or connected to others in his or her social context. (Deci and Ryan, 2002). This theory assumes that life satisfaction and subjective well-being increase significantly when individuals have the opportunity to feel autonomous, competent, and related in important areas of life (Deci and Ryan, 2000).

Sports, exercise, and physical activity environments are inherently social and evaluative (Sabiston et al., 2005). In these environments, more emphasis is made on the shape and function of the body; therefore, a range of positive and negative emotional experiences can be nurtured. With roots in social anxiety and self-presentation, social physique anxiety is a commonly studied emotion that emanates from, or motivates, physical activity behaviors (Sicilia et al., 2016). Although conceptually different, body image is associated with social physique anxiety. Individuals may be interested in how others see their physique because their bodies are objectively unattractive, or they perceive their physique unrealistically negative.

Social physique anxiety is defined as the anxiety experienced by an individual when he or she perceives that others may negatively evaluate his physique. (Sanlier et al., 2018). Crawford and Eklund (1994) also define social physique anxiety as self-presentation anxiety associated with the body (e.g., body fat, muscularity, body proportions) (Crawford and Eklund, 1994). The main negativities of social physique anxiety are body dissatisfaction, eating behavior disorders, depression, concerns about body weight, body shape, and eating (Linardon et al., 2017). Previous studies examining the relationships between exercise motivation and social physique anxiety have suggested that external motives for exercise, such as improving muscle tone and physical attractiveness, are associated with social physique anxiety (Crawford and Eklund, 1994; Frederick and Morrison, 1996). Furthermore, previous studies have shown that social physique anxiety is negatively associated with more self-determined forms of motivation (Gillison et al., 2006).

Some studies examined the relationship and difference between basic psychological needs, motivational arrangements for exercise, and social physique anxiety in various populations based on self-determination theory in the context of exercise (Sicilia et al., 2014; Thøgersen-Ntoumani and Ntoumanis'in, 2006; Thøgersen-Ntoumani and Ntoumanis, 2007; Vallerand, 2007). In exercise environments, it is thought that the satisfaction of basic psychological needs can affect the motivational regulations of the individual. Therefore, the aim of the study is to examine the relationship between basic psychological needs, motivational regulations for exercise, and social physique anxiety, based on the theory of self-determination of individuals between the ages of 25 and 45.

Method

Participants

The research population consisted of individuals between the ages of 25-45 who exercise regularly. In the current study, regular exercise was accepted as exercising a minimum of 30 minutes, three days a week for at least one year. Minimum sample size calculation with Gpower program; effect size was determined as 0.1, margin of error of 5%, power of 95% as 216 people. Accordingly, 420 participants (28.33±6.21), including 193 men and 227 women, who exercise regularly, were included in the study. Participants in the sample group were reported that they did group (pilates, zumba, spinning) and individual exercises under the guidance of a trainer.

Measures

In the study, personal information forms, The Basic Psychological Needs in Exercise Scale, Behavioural Regulations in Exercise Questionnaire-2, and The Social Physique Anxiety Scale were used.

The Basic Psychological Needs in Exercise Scale (BPNES): The BPNES was developed by Vlachopoulos and Mchailidou (2006) to evaluate the three basic needs (autonomy, competence, and relatedness) of Exercise participants, specified within the scope of self-determination theory, in the exercise environment (Vlachopoulos and Michailidou, 2006). The BPNES consists of 12 items measuring each of the need constructs using four items. The participants were requested to indicate the degree of their agreement with each item on a 5-point Likert scale anchored by 1 (I don't agree at all) and 5 (I completely agree). The scale was adapted into Turkish by Vlachopoulos et al. (2013) in a cross-cultural study (Vlachopoulos et al., 2013). The factor loadings for the fit index ($\chi^2(42) = 284.57$, $p<.01$; CFI=.912; RMSEA=.074) of the BPNES and the 12-item scale ranged from .64 to .76. The Cronbach alpha internal consistency coefficient was between .73 (Efficacy) and .80 (Relatedness).

Behavioural Regulations in Exercise Questionnaire-2 (BREQ-2): The 19-item BREQ-2 contains five subscales that measured varying degrees of exercise motivations, namely external, introjected, identified, intrinsic regulations, and amotivation (Markland and Tobin, 2004). Former studies have supported the questionnaire's construct validity and internal reliability (Wilson et al., 2002; Markland and Tobin, 2004). The validity and reliability study of the Turkish version was performed by Ersöz et al. (2012). The Turkish version of BREQ-2 includes four subscales, and each subscale contains four items except intrinsic regulation, which includes seven items (Ersöz et al., 2012). The internal consistency coefficient of the current sample's subscales ranged between 0.73 (external regulation) and 0.84 (intrinsic regulation).

The Social Physique Anxiety Scale (SPAS): The SPAS self-report measure of social physique anxiety. The original SPAS is a 12-items rated on a 5-point Likert scale, from 1= not at all true to 5= extremely true, with total scores ranging from 12-60 (Hart et al., 1989). In this study, the 7-item Turkish version of SPAS was used. The composite reliability coefficient of the SPAS was 0.83 for the Turkish sample (Hagger et al., 2007). The internal consistency coefficient of subscales was found 0.74 in this study.

Data Collection / Processing Way

Participants were informed about filling out data collection tools by making the necessary explanations about the purpose of the research. Participants were voluntarily included in the study. Survey forms were collected by the researchers then were checked and completed; incomplete or incorrect forms were not included in the study's data set. Filling out the personal information form and the scales took approximately 15-20 minutes. Data were collected between September and November 2020.

Design

The data analysis was done with the SPSS package program, and the error level was taken as .05. Whether the data met the prerequisites of parametric tests were decided by examining the skewness and kurtosis test results (Büyüköztürk, 2012). For the analysis of the data, firstly analysis of descriptive statistics and bivariate correlation between all variables, followed by linear regression analysis to analyze motivational regulations and basic psychological needs that bore social physique anxiety.

Results

Table 1. Distributions of scale points

Scales	Sub-Dimensions	N	x̄	Ss	Skewness	Kurtosis
BPNES	Competence	420	3,825	,813	-,617	,977
	Relatedness	420	3,869	,786	,047	,042
	Autonomy	420	3,565	,882	-,453	-,452
BREQ-2	İntrinsic Regulation	420	3,405	,685	,793	,873
	İntrojected Regulation	420	2,699	,965	-,020	,487
	External Regulation	420	,597	,890	,556	,193
	Amotivation	420	,397	,811	-,097	,850
SPAS	-	420	2,698	,995	,370	-,693

When the normal distribution of the research data was examined (Table 1), it was observed that the skewness and kurtosis values of the scores obtained from the scales show a normal distribution of the data.

Table 2. Mean, standard deviation, and correlations between Social Physique Anxiety, Basic Psychological Needs, and Motivational Regulations

	x̄±Ss.	1	2	3	4	5	6	7	8
1- SPAS	2,69±,99								
2- Competence	3,82±,81	-,486*							
3- Relatedness	3,56±,88	-,375*	,587*						
4- Autonomy	3,86±,78	-,234*	,834*	,575*					
5- İntrinsic Regulation	3,40±,68	-,321*	,498*	,392*	,470*				
6- İntrojected Regulation	2,69±,96	,338*	,220*	,185*	,163*	,450*			
7- External Regulation	,59±,89	,345*	,266*	-,476*	-,202*	-,336*	,058		
8- Amotivation	,39±,81	,287*	-354*	-,241*	-,273*	-,554*	,164	,629*	

*p<0.05

As a result of the correlation analysis (Table 2) performed to determine the descriptive statistics of the variables and the relationship between them, it was found that the scores meeting three basic psychological needs were similar to each other; the average score for relatedness was lower than competence and autonomy. Regarding the different types of motivation, the highest scores were obtained from intrinsic regulation (x̄=3.40) and introjected regulation (x̄=2.69); while the lowest scores were obtained from amotivation (x̄=.59) and external regulation (x̄=.39) forms. Pearson correlation analysis revealed that all variables in this study were associated with social physique anxiety. Specifically, the correlation was negative for the relationship between the three basic psychological needs [competence (r =-.486), relatedness (r =-.234), autonomy (r =-.375)] and intrinsic regulation sub-dimension (r =-.321) of social physique anxiety; while a positive correlation was found between the sub-dimensions introjected regulation (r =.138), external regulation (r =.345) and amotivation (r =.287).

Table 3. Linear Regression Analysis Predicting Social Physique Anxiety, Basic Psychological Needs, and Motivational Regulations

	B	t	p	VIF	F	p(Model)	R^2
	4.076	13.058	.000		20.663	.000	.320
Competence	-.182	-1.837	.010	2.158			
Relatedness	.262	2.603	.067	2.150			
Autonomy	-.330	-5.400	.000	1.391			
İntrinsic Regulation	-.316	-3.530	.000	1.780			
İntrojected Regulation	.249	2.912	.004	3.706			
External Regulation	.367	4.251	.000	3.704			
Amotivation	-.007	-.097	.923	1.743			

In the Multiple Linear Regression Analysis (Table 3) performed to determine the predictor between the variables in the research, it was found that the VIF values for all the variables included in the model are much lower than 10. In comparison, the corresponding tolerance

values are considerably larger than .10. The results showed no multi-linearity problem in the model (Neter et al., 1996). According to the results of multiple linear regression analysis, the introjected regulation (β=.24) and external regulation (β=.36) were predicted social physique anxiety significantly and positively; on the contrary, efficacy (β=-.18), autonomy (β=-.33), and intrinsic regulation (β=-.31) predicted negatively. This result explains 32% of the total variance together ($F_{(7,412)}$=26.663; p<.000).

Discussion

This study aimed to examine the relationship between meeting basic psychological needs, motivational arrangements for exercise, and social physique anxiety, based on the self-determination theory of individuals.

It was observed that the satisfaction of psychological needs obtained from the exercise environment was positively correlated with intrinsic regulation and introjected motivational regulation. Studies conducted in the framework of exercise suggested that the need for competence for exercise and health-related behaviors offered stronger relationships with more self-determination motivation than the other two basic psychological needs (Edmunds et al., 2006; Wilson et al., 2003). In addition, the studies were shown a strong association between perceived competence and social physique anxiety (Crocker et al., 2000; Frederick and Morrison, 1996). These results may indicate that in the exercise environment, one's perception of skill development or improvement in physical condition may be more important than reducing anxiety about being negatively evaluated and being integrated into a group or feeling capable of participating in the decision-making process.

This study also showed that social physique anxiety was correlated positively with introjected regulation, external regulation, and amotivation while negatively correlated with intrinsic regulation. The findings are in line with Cox et al. (2011), in which students attended physical education classes and Sicilia et al. (2014) with adolescent exercise participants (Cox et al., 2011; Sicilia et al., 2014). The findings were consistent with studies that suggested a positive relationship between self-determined motivation and body image anxiety (Ingledew and Markland, 2008; Ingledew, Markland and Ferguson, 2009). The current study showed that appearance and weight control motives positively predict extrinsic and introjected regulation in exercise contexts.

While the satisfaction of the need for competence and autonomy predicted social physique anxiety negatively, the need for relatedness does not predict social physique anxiety. This finding is parallel to the results of Thøgersen-Ntoumanis and Ntoumanis (2007) working with aerobics instructors. Consistent with current findings, previous studies were reported that autonomy support was an important element in meeting all three psychological needs, not just autonomy (Gagne et al., 2003; Sheldon et al., 2003). The findings were suggested that the satisfaction of autonomy need may be more important than the satisfaction of competence and relatedness needs in predicting indicators of social physical anxiety.

