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Brief analysis of the Sport-Ginseng relationship, from the perspective of PubMed publications

O scurtă analiză a relaţiei Sport - Ginseng, din perspectiva publicaţiilor PubMed

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Abstract

Background. Sport (S) and Ginseng (GSG) represent subjects of research interest, but the S-GSG relationship is, yet, rarely investigated.

Aims. The purpose of the present paper is a brief analysis of the Sport-Ginseng (S-GSG) relationship, from the perspective of PubMed publications.

Methods. The S-GSG relationship was analyzed in two types of investigations. A) Comparative analysis for the keyword combinations: Sport AND Ginseng (S-GSG), Sport AND Ginseng AND Fatigue (S-GSG-F), Sport AND Ginseng AND Performance (S-GSG-P), Sport AND Ginseng AND Endurance (S-GSG-E). B) Analysis for all keyword combinations, evaluating the Sex filters, with the corresponding subfilters: male (M), female (F).

Results. The total number of S-GSG publications was 150, for a period of 35 years, since 1983 to date. % of publications from S-GSG are: 17% for S-GSG-F; 38% for S-GSG-P; 24.6% for S-GSG-E. % of publications for M are: 63.3% for S-GSG, 40% for S-GSG-F, 54.3% for S-GSG-P, 62.1% for S-GSG-E. % of publications for F are: 20% for S-GSG, 8% for S-GSG-F, 21% for S-GSG-P, 13.5% for S-GSG-E.

Conclusions. 1) The average number per year of PubMed publications for S-GSG is 4.2, and the number of publications for 2018 is 7. 2) Of S-GSG, most of the publications were for S-GSG-P. 3) Most M publications were for S-GSG-E, and most F publications were for S-GSG-P. 4) Studies on the S-GSG relationship, although numerically reduced, are still increasing in recent years, covering the areas of interest F, P and E.

Key words: sport, Ginseng, fatigue, performance, endurance, PubMed filters

Rezumat

Premize. Sportul (S) și ginsengul (GSG) reprezintă subiecte de interes științific, dar relația S-GSG este, totuși, modest investigată.

Obiective. Scopul lucrării este o scurtă analiză a relației S-GSG, din perspectiva publicațiilor PubMed.

Metode. Relația S-GSG a fost analizată în două tipuri de investigații. A) Analiza comparativă pentru combinațiile de cuvinte cheie: sport și ginseng (S-GSG), sport și ginseng și oboseală (S-GSG-F), sport și ginseng și performanță (S-GSG-P), sport și ginseng și anduranță S-GSG-E). B) Analiza pentru toate combinațiile de cuvinte cheie, fiind evaluate filtrele Sex, cu subfiltrele corespunzătoare: masculin (M), feminin (F).

Rezultate. Numărul total de publicaţii S-GSG a fost de 150, pentru o perioadă de 35 de ani, din 1983 până în prezent. % de publicaţii din S-GSG sunt: 17% pentru S-GSG-F; 38% pentru S-GSG-P; 24.6% pentru S-GSG-E. % de publicaţii pentru M sunt: 63.3% pentru S-GSG, 40% pentru S-GSG-F, 54.3% pentru S-GSG-P, 62.1% pentru S-GSG-E. % de publicații pentru F sunt: 20% pentru S-GSG, 8% pentru S-GSG-F, 21% pentru S-GSG-P, 13.5% pentru S-GSG-E.

Concluzii. Numărul de publicaţii PubMed pentru S-GSG are o medie de 4,2 publicaţii per an, iar numărul de publicaţii pentru 2018 este de 7. Dintre S-GSG, cele mai multe au fost pentru S-GSG-P. Cele mai multe publicaţii cu M au fost pentru S-GSG-E, iar cu F, pentru S-GSG-P. Studiile referitoare la relaţia S-GSG, deşi puţin numeroase, sunt în creştere în ultimii ani, acoperind arii de interes precum F, P și E.

Cuvinte cheie: sport, ginseng, oboseală, performanţă, anduranţă, filtre PubMed

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Introduction

Ginseng (Panax ginseng C.A. Meyer; Araliaceae) has been used for several thousand years in Asian culture, for its adaptogenic properties, including resistance to fatigue (Caldwell et al., 2018), as a tonic, prophylactic and "restorative" agent (Bahrke & Morgan, 1994). Panax ginseng provides anti-fatigue effects in patients with idiopathic chronic fatigue (Kim et al., 2013). Physical performance is related to the ability to complete physical tasks faster, with a higher power, with higher intensity (EFSA Panel, 2014). Ginseng is a popular herb used by athletes as an ergogenic aid for many years, to enhance physical performance (Bahrke & Morgan, 1994) and endurance (Yeh et al., 2011).

The present article is a continuation of the authors' previous research concerning the assessment of stress in situations of physical exertion (Jurcău & Jurcău, 2013; Jurcău & Jurcău, 2014a) and the relationship between exercise and stress, through an analysis of PubMed publications (Jurcău & Jurcău, 2014b; Jurcău & Jurcău, 2018).