It was observed that intrinsic regulation negatively predicted social physique anxiety. While this result was in line with the findings of Thøgersen-Ntoumani and Ntoumanis (2006), which showed that social physique anxiety was negatively predicted by internal regulation, contradicted with another study by Thøgersen-Ntoumani and Ntoumanis (2007) with aerobics trainers. Thøgersen-Ntoumani and Ntoumanis suggested that self-determination motivation can increase the pleasure of exercising, make social comparisons unimportant, and reduce concerns about body appearance. Self-determination may indicate that motivation was likely to increase pleasure from exercise, trivialize social assessments, and alleviate concerns about one's physique.

Introjected regulation positively predicts social physique anxiety. This finding showed that being motivated to exercise because of intrinsic pressure or guilt was linked to anxiety about the person's social physique. On the contrary, exercising because of enjoying a particular activity (i.e., intrinsic motivation) or valuing the benefits of exercise (i.e., defined regulation) may not be due to concerns about one's body appearance. The results of the study were also revealed that external regulation positively predicts social physique anxiety. Results of bivariate correlations showed that social physique anxiety was more strongly associated with non-self-determined motivation types (introjected, external regulation, and amotivation) than intrinsic motivation. These results were consistent with studies that have found a positive relationship between self-determination motivation and social physique anxiety (Ingledew and Markland, 2008; Ingledew et al., 2009; Homan and Tylka, 2014; Ersöz, 2016).

Amotivation is defined as representing a "situation in which there is no intention to engage in behavior" and constitutes a form of motivation that is not completely self-determined (Hausenblas and Fallon, 2002). Given that all participants in the current study were exercised and chosen measurement tool to examine motivation did not include it (there has been any such scale yet), amotivation was not specifically discussed in the study.

Conclusion and Suggestion

As a result, this research has shown that basic psychological needs and motivational regulations for exercise can play an important role in social physique anxiety. It was revealed that increasing basic psychological needs in the context of exercise could reduce social physique anxiety in adults by reducing external pressure on exercise and increasing the internalization process in which the value of exercise could be integrated with oneself. Increased intrinsic regulation in the context of exercise may reduce social physique anxiety in adults. Moreover, these results may conclude that basic psychological needs and intrinsic regulation may play an important role in adopting and maintaining healthy life-enhancing behaviors in adults. In addition, participation in the exercise process can be increased by reducing external pressure for exercise both directly and indirectly by increasing the internalization process in which the pleasure of exercise can be directed by the individual's own goals. Also, the study shows that the development of basic psychological needs in exercise can reduce social physique anxiety by helping individuals perceive the value of physical activity and find more self-determined reasons to exercise.

The study has some limitations for the interpretation of the findings. First, the sample consisted only of individuals aged 25-45 years, limiting the findings' generalization to older or younger individuals. In addition, future studies should be studied with larger sample groups that are more diverse in terms of demographics and structure. Second, this study was designed cross-sectionally. Longitude designs should be developed to examine social physique anxiety to determine the results of this study over time and examine whether these relationships are maintained at different life stages. Finally, experimental research designs can examine how environmental conditions can affect social physique anxiety and how such anxiety affects the satisfaction of basic psychological needs and exercise motivation.

REFERENCES

Büyüköztürk Ş (2012). Sosyal bilimler için veri analizi el kitabı. Ankara: Pegem Akademi.

Cox AE, Ullrich-French S, Madonia J, Witty K. (2011). Social physique anxiety in physical education: Social contextual factors and links to motivation and behavior. Psychology of Sport and Exercise 12 (2011) 555-562.

Cox, R. H. (2007). Sport Psychology Concepts and Applications (6th Edition). New York: McGraw-Hill Companies Inc.

Crawford S, Eklund RC. (1994). Social physique anxiety, reasons for exercise, and attitudes toward exercise settings. Journal of Sport & Exercise Psychology, 16(1), 70–82.

Crocker PRE, Snyder J, Kowalski KC, Hoar S. (2000). Don't let me be fat or physically incompetent! The relationship between physical self-concept and social physique anxiety in Canadian high performance female adolescent athletes. Avante. 6, 16–23.

Deci EL, Ryan RM. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. Psychological Inquiry. 11, 227–268.

Deci EL, Ryan RM. (2002). Handbook of Self-Determination Research. Rochester, NY: University of Rochester Press.

Deci EL, Ryan RM. (2008). Hedonia, eudaimonia, and well-being: an introduction. J. Happiness Stud. 9, 1–11.

Edmunds J, Ntoumanis N, Duda JL. (2006). A Test of Self-Determination Theory in the Exercise Domain. Journal of Applied Social Psychology, 36(9), 2240–2265.

Ersöz G, Aşçı FH, Altıparmak E. (2012). Egzersizde davranışsal düzenlemeler ölçeği-2: geçerlilik ve güvenilirlik çalışması (Reliability and validity of behavioral regulations in exercise questionnaire-2). Türkiye Klinikleri Journal Sports Science. 4(1), 22-31.

Ersöz G. (2016). An Examination of Motivational Regulations, Dispositional Flow and Social Physique Anxiety among College Students for Exercise: A Self-Determination Theory Approach. College student journal. 50. 159-170.

Frederick CM, Morrison CS. (1996). Social physique anxiety: Personality constructs, motivations, exercise attitudes and behaviors. Perceptual and Motor Skills. 82, 963–972.

Gagne M, Ryan R, Bargmann K. (2003). Autonomy support and need satisfaction in the motivation and well-being of gymnasts. Journal of Applied Sport Psychology. 15, 372-390.

Gillison FG**,** Standage M, Skevington SM (2006). Relationships among adolescents' weight perceptions, exercise goals, exercise motivation, quality of life and leisure-time exercise behaviour: A self-determination theory approach. *Health Education Research* 21: 836–847.

Hagger MS, Aşçı FH, Lindwall M, Hein V, Mülazimoglu-Balli Ö, Tarrant M, Ruiz Y, Sell V (2007). "Cross-Cultural Validity and Measurement Invariance of the Social Physique Anxiety Scale in Five European Nations". Scandinavian Journal of Medicine and Science in Sports, Dec. 17(6), 703-19.

Hart EA, Leary MR, Rejeski WJ. (1989). The measurement of social physique anxiety. J Sport Exercise Psy, 11, 94- 104.

Hausenblas HA, Fallon EA. (2002) Relationship among body image, exercise Behaviour and exercise dependence symptoms. International Journal of Eating Disorders. 32, 179-185.

Homan KJ, Tylka TL (2014). Appearance-based exercise motivation moderates the relationship between exercise frequency and positive body image, Body Image, Volume 11, Issue 2, Pages 101-108.

Honeybourne, J. (2005). BTEC First Sport. Cheltenham: Nelson Thornes Ltd.

Ingledew DK, Markland D. (2008). The role of motives in exercise participation. Psychology and Health. 23, 807–828.

Ingledew DK, Markland DA, Ferguson E (2009). Three levels of exercise motivation. Applied Psychology: Health and Well-Being. 1, 336–355.

Korkiakangas EE, Alahuhta MA, Laitinen JH (2009). Barriers to regular exercise among adults at high risk or diagnosed with type 2 diabetes: a systematic review. Health Promot Int. 24:416–427.

Krause AE, North AC, Davidson JW (2019). Using self-determination theory to examine musical participation and well-being. Front. Psychol. 10:405.

Linardon J, Braithwaite R, Cousins R, Brennan L (2017). Appearance-based rejection sensitivity as a mediator of the relationship between symptoms of social anxiety and disordered eating cognitions and behaviors. Eat Behav. 27:27-32

Markland D, Tobin V (2004). A modification of the Behavioral Regulation in Exercise Questionnaire to include an assessment of amotivation. Journal of Sport and Exercise Psychology, 26: 191-196.

Mülazımoğlu Ballı Ö, Aşçı FH (2006). Sosyal Fizik Kaygı Envanteri'nin geçerlik ve güvenirlik çalışması. Spor Bilimleri Dergisi, 17(1),11-19.

Mullan E, Markland D (1997). Variations in self-determination across the stages of change for exercise in adults, Motivation and Emotion, 21: 349- 362.

Neter JA, Kutner MH, Nachtsheim CJ, Wasserman W (1996). Applied linear statistical models (4th ed.). Chicago, IL: Irwin.

Parfitt G, Pavey T, Rowlands A. (2009). Children's physical activity and psychological health: the relevance of intensity. Acta Paediatr. 98, 1037–1043.

Ryan RM, Deci EL (2002). An overview of self-determination theory: an organismic-dialectical perspective. In E. L. Deci, R. M. Ryan (Eds.), Handbook of self-determination research (pp. 333). Rochester, NY: The University of Rochester Press.

Sabiston CM, Crocker PRE, Munroe-Chandler KJ (2005). Examining current ideal discrepancy scores and exercise motivations as predictors of social physique anxiety in exercising females. Journal of Sport Behavior. 28, 68–85.

Sanlier N, Pehlivan M, Sabuncular G, Bakan S, Isguzar Y (2018). Determining the relationship between body mass index, healthy lifestyle behaviors and social appearance anxiety. Ec Food Nutr. 57(2), 124-39.

Sheldon KM, Williams G, Joiner T (2003). Self-determination theory in the clinic: Motivating physical and mental health. New Haven, CT: Yale University Press.

Sicilia A, Sáenz-Alvarez P, González-Cutre D, Ferriz R (2016). Social Physique Anxiety and Intention to Be Physically Active: A Self-Determination Theory Approach. Research quarterly for exercise and sport. 87, 1-11.

Sicilia A, Sáenz-Alvarez P, González-Cutre D, Ferriz R (2014). Exercise Motivation and Social Physique Anxiety in Adolescents. Psychologica Belgica 54(1), 111-129.

Sisson SB, Katzmarzik PT. (2008). International prevalence of physical activity in youth and adults. Obesity Reviews, 9:606–614.

Teixeira PJ, Carraça EV, Markland D, Silva, MN, Ryan RM (2012). Exercise, physical activity, and self-determination theory: a systematic review. The international journal of behavioral nutrition and physical activity, 9, 78.

Thøgersen-Ntoumani C, Ntoumanis N (2006). The role of self-determined motivation in the understanding of exercise-related behaviours, cognitions, and physical self-evaluations. Journal of Sports Sciences. 24(4), 393–404.

Thogersen-Ntoumani C, Ntoumanis N (2007) A self-determination theory approach to the study of body image concerns, self-presentation, and self- perceptions in a sample of aerobics instructors. Journal of Health Psychology. 12, 301-315.

Vansteenkiste M, Niemiec CP, Soenens B (2010). The development of the five mini-theories of self-determination theory: an historical overview, emerging trends, and future directions. The Decade Ahead: Theoretical Perspectives on Motivation and Achievement, 105–165.

Vlachopoulos SP, Aşçı FH, Cıd L, Ersöz G, Gonzalez-Cutre D, Moreno- Murcıa JA, Moutao, J (2013). Cross-cultural invariance of the basic psychological needs in exercise scale and need satisfaction latent mean differences among Greek, Spanish, Portuguese, and Turkish samples. Psychology of Sport and Exercise, 14(5): 622-631.

Vlachopoulos SP, Karageorghis CI, Terry PC (2000). Motivation Profiles in Sport: A Self-Determination Theory Perspective. Research Quarterly for Exercise and Sport. 71 (4), 387-397.

Vlachopoulos SP, Michailidou S (2006). Development and initial validation of a measure of autonomy, competence, and relatedness in exercise: The Basic Psychological Needs in Exercise Scale. Measurement in physical education and exercise science, 10(3): 179- 201.

Wilson PM, Rodgers WM, Blanchard CM, Gessell J (2003). The relationship between psychological needs, self-determined motivation, exercise attitudes, and physical fitness. Journal of Applied Social Psychology, 33(11), 2373–2392.

World Health Organization. Stay Physically Active During Self-Quarantine; World Health Organization: Copenhagen, Denmark, 2020.

International Journal of Sport Culture and Science
September 2021 : 9(3)
ISSN : 2148-1148
Doi : 10.14486/IntJSCS.2021.648

Social Media Use of University Students, Social Media Addictions and Academic Procrastination Examining Their Behavior

Recep CENGİZ[1], Bayram KAYA[2], Hakan SUNAY[3]

[1]Celal Bayar Üniversitesi Spor Bilimleri Fakültesi, Manisa, Türkiye

https://orcid.org/0000-0003-4097-2337

[2]Milli Eğitim Müdürlüğü, Kırşehir, Türkiye

https://orcid.org/0000-0003-0249-5572

[3]Ankara Üniversitesi Spor Bilimleri Fakültesi, Ankara, Türkiye

https://orcid.org/0000-0001-5139-14

Email: rcengiz1965@gmail.com, bayramkaya400@gmail.com , hakan.Sunay@ankara.edu.tr

Type: Research Article (Received:06.09.2021– Accepted: 18.11.2021)

Abstract

The aim of this study is to examine the social media use, social media addictions and academic procrastination behaviors of Manisa Celal Bayar University Faculty of Sport Sciences students and the relationships between them. In addition, it was examined whether there were relations between demographic variables such as age, department, device, time and instrument, and social media use, social media addiction and academic procrastination.Karal and Kokoç's (2010) "University Students' Social Media Usage Purposes Scale" applied to university students is in 5-point Likert type with 3 sub-dimensions and it consists of 14 questions. The social media addiction scale was developed by Şahin and Yağcı (2017) and consists of 20 questions, 5 likert type, and 4 sub-dimensions.The population of the research consists of students from Manisa Celal Bayer University Faculty of Sports Sciences Department of Physical Education, Coaching, Recreation and Sports Management. The sample consists of 441 students selected on a voluntary basis. Frequency, percentage, arithmetic averages, independent sample t-test for binary variables, and One Way ANOVA tests for multiple variables were used in the personal information form. Tukey test was applied to determine which variable favored the difference.As a result, a negative relationship was found between social media use and social addiction in this study. It can be stated that university students use social media without being addicted. No relationship was found between social media use and social media addiction and academic procrastination. In groups where social media is used consciously, social media does not cause addiction and does not adversely affect individuals academically.

Keywords: Social Media; Social Media Addiction; Academic Postponement.

Introduction

The communication began in 550 BC, when the Persians first established a postal organization. It can be stated that communication and media have improved greatly to this day. With the use of the Internet, great progress has been made in the field of communication and media (Büyükşener, 2009).

The technical development of the internet has been effective in the emergence of social networking sites, especially preferred by the younger generations. The effect of the Internet in this sense concerns all people (Duran-Okur, and Özkul, 2015).

With the popularization of this concept called' social media", it has become an important issue in human life. People are instantly aware of what is happening in the world through social media. They can access the information they want very easily. They can share their posts, photos and product ads by the help of social media (Kaplan, 2019). Social media is a virtual space where internet users can express themselves and communicate with other users quickly and easily (Özdemir and Erdem, 2016).

Most Internet users spend most of their time on social media. Due to the ease of use and diversity of social media, people find the opportunity to express themselves easily (Bedir and Gülcü, 2016:70). Since the use of social media is through the internet, it can be stated that internet use cannot be separated from social media use (Ünal, 2015).

Currently, social media has become the center of attention in society due to the various opportunities it offers to people in all age groups. People use social media and the internet unconsciously and for a long time (Seferoğlu and Yıldız, 2013). One of the dangers that arise as a result of excessive use of social media and the Internet is internet addiction or social media addiction (Deniz and Gürültü, 2018). Along with the remarkable increase in the amount of internet use, internet addiction has become a more negative situation observed in people (Balcı and Gülnar, 2009). New technologies can bring new risks, according to Aker (2014). Uncontrolled use of this technology, lack of control over technologies and time spent on technologies can lead to unintended consequences (Akter, 2014). In contrast, individuals can benefit from controlled and conscious use of the internet and associated social media in a social and academic sense (Akar, 2016).

Academic procrastination is a type of procrastination behavior. It is the delay that occurs during the execution of academic-based tasks (Akdemir, 2013). In academic procrastination, there is a postponement of what needs to be done about the school. Academic procrastination includes the following elements such as:

-Leaving the completion of work to the last minute,
- The work to be done takes more time than necessary,
- Having an anxiety state (Cited by: Çetin, 2016).

In academic procrastination, the individual cannot use time effectively and cannot make academic plans in order of priority. In addition, one of the factors leading to academic procrastination is the inability to acquire effective and efficient study habits (Yüce, 2016).

The Aim of the Study

The aim of this study is to examine the social media use, social media addictions and academic procrastination behaviors of Manisa Celal Bayar University Faculty of Sport Sciences students and the relationships between them. In addition, it was examined whether there were relations between demographic variables such as age, department, device, time and instrument, and social media use, social media addiction and academic procrastination.

Material and Method

The method used for this research is the descriptive survey method. This method is used to determine the beliefs, views and attitudes of the determined group (McMillan and Schumacher, 2006).

In the personal information form prepared for the research, 5 questions were arranged as age, department, device, time and instrument. Karal and Kokoç's (2010) "University Students' Social Media Usage Purposes Scale" applied to university students is in 5-point Likert type with 3 sub-dimensions and it consists of 14 questions. The codes for determining the media usage purposes of university students are as follows: ‘’ 1: Totally Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Totally Agree ‘.The social media addiction scale was developed by Şahin and Yağcı (2017) and consists of 20 questions, 5 likert type, and 4 sub-dimensions. This scale was coded as “1: not suitable for me at all, 2: not suitable for me, 3: neutral, 4: suitable for me, 5: very suitable for me”. The academic procrastination scale developed by Çakıcı (2003) consists of 19 items and one dimension. The 5-point scale was coded as “does not reflect me at all, slightly reflects me, reflects me a bit, mostly reflects me, and completely reflects me”. The population of the research consists of students from Manisa Celal Bayer University Faculty of Sports Sciences Department of Physical Education, Coaching, Recreation and Sports Management. The sample consists of 441 students selected on a voluntary basis. Frequency, percentage, arithmetic averages, independent sample t-test for binary variables, and One Way ANOVA tests for multiple variables were used in the personal information form. Tukey test was applied to determine which variable favored the difference.

Results

Table 1:

Personal Information	Sub groups	Frequency (f)	Percent (%)
Age	18-25 Age	347	78,7
	26-30 Age	84	19,0
	30+ Age	10	2,3
	Total	441	100,0
Episode	Physical education	138	31,3
	Coaching	149	33,8
	Recreation	100	22,7
	Management	54	12,2
	Total	441	100,0
Class	1.Class	128	29,0
	2.Class	99	22,4
	3.Class	181	41,0
	4.Class	33	7,5
	Total	441	100,0
Device	Sımart Telophone	326	73,9
	Computer İnternet	115	26,1
	Total	441	100,0
Hour	1 Less than Hour	81	18,4
	1-3 Hour	113	25,6
	4-6 Hour	226	51,2
	7 Hours and Over	21	4,8
	Total	441	100,0
Vehicle	Facebook	85	19,3
	Twitter	142	32,2
	İnstagram	92	20,9

	Youtube	109	24,7
	other	13	2,9
	Total	441	100,0

According to Table 1, 78.7% of the participating students are in the 18-25 age group. It was stated that 73.9% of the students follow social media on smart phones. It was determined that students use general social media tools at a similar rate to each other.

Table 2:

Factors	Skewness	Kurtosis	Kolmogorov-Smirnow
Socıal Medıa Use	**,016**	**-1,452**	**3,390**
SMU Recognition	,554	-,521	4,631
SMU Contact	,627	-,638	3,971
SMU Education	,554	-,521	3,971
Socıal Medıa Addıctıon	**-,077**	**-,997**	**2,026**
SMA Safe	,132	-1,269	2,429
SMA İndifferent	-,551	-,489	4,534
SMA Obsession	-,212	-1,066	3,190
SMA Fear	-,510	,527	2,642
Academy Delay	**-,539**	**1,537**	**2,311**

According to Table 2, Skewness-Kurtosis values across the scale and in its sub-dimensions were found to be between -2<X<+2 (Şencan, 2002). It was decided to perform the parametric test according to the Kolmogorov-Smirnov Z test.

Table 3:

Factors	Confidence Coefficient (Cronbach Alpha)
Socıal Medıa Use	,871
SMU Recognition	,924
SMU Contact	,932
SMU Education	,862
Socıal Medıa Addıctıon	,833
SMA Safe	,859
SMA İndifferent	,895
SMA Obsession	,853
SMA Fear	,913
Academy Delay	,622

In Table 3, reliability coefficients (Cronbach Alpha) were calculated for the scale and its sub-dimensions.

Table 4:

Source of Variance	Age	N	$\bar{X}$	SD	F	P*	Tukey
Socıal Medıa Use	18-25 Age	347	2,3131	,61467	2,366	,096	
	26-30 Age	84	2,2849	,58886			
	30+	10	2,7214	,21678			
SMU Recognition	18-25 Age	347	2,2637	,76949	1,870	,155	
	26-30 Age	84	2,1696	,78114			
	30+	10	2,6500	,45947			

SMU Contact	18-25 Age	347	1,9155	,76569	3,090	,057	
	26-30 Age	84	1,7738	,77987			
	30+	10	2,3667	,42889			
SMU Education	18-25 Age	347	1,9155	,76569	3,090	,067	
	26-30 Age	84	1,7738	,77987			
	30+	10	2,3667	,42889			
Socıal Medıa Addıctıon	18-25 Age	347	3,0887	,56409	5,564	,004	**18-25**
	26-30 Age	84	3,2343	,52494			**26-30**
	30+	10	2,6684	,31584			30+
SMA Safe	18-25 Age	347	3,2351	,85485	4,944	,008	**26-30**
	26-30 Age	84	3,4881	,82415			
	30+	10	2,7571	,56765			30+
SMA İndifferent	18-25Age	347	2,8444	,75857	1,598	,203	
	26-30 Age	84	2,9702	,70005			
	30+	10	2,6000	,65828			
SMA Obsession	18-25 Age	347	3,2467	,74089	4,634	,010	**18-25**
	26-30 Age	84	3,4857	,71358			
	30+	10	2,9600	,44020			26-30
SMA Fear	18-25 Age	347	2,9332	,46136	7,992	,000	**30+**
	26-30 Age	84	2,9167	,36816			18-25
	30+	10	2,3667	,25820			26-30
Academy Delay	18-25Age	347	3,8039	,47351	1,630	,197	
	26-30Age	84	3,8586	,36728			
	30+	10	4,0313	,13582			

Social Media Use, Social Media Addiction and Academic Procrastination Dimensions and their sub-dimensions are compared according to the age variable in Table 4. The difference between age variable and the size of Social Media Use and all its lower dimensions was not significant. The difference between the age variable and the size of Social Media Addiction and the sub-dimensions of safe attachment, obsessive attachment, fearful attachment is significant. In Tukey's analysis, which was conducted to determine the difference between the groups, the statistical difference between the 18-25 and 26-30 age groups and the 30+ age group in the dimension of Social Media Addiction is significant in favor of the 18-25 age groups and 26-30 age groups. In the secure attachment sub-dimension of Social Media Addiction, the difference between the 26-30 age group and the 30+ age group was found to be significant in favor of the 26-30 age group. In the SMA obsessive attachment sub-dimension, the difference between the 18-25 age group and the 26-30 age group was found to be significant in favor of the 18-25 age group. In the SMA fearful attachment sub-dimension, the difference between the 30+ age group and the 18-25, 26-30 age group was found to be significant in favor of the 30+ age group. In the Dismissive Attachment sub-dimension, the difference was found to be insignificant. There was no significant difference between the age variable and the Academic Procrastination dimension.