Hypothesis

Ginseng is historically known for its anti-fatigue effects as well as for improving results in sports.

Objectives

The aim of the current study is the evaluation of research papers regarding the relationship between sport and Ginseng (S-GSG) by using several keywords.

Material and methods

Fatigue (F), performance (P) and endurance (E) are frequently approached in sports, both for professional athletes and sedentary persons. On the other hand, gender can influence these three parameters - F, P and E.

The S-GSG relationship was analyzed in two types of investigations:

a) Comparative analysis for the keyword combinations: Sport AND Ginseng (S-GSG), Sport AND Ginseng AND Fatigue (S-GSG-F), Sport AND Ginseng AND Performance (S-GSG-P), Sport AND Ginseng AND Endurance (S-GSG-E).

b) Analysis for all keyword combinations, evaluating the Sex filters, with the corresponding subfilters: male (M), female (F).

c) Because animal studies have also been conducted, the *Other Animals* subfilter was analyzed comparatively. Also, given the importance of synthesis papers for summarizing the information over a certain period of time, we analyzed comparatively the *Review* subfilter as well.

d) Evaluation was performed for 35 years, the 1983-2018 time period, and had the following *elements of analysis*:

- *the average number of publications per annum* for decades 1980-89, 1990-99, 2000-2009; and the number of publications per year for the years 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017 and 2018;
- *the percentage % of the total number of publications*, for gender subfilters and keyword combinations, for the entire period 1983-2018, as well as for the decades and years taken into consideration.

Results

Data collection was performed in October 2018. For all groups, data distribution was normal, according to the Kolmogorov-Smirnov test. The analysis was made on the chosen time periods.

A. Analysis for the combinations of the chosen keywords

Table I includes: the periods of time within which the PubMed studies retrieved using these keyword combinations were published; length of these periods (no of years); total number of publications for the entire period (N); and number of publications per year (N/year).

N and N/year is highest for S-GSG, and lowest for S-GSG-F, although the publishing periods are equal, 35 years. Publishing periods are equal for S-GSG-P and S-GSG-E, but N and N/year are higher for S-GSG-P.

Table I
Analysis for the combinations of the chosen keywords

		Period	No of years	N	N/year
Sport AND Ginseng	S-GSG	1983-2018	35	**151**	4.31
Sport AND Ginseng AND Fatigue	S-GSG-F	1983-2018	35	*25*	0.71
Sport AND Ginseng AND Performance	S-GSG-P	1985-2018	33	57	1.72
Sport AND Ginseng AND Endurance	S-GSG-E	1985-2018	33	37	1.12

Analysis for the combinations of selected keywords and analyzed subfilters (Fig.1)

Most reviews were for S-GSG, while the fewest were for S-GSG-F. Most animal studies were for S-GSG; the fewest were for S-GSG-E. Most studies with HM, HF and HM+HF were for S-GSG; the fewest were for S-GSG-F. Animal studies were more numerous than studies on human subjects, only for S-GSG-F. Compared to the An, HM, HF, and HM+HF subfilters, the Review subfilter retrieved the smallest number of articles for all combinations of the chosen keywords.

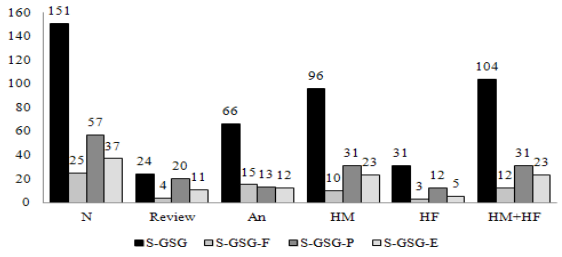

Fig. 1 – N for the combinations of selected keywords and the analyzed subfilters

B. Analysis of S-GSG for the combinations of the chosen keywords, depending on the analyzed subfilters (Table II, Fig. 2)

Analysis of the total number of publications (Table II). Most publications were: of all keyword combinations, for S-GSG; of all subfilters, for HM+HF. The fewest publications were: of all keyword combinations, for S-GSG-F; of all subfilters, for HF.

Percentage analysis (%) of S-GSG. For N, Review, HM, HF and HM + HF, the highest % of S-GSG was for S-GSG-P, and the lowest % was for S-GSG-F. For An, the

highest % of S-GSG was for S-GSG-F, and the lowest % was for S-GSG-E. Although the Review subfilter had the lowest N compared to the other analyzed subfilters, the % of S-GSG for the combinations of the chosen keywords was the highest. The highest % of S-GSG was for the Review subfilter, for S-GSG-P; the smallest % of S-GSG was for the HF subfilter, for S-GSG-F.