Table 5:

Source of Variance	Episode	N	$\bar{X}$	SD	F	P*	Tukey
Socıal Medıa Use	PHYSICAL EDUCATION	138	2,0916	,58521	21,938	,000	PHYSICAL **EDUCATION**
	COACHING	149	2,2991	,60338			**COACHING**
	RECREATION	100	2,3829	,60851			**RECREATION**
	MANAGEMENT	54	2,8201	,23942			**MANAGEMEN T**
Socıal Medıa Use	PHYSICAL EDUCATION	138	2,0054	,77275	16,473	,000	MANAGEMENT PHYSICAL

	COACHING	149	2,2248	,72582			EDUCATION
	RECREATION	100	2,3400	,76995			
	MANAGEMENT	54	2,8148	,52796			
SMU Contact	PHYSICAL EDUCATION	138	1,5773	,65133	25,226	,000	**MANAGEMEN T** **PHYSICAL EDUCATION** **COACHING** **RECREATION**
	COACHING	149	1,9060	,77893			
	RECREATION	100	1,9767	,75842			
	MANAGEMENT	54	2,5556	,54176			
SMU Education	PHYSICAL EDUCATION	138	1,5773	,65133	25,226	,000	PHYSICAL EDUCATION COACHING RECREATION MANAGEMENT
	COACHING	149	1,9060	,77893			
	RECREATION	100	1,9767	,75842			
	MANAGEMENT	54	2,5556	,54176			
Socıal Medıa Addıctıon	PHYSICAL EDUCATION	138	3,3295	,51636	25,395	,000	**PHYSICAL** EDUCATION COACHING RECREATION MANAGEMENT
	COACHING	149	3,0918	,56901			
	RECREATION	100	3,0921	,52072			
	MANAGEMENT	54	2,6072	,32504			
SMA Safe	PHYSICAL EDUCATION	138	3,6335	,79267	29,863	,000	**PHYSICAL EDUCATION** **COACHING** **RECREATION** **MANAGEMEN T**
	COACHING	149	3,2656	,84271			
	RECREATION	100	3,2257	,82233			
	MANAGEMENT	54	2,4550	,35655			
SMA İndifferent	PHYSICAL EDUCATION	138	3,1051	,68469	24,539	,000	MANAGEMENT PHYSICAL EDUCATION COACHING RECREATION
	COACHING	149	2,9463	,69783			
	RECREATION	100	2,7750	,73641			
	MANAGEMENT	54	2,1759	,61550			
SMA Obsession	PHYSICAL EDUCATION	138	3,5594	,70210	24,755	,000	**PHYSICAL EDUCATION** **COACHING** **RECREATION** **MANAGEMEN T**
	COACHING	149	3,2685	,73218			
	RECREATION	100	3,2960	,66514			
	MANAGEMENT	54	2,6148	,50485			
SMA Fear	PHYSICAL EDUCATION	138	2,9855	,40198	2,215	,086	-
	ANTRENÖRLÜK	149	2,8803	,49170			
	RECREATION	100	2,9283	,43504			
	MANAGEMENT	54	2,8241	,44794			
Academy Delay	PHYSICAL EDUCATION	138	3,7758	,48127	,757	,518	-
	COACHING	149	3,8406	,42783			
	RECREATION	100	3,8213	,45894			
	MANAGEMENT	54	3,8692	,42255			

Although there was no significant difference between the department variable and the Academic Procrastination dimension and the SMA Fearful Attachment sub-dimension in Table 5, a significant difference was found in the Social Media Use, Social Media Addiction dimensions and their sub-dimensions. In Tukey's analysis to determine between which groups there is a difference, the statistical difference between the physical education department and the Coaching, Recreation and Management departments was found to be significant in the Social Media Usage dimension in favor of the Coaching, Recreation and Management departments. In the Social Media Addiction dimension, the statistical difference between the Physical Education department and the Coaching, Recreation and Management departments was found to be significant in favor of the Physical Education Department.

Table 6:

Source of Variance	Episode	N	$\bar{X}$	SD	F	P*	Tukey
Socıal Medıa Use	1	128	2,5257	,55246			**4**
	2	99	2,4654	,57018	38,982	,000	
	3	181	1,9984	,53425			1-2-3
	4	33	2,8095	,41560			
SMU recognition	1	128	2,4375	,76847			**1-2-4**
	2	99	2,4242	,79013	23,016	,000	
	3	181	1,9337	,64638			3
	4	33	2,7955	,63262			
SMU Contact	1	128	2,1120	,65779			**4**
	2	99	2,0909	,77492	31,454	,000	
	3	181	1,5322	,66275			1-2-3
	4	33	2,5051	,78670			
SMU education	1	128	2,1120	,65779			**4**
	2	99	2,0909	,77492	31,454	,000	
	3	181	1,5322	,66275			1-2-3
	4	33	2,5052	,78670			
Socıal Medıa Addıctıon	1	128	2,8803	,53261			**3**
	2	99	3,0260	,48660	26,455	,000	
	3	181	3,3597	,53255			1-2-4
	4	33	2,8421	,42900			
SMA safe	1	128	2,9029	,82172			**3**
	2	99	3,1299	,77365	29,703	,000	
	3	181	3,6796	,78703			1-2-4
	4	33	2,9004	,53629			
SMA indifferent	1	128	2,5508	,70666			**3**
	2	99	2,7980	,72815	23,973	,000	
	3	181	3,1796	,66003			1-2-4
	4	33	2,5303	,72822			
SMA obsession	1	128	3,0047	,73236			**3**
	2	99	3,2586	,61561	19,736	,000	
	3	181	3,5646	,72577			1-2-4
	4	33	2,9273	,56749			
SMA fear	1	128	2,8919	,45946			**3**
	2	99	2,8300	,46716	5,946	,001	
	3	181	3,0138	,39786			2-4
	4	33	2,7475	,51391			
Academy Delay	1	128	3,8486	,38945			
	2	99	3,8996	,37466	2,284	,078	-
	3	181	3,7659	,52113			
	4	33	3,7595	,44418			

Sosyal Medya Kullanımı ve Sosyal Medya Bağımlılığı boyutlarında ve tüm alt boyutlarda sınıf değişkenine göre anlamlı fark bulunmuştur. Akademik Erteleme boyutunda anlamlı fark bulunamamıştır. Hangi gruplar arasında fark olduğunu belirlemeye dönük yapılan Tukey analizinde; Sosyal Medya Kullanımı boyutunda 1,2 ve 3.sınıflar ile 4.sınıflar arasında istatistiksel olarak fark 4.sınıflar lehine anlamlı, Sosyal Medya Bağımlılığı boyutunda 1,2,4.sınıflar ile 3.sınıflar arasında fark 3.sınıfların lehine anlamlı bulunmuştur.

Table 7:

	Device	N	$\bar{X}$	SD	T	P*
Social Media Use	Smart phone	326	2,4439	,58614	7,905	,000
	Computer Internet	115	1,9571	,51175		
SMU recognition	Smart phone	326	2,4103	,75791	7,619	,000
	Computer Internet	115	1,8130	,61134		
SMU Contact	Smart phone	326	2,0532	,73210	7,565	,000
	Computer Internet	115	1,4609	,69189		
SMU training	Smart phone	326	2,0532	,73210	7,565	,000
	Computer Internet	115	1,4609	,69189		
Social Media Addiction	Smart phone	326	3,0079	,53432	-6,561	,000
	Computer Internet	115	3,3876	,53166		
SMA safe	Smart phone	326	3,0925	,81802	-7,987	,000
	Computer Internet	115	3,7826	,73268		
SMA indifferent	Smart phone	326	2,7607	,77923	-4,960	,000
	Computer Internet	115	3,1522	,55478		
SMA obsession	Akıllı Telefon	326	3,1601	,69972	-6,285	,000
	Computer Internet	115	3,6417	,72572		
SMA fear	Smart phone	326	2,9064	,45894	-,850	,396
	Computer Internet	115	2,9478	,41907		
Academy Delay	Smart phone	326	3,7880	,45789	-2,481	,013
	Computer Internet	115	3,9087	,42116		

Although no significant difference was found in the SMB Fearful Attachment sub-dimension according to the device variable in Table 7, a significant difference was found in the Social Media Use, Social Media Addiction and Academic Procrastination dimensions.

Table 8:

Source of Variance	Time	N	$\bar{X}$	SD	F	P*
Social Media Use	1 Less than Hour	81	2,2213	,59318	2,206	,087
	1-3 Hour Break	113	2,2478	,59754		
	4-6 Hour	226	2,3875	,60146		
	7 Hours and Over	21	2,2993	,69679		
SMU recognition	1 Less than Hour	81	2,1111	,71480	2,896	,055
	1-3 Hour Break	113	2,1659	,73770		
	4-6 Hour	226	2,3573	,78940		
	7 Hours and Over	21	2,1786	,79113		
SMU Contact	1 Less than Hour	81	1,7366	,74669	2,010	,112
	1-3 Hour Break	113	1,8673	,76835		
	4-6 Hour	226	1,9587	,75180		
	7 Hours and Over	21	2,0476	,92668		
SMU training	1 Less than Hour	81	1,7366	,74669		

	1-3 Hour Break	113	1,8673	,76835	2,010	,112
	4-6 Hour	226	1,9587	,75180		
	7 Hours and Over	21	2,0476	,92668		
Socıal Medıa Addıctıon	1 Less than Hour	81	3,1735	,58249	1,095	,351
	1-3 Hour Break	113	3,1509	,54235		
	4-6 Hour	226	3,0629	,55313		
	7 Hours and Over	21	3,0877	,60477		
SMA safe	1 Less than Hour	81	3,3298	,90510	,553	,646
	1-3 Hour Break	113	3,3325	,87220		
	4-6 Hour	226	3,2250	,82463		
	7 Hours and Over	21	3,2381	,84314		
SMA indifferent	1 Less than Hour	81	2,9259	,79887	,325	,808
	1-3 Hour Break	113	2,8717	,71270		
	4-6 Hour	226	2,8429	,74885		
	7 Hours and Over	21	2,7857	,73436		
SMA obsession	1 Less than Hour	81	3,3605	,79399	1,336	,262
	1-3 Hour Break	113	3,3611	,67658		
	4-6 Hour	226	3,2177	,74120		
	7 Hours and Over	21	3,3238	,75492		
SMA fear	1 Less than Hour	81	3,0000	,40654	1,787	,149
	1-3 Hour Break	113	2,9425	,45358		
	4-6 Hour	226	2,8732	,45476		
	7 Hours and Over	21	2,9365	,48727		
Academy Delay	1 Less than Hour	81	3,8495	,45563	,435	,728
	1-3 Hour Break	113	3,8103	,44766		
	4-6 Hour	226	3,8219	,44544		
	7 Hours and Over	21	3,7262	,53087		

According to Table 8, no significant difference was found in Social Media Use, Social Media Addiction and Academic Procrastination dimensions and in all sub-dimensions according to the time variable.

Table 9:

Source of Variance	Vehicles	N	$\overline{X}$	SD	F	P*	Tukey
Socıal Medıa Use	Facebook	85	2,0109	,57329	18,235	,000	**Twitter**
	Twitter	142	2,1901	,56550			**Instagram**
	Instagram	92	2,3929	,65564			**Youtube**
	Youtube	109	2,5872	,48808			**Diğer**
	Other	13	2,9011	,28052			Facebook
SMU recognition	Facebook	85	1,9765	,78455	10,753	,000	**Instagram**
	Twitter	142	2,1320	,72609			**Youtube**
	Instagram	92	2,3315	,78368			**Diğer**
	Youtube	109	2,4656	,68589			
	Other	13	3,0962	,54523			Facebook
SMU Contact	Facebook	85	1,5373	,60613	21,349	,000	**Diğer**
	Twitter	142	1,6925	,62402			
	Instagram	92	1,9638	,85942			Twitter
	Youtube	109	2,3119	,73602			Instagram
	Other	13	2,5897	,62589			Facebook
SMU education	Facebook	85	1,5373	,60661	21,349	,000	**Diğer**
	Twitter	142	1,6925	,62402			
	Instagram	92	1,9638	,85942			Twitter
	Youtube	109	2,3119	,73602			Instagram
	Other	13	2,5897	,62589			Facebook

Socıal Medıa Addıctıon	Facebook	85	3,3412	,52935			**Facebook**
	Twitter	142	3,2090	,57964	12,637	,000	
	Instagram	92	3,0727	,53223			Instagram
	Youtube	109	2,8498	,48311			Youtube
	Other	13	2,8583	,30416			Diğer
SMA safe	Facebook	85	3,6101	,80944			**Twitter**
	Twitter	142	3,4004	,90130	12,482	,000	**Instagram**
	Instagram	92	3,3075	,77553			**Facebook**
	Youtube	109	2,8716	,74711			
	Other	13	2,7802	,38516			Youtube
SMA indifferent	Facebook	85	3,0941	,56428			**Facebook**
	Twitter	142	2,9824	,72055	8,308	,000	**Twitter**
	Instagram	92	2,8533	,79676			
	Youtube	109	2,5872	,76329			
	Other	13	2,4231	,78650			Youtube
SMA obsession	Facebook	85	3,6118	,63347			**Facebook**
	Twitter	142	3,4127	,74727	12,459	,000	
	Instagram	92	3,2109	,74678			
	Youtube	109	2,9505	,67995			Instagram
	Other	13	3,1077	,32265			Youtube
SMA fear	Facebook	85	3,0020	,46823			**Twitter**
	Twitter	142	2,9894	,41883	3,566	,007	
	Instagram	92	2,8261	,40216			
	Youtube	109	2,8471	,47851			Instagram
	Other	13	2,8077	,51750			
	Facebook	85	3,7853	,50779			
Academıc Delay	Twitter	142	3,8151	,47189	1,420	,226	
	Instagram	92	3,8240	,44145			
	Youtube	109	3,8756	,38485			
	Other	13	3,5865	,37198			

In Table 9, a significant difference was found in the Social Media Use, Social Media Addiction dimensions and all sub-dimensions, except for the instrument variable and the Academic Procrastination dimension. In Tukey's analysis to determine between which groups there is a difference, the difference between Twitter, Instagram, Youtube and Others and Facebook was found to be significant in favor of Twitter, Instagram, Youtube and Others in terms of Social Media Usage. In the dimension of Social Media Addiction, the difference between Facebook and Twitter, Instagram, Youtube and Others was found to be significant in favor of Facebook.

Table 10:

		Social Media Usage	**Social Media Addiction**	**Academic Postponement**
Social Media Usage	r	1	**-,745****	**,074**
	p		,000	,120
	n	441	441	441
Social Media Addiction	r	**-,745****	1	**-,010**
	p	,000		,830
	n	441	441	441
Academic Postponement	r	**,074**	**-,010**	1
	p	,120	,830	

n	441	441	441

In Table 10, there is a high negative (r=-.745; p<0.001) relationship between Social Media Use and Social Media Addiction, while a low positive (r=.074) relationship between Social Media Use and Academic Procrastination. There was a low negative (r=-.010) relationship between Social Media Addiction and Academic Procrastination.

Discussion and Conclusion

Social Media Usage, Social Media Addiction and Academic Procrastination Dimensions and sub-dimensions were compared according to the age variable. There was no significant difference in age variable and Social Media Use dimension and all sub-dimensions. There is a significant difference between the age variable and the Social Media Addiction dimension and the Secure Attachment, Preoccupied Attachment and Fearful Attachment sub-dimensions.

In Kaplan 's study called "Examination of the Relationship Between Social Media Addiction Levels, Social Media Use Purposes and Attachment Styles of University Students"(2019) and in Koçer's (2012) study, the fact that they could not find a difference between Social Media Use and age variable supports this study. The fact that Eren (2014) did not find a significant difference between the age variable and the communication dimension in terms of the purpose of Social Media Use is in line with our study. The fact that Eren (2014) found a significant difference between age variables in the education dimension does not coincide with this study. It can be thought that a large part of the sample size in Eren (2104)'s study stems from the departments where academic studies are more intense, such as law faculty, medical school, and engineering faculty.

Finding a significant difference between Social Media Addiction and age variable, and finding a significant difference between 18-24 age group participants and Social Media Addiction in Şentürk (2017) study coincides with this study. The fact that Kaplan (2019) and Ünal (2015) did not find a significant difference between Social Media Addiction and age variable in their studies does not overlap with this study. The high level of social media addiction of younger age group students may be due to their lower awareness.

The fact that there was no significant difference between the Academic Procrastination Dimension and the age variable can be explained by the application of the study to student groups who have reached a certain level, and therefore the students' awareness.

Although no significant difference was found between the department variable and the Academic Procrastination dimension and the SMA Fearful Attachment sub-dimension, a significant difference was found in the Social Media Use, Social Media Addiction dimensions and their sub-dimensions. In the study of Ünal (2015), it was stated that the social dependency levels of the students vary according to the faculties. In this study, the difference between the departments supports the study.

A significant difference was found in the Social Media Use and Social Media Addiction dimensions and in all sub-dimensions according to the class variable. No significant difference was found in the dimension of Academic Procrastination. The fact that there is no significant difference between academic procrastination and the class variable can be seen as an expected result for students to reach these levels only by showing academic success. The fact that Filiz et al. (2014) found a significant difference between grade level and internet addiction in their study is in line with this study. The fact that Akdemir (2013), Noise (2016) and Durdu (2019) did not find a significant difference between social addiction and class level in their studies does not overlap with this study.

Although no significant difference was found in the Social Media Addiction Fearful Attachment sub-dimension according to the device variable, a significant difference was found in the Social Media Use, Social Media Addiction and Academic Procrastination dimensions and their sub-dimensions. Regarding Social Media Usage and its sub-dimensions, it can be said that the fact that the average of smartphone usage is higher than the average of computer/internet usage is due to the fact that access to social media is always accessible by the help of smartphone. We can say that Social Media Addiction, SMA secure attachment, SMA dismissive attachment and SMA obsessive attachment are higher with computer internet use.

No significant difference was found in Social Media Use, Social Media Addiction and Academic Procrastination dimensions and in all sub-dimensions according to the time variable. Although there is no significant difference between the SMU communication and SMU educational sub-dimensions of the Social Media Usage dimension and the duration of using social media, we can say that social media has been used for communication and education purposes for a long time. Ergenç (2011) Akdemir (2013), Durdu (2019) and Şentürk (2017) found in their studies that social media addictions increase as the duration of internet use increases. In this study, university students are expected to use social media for educational and communication purposes.

A significant difference was found in the Social Media Use, Social Media Addiction dimensions and all sub-dimensions, except for the instrumental variable and the Academic Procrastination dimension. In a study conducted by Koçer (2012) on university students, it was stated that every time students access Twitter, Youtube and Facebook, they use at least one social media tool for the purpose of communicating, getting information and doing homework. Çam and İşbulan (2012) found in their study that the use of Facebook social media tool has significant differences according to gender and increases social media addiction. The findings of Koçer (2012) and Çam and İşbulan (2012) that social media tools increase social media use and social media addiction overlap with this study. In this case, the use of social media tools increases the use of social media and social media addiction. We see that Facebook has a lot of influence, especially in terms of Social Media Addiction.

There was a high negative correlation ($r=-.745$; $p<0.001$) between Social Media Use and Social Media Addiction. A low positive correlation ($r=.074$) was found between Social Media Use and Academic Procrastination. There was a low negative ($r=-.010$) relationship between Social Media Addiction and Academic Procrastination. Kaplan(2019) found a positive relationship between social media use and social media addiction. Filiz, Erol, Dönmez, and Kurt (2014) stated in their study that there is a low level of positive correlation between social media use and internet addiction. The studies carried out support this study. The finding of a significant relationship between social media and academic procrastination by Durdu (2019), Noise (2016) and Akdemir (2013) does not overlap with this study.

As a result, a negative relationship was found between social media use and social addiction in this study. It can be stated that university students use social media without being addicted. No relationship was found between social media use and social media addiction and academic procrastination. In groups where social media is used consciously, social media does not cause addiction and does not adversely affect individuals academically.

Recommendations

- Social media courses can be given to schools at all levels in order to use social media consciously.
- Similar studies can be applied to students of different age groups, different universities and departments.

- Due to the obsessive addiction of students aged 18-25, which is revealed in the research findings, seminars and courses can be organized for this age group on conscious use of social media.

REFERENCES

Akar F (2017). Purposes and characteristics of internet use of adolescents. Pegem Journal of Education and Training, 7(2), 257.

Akdemir N (2013). "Examination of the Relationships Between Elementary School Students' Facebook Attitudes and Academic Procrastination Behaviors and Academic Success". Master Thesis, Marmara University Institute of Educational Sciences, Istanbul.

Akter T (2014). Social media addiction, resistance, and influence of awareness: Measurement of psychology students resistance to Facebook addiction. Mediterranean Journal of Social Sciences, 5(8), 456.

Balci S, Gulnar B (2009). Internet addiction among university students and the profile of internet addicts. Selcuk University Faculty of Communication Academic Journal, 6(1), 5-22.

Bedir A, Gülcü A (2016). The effect of social media use on the academic achievement and attitudes of university students. Unpublished Master's Thesis. Erzurum Ataturk University, Erzurum.

Büyükşener E (2009). The place of social networks in Turkey and an overview of social media. Paper presented at the internet conference in Turkey, Istanbul Bilgi University, Istanbul

Çam E, İşbulan O (2012:17). A new addiction for teacher candidates: Social networks. The Turkish Online Journal of Educational Technology (TOJET), 11 (3), 14-19.

Cetin N (2016). Investigation of Academic Procrastination Behaviors of High School Students, Master Thesis, Anadolu University Institute of Educational Sciences, Eskişehir.

Deniz L, Noise E (2018). Social Media Addictions of High School Students. Kastamonu Education Journal, 26(2), 355-367.

Okur HD, Özkul M (2015). The interface of modern communication: The effect of virtual communication social networking sites on the forms of social interaction (Facebook example). Süleyman Demirel University Journal of Social Sciences Institute, 1(21), 213-246.

Durdu A (2019). Social Media Addictions and Academic Procrastination of Secondary School 7th and 8th Grade Students Investigation of Behaviors, Toros University Institute of Social Sciences, Department of Psychology, Master's Program in Psychology.

Eren ES (2014). Developing the social media usage purposes scale and examining it according to some personal variables. Hacettepe University Faculty of Education Journal, 29(4),230-243.

Ergenc A (2011). Web 2.0 and virtual socialization: The example of Facebook. Master's thesis, Maltepe University, Institute of Social Sciences, Istanbul.

Filiz O, Erol O, Dönmez Fİ, Kurt AA (2014). Investigation of the relationship between the purpose of using social networking sites and internet addictions of CEIT students. Journal of Instructional Technologies and Teacher Education, 3(2).

Noise E (2016). “Examination of the Relationship Between Social Media Addictions and Academic Procrastination Behaviors of High School Students”, Master Thesis, Marmara University Institute of Educational Sciences, Istanbul.

Kaplan M (2019). Investigation of the Relationship Between Social Media Addiction Levels, Social Media Usage Purposes and Attachment Styles of University Students, Hasan Kalyoncu University Institute of Social Sciences Psychology Department, Master's Thesis.

Koçer M (2012). Internet and Social Media Usage Habits of Erciyes University Students. Akdeniz Communication, (18).

McMillan HJ, Schumacher S (2006). Research in education evidence-based inquiry. 6th Edition, Boston: Allynand Bacon Inc.

Okur HD, Ozkul M (2015). The interface of modern communication: The effect of virtual communication social networking sites on the forms of social interaction (Facebook example). Süleyman Demirel University Journal of Social Sciences Institute, 1(21), 213-246.

Özdemir S, Erdem R (2016). The Role of Social Media in Internal Communication. Manas Journal of Social Research, 5 (3). 247-270.

Seferoğlu SS, Yıldız H (2013). Children of the digital age: A research on primary school students' Facebook usage and internet addiction. Communication and Diplomacy, 2, 31-48.

Şahin C, Yağcı M (2017). Social media addiction scale-adult form: Validity and reliability study. Ahi Evran University Journal of Kirsehir Education Faculty (KEFAD), 14(1), 523-538.

Senturk (2017). Comparison of social media addiction between patients with depression, anxiety disorder, mixed anxiety and depressive disorder and control group and investigating the relationship between users' personality traits. Unpublished doctoral thesis, Gazi University, Ankara.

Unal A (2015). Social media addiction: A study on university students. Unpublished doctoral thesis, Marmara University, Istanbul. 15-265.

Yuce UE (2016). The Effect of Sports on Academic Procrastination Behavior of High School Students in Muğla Province, Master Thesis, Muğla University Health Sciences Institute, Mugla.

International Journal of Sport Culture and Science
September 2021 : 9(3)
ISSN : 2148-1148
Doi : 10.14486/IntJSCS.2021.649

The Physical Characteristics of Elite Female Figure Skaters

Emine KUTLAY[1], Gamze GÜNER[2], Eylül KAPLAN[1]
[1] Ege University, İzmir, Türkiye
https://orcid.org/0000-0002-6999-5961
[2] Figure Skating National Team Coach, İzmir, Türkiye
https://orcid.org/0000-0002-9894-6659
[1]Ege University, İzmir, Türkiye
https://orcid.org/0000-0002-7191-2619

Email: emine.kutlay@ege.edu.tr, gamzeiyiis@gmail.com, leylulkaplan@gmail.com

Type: Research Article (Received:05.09.2021– Accepted: 19.10.2021)

Abstract

The physical characteristics of high-level athletes differ in each sport, and coaches and athletes have a tendency to these traits. In this study, the physical characteristics of figure skaters (N=22) were examined. Anthropometric measurements were taken in accordance with ISAK protocol. Variables that were derived from anthropometric measurements and somatotype components of the athletes were calculated. Descriptive statistics analyses were carried out using IBM SPSS 25.0 statistics program. Percentage increase amounts were calculated in age groups and significant increase rates were examined. Body mass (BM), biceps, iliac crest, suprasipinale, abdominal, front tight skinfold thickness (ST), Σ6 and Σ8 between Groups I and II; biceps ST between Groups II and III; BM, subscapular, iliac crest, suprasipinale, abdominal ST and Trunk/Extremity ratio between Groups III and IV; BM, biceps, medial calf ST between Groups IV and V showed changes of 20% and more. In Groups II and IV an increase was observed in more parameters and ST values. In arm girth measurements were observed a change of 15.5% in groups III, IV and in other girth measurements were observed a change of 10% between age groups. In breadth measurement values, the most significant change was seen between Groups IV and V (12-16%). Somatotype components were determined 2.3-3.2-3.4 and 2.3-3.5-3.3 in Group IV, V. In our study, the physical characteristics of the athletes in the groups have changed with maturation. As the age progressed, an increase in the parameters related to the amount of body fat was observed.

Keywords: Physical characteristics, Anthropometric measurements, Figure skating, Athletes.

Introduction

Physical morphology or physical state, body weight or composition, body size and shape are important in a lot of branches of sports to optimize performance (Slater, O'Connor, & Kerr, 2018; Durakovic, 2012). Figure skating is an aesthetic and technical branch of sport performed in different age groups, levels and disciplines (singles, pairs, dance, synchronize) accompanied by music applied with different body dificulties. The harmony of conditional and coordinative capabilities are important in coreographic movements. Balancing movements on thin and slippery ground, using the lines on the ice and space skillfully and perfectly, leaving a good impression on judges and viewers take long training hours and years of a skater. In figure skating, with technical movements, artistic presentation, aesthetic attraction and physical appearance are given great importance.

Athletes competing in aesthetic sports may feel more pressure to lose weight than athletes in different sports branches (de Bruin, Oudejans, & Bakker, 2007). In figure skating, there are studies that indicate eating disorders of athletes to control their body weight (Dwyer, Eisenberg, Prelack, Song, Sonneville, & Ziegler, 2012; Voelker, Gould, & Reel, 2014). In a study conducted, 92.7% of figure skaters (ages 16 - 22), stated that they feel the pressure of losing weight (Taylor, & Ste-Marie, 2001).

Anthropometric measurements are taken regularly for different purposes such as observing athletes, monitoring growth and development, ageing and motor performance, physical activity, nutrition intervention to changes in body composition (Marfell-Jones, Olds, Stewart, & Carter, 2007). Because of the fact that figure skating is a kind of sport that specialized earlier (American Academy of Pediatrics (AAP), 2000), anthropometric measurements could be beneficial to watch training effects, physical developments and compare skaters within their group or with other groups. In this study, physical characteristics of the elite figure skaters competing were examined.

Metod

*Participants:*Twenty-six figure skaters, including national athletes (aged 6 - 17) (decimal age) from The Municipality of İzmir Sports Club took part in this study as competitors in the discipline of singles. Because the number of male athletes were inadequate in age groups (n=4), they were not involved in the study. The sports start ages of the girls (N=22) was 6.0 ± 1.6 year, and the weekly training hour was 8.8 ± 1.6 hour. Five different age categories were created. (Group I; n:5; 6.0 - 8.2 years), (Group II; n:5; 8.5 - 10.3 years), (Group III; n:5; 10.8 - 12.2 years), (Group IV; n:3; 13.0 - 13.1 years), (Group V; n:4; 15.9 - 17.9 years). The aim of this study and the measurements to be applied were explained to the athletes, their families and trainers, and their written consent was obtained.

*Anthropometric Measurements:*Anthropometric measurements were performed according to the ISAK (International Society for the Advancement of Kinanthropometry) (Restricted Profile - 17 parameters, bolded in tables) protocol (Marfell-Jones, Olds, Stewart, & Carter, 2007) by an accredited ISAK Level III anthropometrist in the Kinesiology Laboratory of

Ege University Faculty of Sport Sciences at the beginning of the season, in morning hours and in 2017.

Body mass (BM) was measured through a scale with a sensitivity of 0.1kg, stature (S) was measured by a stadiometer with a sensitivity of 0.1 cm (Seca 769, Germany). Sitting height (SH) and arm span (AS) were measured with a sensitivity of 0.1 cm. Skinfold thicknesses of triceps, subscapular, biceps, iliac crest, supraspinale, abdominal, front thigh, and medial calf regions were measured by skinfold caliper (nearest 0.2 mm, pressure of 10 g/mm², Holtain Ltd., UK), arm (relaxed), arm (flexed and tensed), waist, gluteal (hip) and calf girths were measured with a steel anthropometric tape (Cescorf Brasil, 0.1 cm distinction). The breadths of Humerus and Femur were measured with a small caliper and foot length was measured with a large caliper (Holtain Ltd., UK). Measurements were performed at the right side of the body. By using Microsoft Office Excel 2007 program, data recording and consistency between measurements were ensured.

Variables were derived from anthropometric measurements; Skinfold thickness of Σ6 (*Triceps* + *subscapular* + *supraspinale* + *abdominal* + *front thigh* + *medial calf*), and Σ8 (sum of all skinfold values) were calculated. Body mass index (BMI) was determined using the following formula: [(Body weight (kg) / height (m^2)], body fat ratio (%BF) was determined using the following formula: [0,610 x (*triceps* + *medial calf*) + 5.1] (Slaughter, Lohman, Boileau, Horswill, Stillman, Van Loan, & Bemben, 1988). Manouvrier Index (MI) was determined using the following formula: (Stature – Sitting Height / Sitting Height) x100. Waist/hip ratio (WHR) (%) was calculated. Sitting height/Stature ratio was determined using the following formula: (SH/S) x 100 (Monsma & Malina, 2005). The sum of trunk ST (*subscapular* + *suprailiac/suprasipinal* + *abdominal) /* the sum of extremity ST *(triceps* + *biceps* + *medial calf*) Trunk/Extremity skinfold ratios (T/E) (Monsma et al., 2005), and somatotype components were calculated in Group IV and V (Carter & Heath, 1990).

*Statistical Analyses:*Descriptive statistics analyses were carried out using IBM SPSS 25.0 statistics program. Percentage increase amounts were calculated in age groups and significant increase rates (%) were examined.

Results

Descriptive statistics of the physical properties of figure skaters are given in Table 1. BM, biceps, iliac crest, suprasipinale, abdominal, front tight ST, Σ6 and Σ8 between Groups I and II; biceps ST between Groups II and III; BM, subscapular, iliac crest, suprasipinale, abdominal ST and trunk/extremity ratio between Groups III and IV; BM, biceps, medial calf ST in Groups IV and V showed changes of 20% and more In Groups II and IV an increase was observed in more parametres and ST values (Table 2).

In arm girth were observed a change of 15.5% in groups III and IV and in other girth measurements were observed a change of ≈10 % between age groups. In breadth measurement values, the most significant change was detected between Groups IV and V

(12% - 16%) (Table 2).

Considering somatotype chatacteristics, endomorphy, mezomorphy and ectomorphy values were respectively 2.3 - 3.2 - 3.4 and 2.3 - 3.5 - 3.3 in Group IV and V (Table 1).

Table 1. The physical properties of female figure skaters.

N=22	Group I (n=5) (6-8.2 Age) Mean ± SD	Group II (n=5) (8.5-10.3 Age) Mean ± SD	Group III (n=5) (10.8-12.2 Age) Mean ± SD	Group IV (n=3) (13.0-13.1 Age) Mean ± SD	Group V (n=4) (15.9-17.9 Age) Mean ± SD
Starting (Age)	5.2 ± 0.7	5.2 ± 1.3	5.6 ± 0.5	7.0 ± 1.0	8.2 ± 2.2
Training weekly (h)	9.2 ± 1.7	9.2 ± 1.0	6.8 ± 1.0	9.3 ± 2.0	10 ± 0.0
Body Mass (kg)	**21.9 ± 2.9**	**28.0 ± 3.8**	**33.0 ± 4.4**	**42.5 ± 4.3**	**53.6 ± 4.2**
Stature (cm)	**121.3 ±5.8**	**131.8 ± 7.8**	**148.4 ± 3.6**	**153.8 ± 6.4**	**164.2 ± 5.3**
Arm Span (cm)	120.2 ± 8.3	130.7 ± 10.1	147.8 ± 2.4	153.7 ± 13.9	164.1 ± 6.3
Sitting Height (cm)	65.2 ± 2.2	68.3 ± 2.3	73.7 ± 3.7	77.7 ± 2.1	85.4 ± 1.7
Sitting Height/Stature (%)	53.7 ± 1.8	51.9 ± 1.4	49.6 ± 1.3	50.5 ± 0.8	52.0 ± 2.0
Manouvrier Index (MI)	85.7 ± 6.3	92.7 ± 5.5	101.4 ± 5.6	97.7 ± 3.3	92.3 ± 7.5
BMI (kg/m^2)	14.8 ± 1.1	16.0 ± 1.0	14.9 ± 1.9	17.9 ± 0.6	19.9 ± 1.8
WHR (%)	0.78 ± 0.01	0.78 ± 0.02	0.76 ± 0.04	0.75 ± 0.03	0.71 ± 0.02
BF (%)	14.6 ± 0.9	16.2 ± 2.9	16.2 ± 3.2	16.0 ± 0.5	18.1 ± 3.4
Triceps skf. (mm)	**8.3 ± 0.7**	**9.6 ± 2.8**	**8.9 ± 2.0**	**9.5 ± 1.9**	**9.9 ± 1.5**
Subscapular skf. (mm)	**4.4 ± 0.6**	**5.0 ± 0.5**	**5.4 ± 1.0**	**6.7 ± 0.7**	**6.6 ± 1.3**
Biceps sf. (mm)	**4.7 ± 0.7**	**6.0 ± 1.6**	**4.5 ± 1.1**	**4.7 ± 0.8**	**5.9 ± 3.0**
Iliac Crest skf. (mm)	**5.9 ± 0.8**	**8.4 ± 3.0**	**8.9 ± 4.3**	**9.9 ± 2.4**	**11.6 ± 4.8**
Supraspinale skf. (mm)	**3.6 ± 0.6**	**5.2 ± 1.3**	**4.6 ± 1.1**	**5.9 ± 1.1**	**6.1 ± 1.4**
Abdominal skf. (mm)	**5.1 ± 0.8**	**6.7 ± 1.4**	**7.5 ± 2.1**	**9.6 ± 1.7**	**11.0 ± 5.1**
Front Thigh skf. (mm)	**11.3 ± 1.0**	**14.3 ± 3.7**	**13.7 ± 5.0**	**14.3 ± 3.6**	**14.5 ± 2.9**
Medial Calf skf. (mm)	**7.3 ± 1.3**	**8.6 ± 2.0**	**9.6 ± 3.0**	**8.3 ± 1.1**	**11.3 ± 4.3**
Sum of 6 skf. (mm)	40.2 ± 3.3	49.6 ± 10.9	49.8 ± 13.7	54.4 ± 7.1	59.4 ± 15.1
Sum of 8 skf. (mm)	50.8 ± 4.5	64.0 ± 15.4	63.3 ± 18.1	69.1 ± 10.0	77.0 ± 22.5
Trunk/Ext. skf. (%) 3 Reg.	0.65 ± 0.06	0.71 ± 0.12	0.78 ± 0.13	0.98 ± 0.08	0.87 ± 0.08
Trunk/Ext. skf. (%) 4 Reg.	0.60 ± 0.07	0.66 ± 0.09	0.74 ± 0.15	0.87 ± 0.11	0.84 ± 0.07
Arm Girth (relaxed) (cm)	**16.7 ± 1.1**	**18.8 ± 1.2**	**18.8 ± 1.5**	**21.8 ± 0.6**	**24.1 ± 1.6**
Arm Girth (flexed-tensed) (cm)	**17.9 ± 0.9**	**19.8 ± 1.0**	**20.2 ± 1.8**	**22.8 ± 0.8**	**25.4 ± 1.3**
Waist Girth (min.) (cm)	**48.2 ± 5.7**	**52.9 ± 3.1**	**56.2 ± 5.6**	**61.4 ± 1.2**	**64.5 ± 1.9**
Gluteal Girth (hips) (cm)	**61.6 ± 3.1**	**67.1 ± 4.8**	**73.7 ± 4.3**	**81.2 ± 1.9**	**90.4 ± 3.9**
Calf Girth (max.) (cm)	**24.4 ± 1.7**	**27.4 ± 1.0**	**27.2 ± 2.4**	**30.5 ± 0.9**	**34.3 ± 2.5**
Humerus breadth (cm)	**4.7 ± 0.3**	**4.9 ± 0.2**	**5.4 ± 0.3**	**5.5 ± 0.4**	**6.1 ± 0.2**
Femur breadth (cm)	**7.2 ± 0.3**	**7.6 ± 0.3**	**8.1 ± 0.2**	**8.3 ± 0.2**	**7.9 ± 0.6**
Bi-styloid, breadth (cm)	4.0 ± 0.4	4.3 ± 0.2	4.6 ± 0.1	4.6 ± 0.05	5.4 ± 0.1
Foot length (cm)	18.6 ± 1.1	20.6 ± 1.9	22.3 ± 0.3	22.8 ± 0.7	24.5 ± 0.7
Endomorphy				2.3 ± 0.4	2.3 ± 0.3
Mesomorphy				3.2 ± 0.9	3.5 ± 1.2
Ectomorphy				3.4 ± 0.8	3.3 ± 1.1

Table 2. The amount of increase (%) in physical properties compared to the previous age group of female figure skaters.

N=22	Group I (n=5) (6-8.2 Age)	Group II (n=5) (8.5-10.3 Age) % Increase	Group III (n=5) (10.8-12.2 Age) % Increase	Group IV (n=3) (13.0-13.1 Age) % Increase	Group V (n=4) (15.9-17.9 Age) % Increase
Starting (Age)		0	7.6	25.0	17.8
Training weekly (h)		0	-26.0	37.2	7.1
Body Mass (kg)		27.3	17.9	28.8	26.0
Stature (cm)		8.7	12.5	3.6	6.7
Arm Span (cm)		8.7	13.0	4.0	6.7
Sitting Height (cm)		4.8	7.9	5.4	9.8
Sitting Height/Stature (%)		-3.5	-4.3	1.8	2.8
Manouvrier Index (MI)		7.7	9.3	-3.6	-5.4
BMI (kg/m^2)		7.9	-6.7	19.7	10.9
WHR (%)		0.7	-2.7	-0.9	-5.1
BF (%)		10.7	0.2	-1.0	12.5
Triceps skf. (mm)		15.3	-7.4	7.1	4.3
Subscapular skf. (mm)		14.0	7.9	23.7	-0.8
Biceps skf. (mm)		27.5	-24.9	4.7	24.6
Iliac Crest skf. (mm)		41.8	-10.7	28.0	3.0
Supraspinale skf. (mm)		41.8	-10.7	28.0	3.0
Abdominal skf. (mm)		31.3	11.2	27.3	14.8
Front Thigh skf. (mm)		26.6	-4.5	4.3	1.7
Medial Calf skf. (mm)		17.7	11.6	-13.3	36.5
Sum of 6 skf. (mm)		23.2	0.4	9.2	9.1
Sum of 8 skf. (mm)		25.9	-1.18	9.2	11.3
Trunk/Ext. skf. (%) 3 Regions		10.4	8.9	25.7	-10.7
Trunk/Ext. skf. (%) 4 Regions		9.9	11.7	18.1	4.8
Arm Girths (relaxed) (cm)		12.3	0	15.5	10.7
Arm Girths (flexed-tensed) (cm)		10.3	1.8	13.2	11.4
Waist Girths (min.) (cm)		9.7	6.3	9.2	5.0
Gluteal Girths (hips) (cm)		8.9	9.9	10.1	11.3
Calf Girths (max.) (cm)		12.2	-0.9	12.2	12.3
Humerus breadth (cm)		3.7	9.7	0.6	12.7
Femur breadth (cm)		5.8	6.5	1.7	6.0
Bi-styloid, breadth (cm)		7.4	7.8	-0.2	16.7
Foot length (cm)		11.1	7.9	2.1	5.4

Discussion and Conclusion

Models in "long-term athlete development" programs (Balyi & Hamilton, 1995; Açıkada & Hazır, 2016) are discussed to achieve success in sports. Factors including physiological, biomechanical characteristics and capability features of athletes are important, but an athlete's anthropometric dimensions, body shape, body proportion and body composition are variables involved in determining potential for success (Norton, Olds, Olive, & Craig, 1996). Monitoring physical characteristics together with certain performance data can provide athletes to preserve their sportive lives in a healthy way for a long time. In addition, the mechanical advantages of morphological properties and their effects on movement technique have been the subject of research. In this study, the physical characteristics of figure skaters were examined.

Children generally start ice skating between the ages of 3 and 4 (Barton, Hunter, Williams, McGrigor, & Slaght, 2012). The age to start this sport is between 7 to 9 ages, getting specialized in it is between 11 to 13 ages and development is between 18 and 25 ages (Açıkada et al., 2016). In our study, starting age mean is determined as 6.0 ± 1.6 year (Table 1). Due to the metropolitan advantages and families' awareness, children can start this sport at an earlier age.

The period before puberty and during puberty is the periods when development of BF%, lean body mass and development are at their fastest (Webster & Barr, 1993). Characteristics like body mass, lean mass and fat mass are plastic and can be manipulated (Slater et al., 2018). Training has the effect to change body composition (Malina & Bouchard, 1991). In this study when amounts of increase (%) compared to earlier age group is examined, an increase in more parameters were seen in Group II and IV (Table 2).

BM and length or stature, the most basic information used to assess growth and nutritional status (Zemel, 2002). In figure skating, athletes being relatively small, lean and muscular, own smaller percent fat values compared to normal population (Faulkner, 1976). In a study (age 15.3 ± 2.3, n:60) S, BM and BMI mean values were stated as respectively 157.7 cm, 51.0 kg, 20.4 (Monsma et al., 2005). In our study, the average values of these features were determined as 164.2 cm, 53.6 kg, 19.9 in Group V (matching age group) (Table 1). It was observed that our skaters' S mean values were higher and BM, BMI values had similar characteristics. In addition, the mean BM and BMI values of all our groups were lower than the mean values of non-athletes Turkish girls (at the 25th Percentile) and the S mean values were close to the values at the 50th Percentile (Neyzi et al., 2008).

In figure skating, lower extremity lengths could provide aesthetic attractiveness while creating movement size. SH/S ratio can give information about lower extremity length. In a study conducted this ratio was found as 53.0% (Monsma et al., 2005). In our study the value was found as 52.0%. However, in Groups II, III, a little longer leg structure was observed (Table 1). MI also provides information about lower extremity length and in our study the highest value was observed in Group III (Table 1). However, no comparable data was found in literature considering MI. In a study conducted with figure skating athletes (Duraković, 2005) it was observed that the mean values of S, AS were consistent with the mean values of Group II, III in our study. The AS mean values of Group IV (153.7 ± 13.9) were found to be lower than Turkish children (non athlete - age 13, 157.2 ± 10.0 cm) (Mazıcıoğlu et al., 2009).

In a comprehensive study (Duraković, et al., 2005), conducted on in young female ballet dancers, rhythmic gymnasts, and figure skaters (ages 10-11, N=12), it was observed that the mean values of S and AS were similar to the mean values of our athletes, but BF%, BMI, breadth, girth and skinfold thickness were higher than the mean values of our athletes in Groups II and III. In another study conducted in rhythmic gymnastics, the mean values of BF% and all skinfold thickness of the gymnasts were found to be lower than the mean values of our athletes in Groups I, II, III, but the values of MI, BM, SH, AS, BMI and girth measurements were similar in both sports branches (Kutlay & Türkkanlı., 2012).

In a study (ages 9-12, N=32) (Mostaert, Deconinck, Pion, & Lenoir, 2016), S, SH, BM, BF% mean values were respectively determined as 144.8 ± 8.7 cm, 75.7 ± 4.6 cm, 36.3 ± 7.3 kg, 17.3 ± 5.7 %. It was observed that the values except S were lower in our skaters in similar age groups, and BF% was determined by the Bioelectrical Impedance Analysis (BIA) method, which limited the comparison of this value with our data. It was emphasized in a study that the BF% obtained using the BIA formula could not be compared with the anthropometric method. (Harbili et al., 2008).

Σ6 and Σ8 skinfold thickness values could give better information to estimate fatness level and to make comparisons. Ultrasound measurement technique is also recommended to measure subcutaneous fat without squeezing (Müller et al., 2013), but measurements done with skinfold caliper, is used in large populations and is preferred because of being economical. Measurement methods, measuring equipment, preferred equations, the level of education and experience of the measurer can affect results and limit comparisons.

Special ST and the ratio between skinfold thicknesses are used to show subcutaneous fat distribution (Abernethy, Olds, Eden, Neill, & Baines, 1996). In our study, Σ6 mean value of Group V (*triceps + subscapular + supraspinale + abdominal + front thigh + medial calf*) was determined as 59.4 mm. At similar age, Monsma et al. (2005) found this value to be 58.7 mm.

To determine the value of Σ6 in our study, 3 trunk, 2 leg and 1 arm areas, whereas in the other study (Monsma et al., 2005) 3 trunk, 2 arm and 1 leg area (triceps + biceps + subscapular + suprailiac / suprasipinale + abdominal + media calf)) has been evaluated. In figure skating, movements like speed up, stops, jumps/leaps, balances, spins, etc. mostly are loaded on lower extremities. No studies were found in the related literature considering the effect of regional fat deposition on athletic skills.

On estimate subcutaneous fat distribution, T/E mean value (n=60, age 15,6 ± 2.4, free style) have determined as 0.94 (Monsma et al., 2005). In our study, skin fold thicknesses were taken from similar regions. The extremity areas of Σ6 (triceps + front thigh + calf) were different (1 arm, 2 leg area) according to ISAK protocol, this value of our athletes was determined as 0.87 in Group V (Table 1). In another approach, in our athletes, T/E value, when the sum of not 3 but 4 trunk region ST were divided by the sum of ST of 4 extremity region, the T/E value was found to be 0.87 in Group IV and 0.84 in Group V. Genetic characteristics, training types, diet and life styles could create these differences.

Waist girth provides a simple yet effective measure of truncal adiposity in children and adolescents (Taylor, Jones, Williams, & Goulding, 2000). In this study skaters' girth measurement increased with age, however, it differed less by skinfold thickness and waist girth values of Group IV, were lower (61.4 ± 1.2 cm) than Turkish children (non athletes - age 13, 63.5 ± 6.0 cm) (Hatipoğlu et al., 2008). While a difference of 15,5% was observed between Group III and IV considering arm circumference, changes of ≈10% were determined in other girth measurements (Table 2). Monsma et al. (2005) determined the mean values of arm (relaxed, bent and stretched) and calf girth as 24.5, 25.8 and 32.6 cm, respectively, these values were determined as 24.1, 25.4 and 34.3 cm in our athletes (Group V). Sportive background, training types and genetic factors are thought to be effective in girth measurements. Extremity girth measurements are used to monitor bilateral muscle tissue development and can be useful to prevent asymmetrical development.

In this study the most significant humerus and femur breadth measurement differences were observed between Groups IV and V (12% - 16%) (Table 2). Maturation process about bone development is related to a number of factors. In this sport branch, training is done indoors on hard ground. Bone development is also important in athletes that can tolerate the mechanical loads of training. It was shown that athletes in singles and pairs categories have higher bone mineral density and the osteogenic effect of training (Prelack, Dwyer, Ziegler, & Kehayias, 2012). Determination of training areas where skaters can benefit from daylight during training at the outside the ice rink and monitoring their diet are important.

No studies were met in literature about foot lengths being an advantage in learning and developing the skill in figure skating. However, in a study (Faulkner., 1976), foot length mean value was stated 23.2cm (age 15.7, n:18). In our study foot length mean value was determined as 24.5 cm for similar ages in Group V.

The somatotype is phenotypical and thus, amenable to change under the influence of growth, ageing, exercise and nutrition (Carter., 1996). In a study conducted on elite female skaters (age 15.7, n=17) ectomesomorphic characteristic was observed and endomorphy, mezomorphy and ectomorphy values were respectively 2.6 - 3.8 - 3.0 (Faulkner., 1976). In another study (age 15,6 ± 2.4, n=60, free style) these values were respectively 3.1 - 3.4 - 3.0 (Monsma et al., 2005). In our study the same values were respectively determined as 2.3 - 3.2 - 3.4 in Group IV and 2.3 - 3.5 - 3.3 in Group V (Table 1) and similar characteristics were observed. There is a need for studies in different categories and levels, followed for a long time and involving more athletes.

A follow-up of anthropometric characteristics, body composition and somatotypes is important in young ballerinas and performers in aesthetic sports (Durakovic, 2012). In this study conducted with a small group also including Turkish National skaters, physical characteristics of ice skating athletes were examined using a standard methot. In our study, the physical characteristics of the athletes in the groups have changed with maturation. As the age progressed, an increasing trend was observed in the parameters determining the body fat ratio. Collected data on athletes' physical characteristics and performance can assist coaches in setting training goals.

Acknowledgement

We would like to thank the Izmir Metropolitan Municipality Figure Skating Clup and their coaches, skaters for their interest and participation.
*This study was presented as a poster presentation at the 16th International Sports Sciences Congress held in Antalya-Türkiye on 31 October-3 November 2018.

REFERENCES

Abernethy, P., Olds, T., Eden, B., Neill, M., & Baines, L. (1996). Anthropometry, health and body composition. In: Anthropometrica, Edited by: Kevin Norton & Tim Olds, UNSW press, Australia, 376.

Açıkada, C., & Hazır, T. (2016). Uzun süreli sporcu gelişim programları: Hangi bilimsel temellere oturuyor?. Spor Bilimleri Dergisi, 27(2), 84-100.

American Academy of Pediatrics (2000). Pediatrics, Vol. 106 No. 1 July.

Balyi, I., & Hamilton, A. (1995). The concept of long-term athlete development. Strength and conditioning coach, 3(2), 5-6.

Barton, T., Hunter, J., Williams, D., McGrigor, J., & Slaght, A. (2012). Long term athlete development implementation plan. Skate Canada - BC/YT, 1-72.

Carter, L. (1996). Somatotyping. In: Anthropometrica, Edited by: Kevin Norton & Tim Olds, UNSW press, Australia, 148.

de Bruin, A. P. (K.), Oudejans, R. R. D., & Bakker, F. C. (2007). Dieting and body image in aesthetic sports: A comparison of Dutch female gymnasts and non-aesthetic sport participants. Psychology of Sport and Exercise, *8*(4), 507-520.

Duraković, M. M. (2012). Anthropometry in premenarcheal female esthetic sports athletes and ballerinas. In: Handbook of Anthropometry, Edited by: Victor R. Preedy, Springer, 2012th edition, 1817-1836.

Duraković, M. M., Vucetic, V., Duraković, Z., Wolf-Cvitak, J., Matkovic, Br., Corovic, N., & Bonevski, A. (2005). Body physique and composition in premenarcheal ballerinas and female athletes in aestetic sports. Medical Problems of Performing Artists, 20(4), 175-179.

Dwyer, J., Eisenberg, A., Prelack, K., Song, W. O., Sonneville, K., & Ziegler, P. (2012). Eating attitudes and food intakes of elite adolescent female figure skaters: a cross sectional study. Journal of the International Society of Sports Nutrition, 9, 53.

Faulkner, R. A. (1976). Physique characteristics of Canadian figure skaters. Master of Science (Kinesiology), Simon Fraser University, September.

Harbili, S., Hazır, T., Hazır, S., Şahin, Z., Harbili, E., & Açıkada, C. (2008). Çocuk ve genç atletlerde vücut kompozisyonunun değerlendirilmesi: karşılaştırma çalışması. Spor Bilimleri Dergisi, 19(3), 181-202.

Hatipoğlu, N., Öztürk, A., Mazıcıoğlu, M. M., Kurtoğlu, S., Seyhan, S., & Lokoğlu, F. (2008). Waist circumference percentiles for 7- to 17- year-old Turkish children and adolescents. Eur J Pediatr, 167(4), 383-389.

Kutlay, E., & Türkkanlı, A. (2012). The comparison of some anthropometric characteristics in pre-junior rhythmic gymnasts. International Convention on Science, Education & Medicine in Sport, Glasgow (unpublished paper).

Lindsay Carter, J. E., & Honeyman Heath, B. (1990). Somatotyping: Development and Applications (Cambridge Studies in Biological Anthropology vol. 5). Cambridge: Cambridge University Press.

Malina, R. M., & Bouchard, C. (1991). Growth, maturation, and physical activity. Champaign, IL: Human Kinetics.

Marfell-Jones, M. J., Olds, T., Stewart, A. D., & Carter, L. (2007). International standards for anthropometric assessment. Potchefstroom, South Africa.

Mazıcıoğlu, M. M, Hatipoğlu, N., Öztürk, A., Gün, İ., Üstünbaş, H. B., & Kurtoğlu, S. (2009). Age references for the arm span and stature of Turkish children and adolescents. Annals of Human Biology, 36(3), 308-319.

Monsma, E. V., & Malina RM. (2005). Anthropometry and somatotype of competitive female figure skaters 11-22 years variation by competitive level and discipline. Journal of Sports Medicine and Physical Fitness, 45(4), 491-500.

Mostaert, M., Deconinck, F., Pion, J., & Lenoir, M. (2016). Anthropometry, physical fitness and coordination of young figure skaters of Different Levels. Int J Sports Med, (37), 531-538.

Müller, W., Horn, M., Fürhapter-Rieger, A., et al. (2013). Body composition in sport: interobserver reliability of a novel ultrasound measure of subcutaneous fat tissue. Br J Sports Med, 47(16), 1-8.

Neyzi, O., Günöz, H., Furman, A., Bundak, R., Gökçay, G., Darendeliler, F., & Baş, F. (2008). Türk çocuklarında vücut ağırlığı, boy uzunluğu, baş çevresi ve vücut kitle indeksi referans değerleri. Çocuk Sağlığı ve Hastalıkları Dergisi, 51, 1-14.

Norton, K., Olds, T., Olive, S., & Craig, N. (1996). Anthropometry and sports performance. In: Anthropometrica, Edited by: Kevin Norton & Tim Olds, UNSW press, Australia, 289.

Prelack, K., Dwyer, J., Ziegler, P., & Kehayias, J. J. (2012). Bone mineral density in elite adolescent female figure skaters. Journal of the International Society of Sports Nutrition, 9(1), 57.

Slater, G., O'Connor, H., & Kerr, A. (2018). Optimising physique for sports performance. In, Best practice protocols for physique assessment in sport, ed: Patria A. Hume, Deborah A. Kerr, Timothy R. Ackland, Springer Nature Singapore Pte Ltd., 27-36, (Abstract).

Slaughter, M. H., Lohman, T. G., Boileau, R. A., Horswill, C. A., Stillman, R. J., Van Loan, M. D., & Bemben, D. A. (1998). Skinfold equations for estimation of body fatness in children and youth. Hum Biol., 60, 709-723.

Taylor, G. M., & Ste-Marie, D. M. (2001). Eating disorders symptoms in Canadian female pair and dance figure skaters. International Journal of Sport Psychology, 32(1), 21-28 (abstract).

Taylor, R. W., Jones, I. E., Williams, S. M., & Goulding A. (2000). Evaluation of waist circumference, waist-to-hip ratio, and the conicity index as screening tools for high trunk fat mass, as measured by dual-energy X-ray absorptiometry, in children aged 3-19 y. The American Journal of Clinical Nutrition, 72(2), 490-495.

Voelker, D. K., Gould, D., & Reel, J. J. (2014). Prevalence and correlates of disordered eating in female figure skaters. Psychology of Sport and Exercise, 15(6), 696-704.

Webster, B. L., & Barr, S. I. (1993). Body composition analysis of female adolescent athletes: comparing six regression equations. Med. Sci. Sports Exercise, 25(5), 648-653.

Zemel, B. (2002). Body composition during growth and development. In: Human Growth and Development, Edited by: Noel Cameron, Elsevier Science, USA, 271-291.