Table II
Analysis of the total number of publications

	N	Review	An	HM	HF	HM+HF
S-GSG	151	24	66	96	31	104
S-GSG-F	25	4	15	10	3	12
S-GSG-P	57	20	13	31	12	31
S-GSG-E	37	11	12	23	5	23

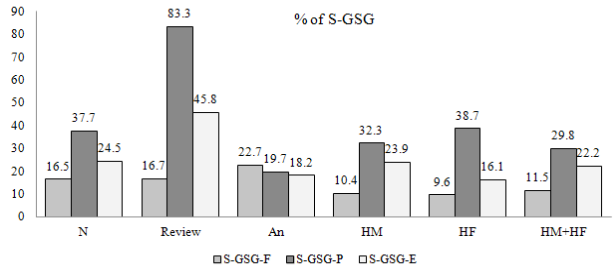

Fig. 2 – % of S-GSG for the combinations of the chosen keywords,depending on the analyzed subfilters

C. Analysis of S-GSG for N/year (Table III, Fig. 3)

In the case of S-GSG, for N, HM, HF and HM + HF, the evolution curves for 1980-2018 had the lowest values between 1980-1989. Most N/year were: for N and HF in 2016; for HM and HM+HF in 2011. In the case of H subfilters, N/year: had the same value for HM and HM+HF during 1980-1989, 1990-1989, 2010, 2012, 2013, 2014; had a higher value for HM+HF in the other periods; had the lowest value for HF in all periods.

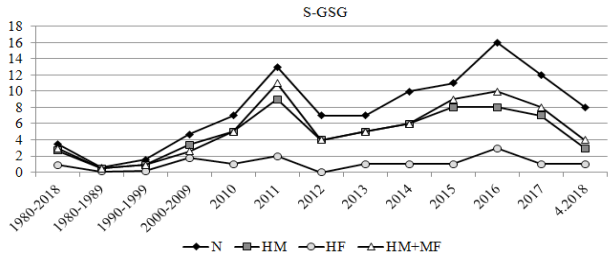

Fig. 3 – Analysis of S-GSG for N/year

D. Analysis of S-GSG-F for N/year (Table IV, Fig. 4)

Most N/year were: for N in 2015 and 2016; for HM in 2010 and 2014; for HF and HM+HF in 2014, 2015 and 2016. In the case of H subfilters, N/year: had the same value for HM and HM+HF in the years 2010, 2013, 2014, 2017, 2018; had a higher value for HM+HF in the other periods; had the lowest value for HF in all periods.

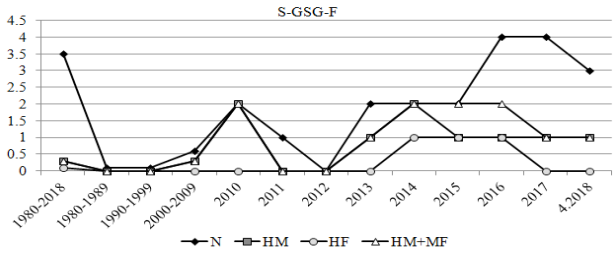

Fig. 4 – Analysis of S-GSG-F for N/year

Table III
Analysis for S-GSG of N/Year

S-GSG	1980-2018	1980-1989	1990-1999	2000-2009	2010	2011	2012	2013	2014	2015	2016	2017	4.2018
N	3.5	*0.6*	1.6	4.7	7	13	7	7	10	11	**16**	12	8
HM	2.7	*0.5*	0.9	3.4	5	**9**	4	5	6	8	8	7	3
HF	0.9	*0.1*	0.2	1.8	1	2	0	1	1	1	**3**	1	1
HM+MF	3	*0.5*	0.9	2.6	5	**11**	4	5	6	9	10	8	4

Table IV
Analysis for S-GSG-F of N/Year

S-GSG-F	1980-2018	1980-1989	1990-1999	2000-2009	2010	2011	2012	2013	2014	2015	2016	2017	4.2018
N	3.5	0.1	0.1	0.6	2	1	0	2	2	2	**4**	**4**	3
HM	0.3	0	0	0.3	**2**	0	0	1	**2**	1	1	1	1
HF	0.09	0	0	0	0	0	0	0	**1**	**1**	**1**	0	0
HM+MF	0.3	0	0	0.3	2	0	0	1	**2**	**2**	**2**	1	1

Table V
Analysis for S-GSG-P of N/Year

S-GSG-P	1980-2018	1980-1989	1990-1999	2000-2009	2010	2011	2012	2013	2014	2015	2016	2017	4.2018
N	3.3	0.1	0.8	2	**4**	**4**	3	3	1	**4**	**4**	3	5
HM	0.9	0.1	0.4	1.2	2	3	1	1	0	**4**	2	2	2
HF	0.7	0.1	0.1	0.9	**1**	0	0	0	0	0	0	0	0
HM+MF	0.9	0.1	0.4	1.2	2	3	1	1	0	**4**	2	2	2

Table VI
Analysis for S-GSG-E of N/Year

S-GSG-P	1980-2018	1980-1989	1990-1999	2000-2009	2010	2011	2012	2013	2014	2015	2016	2017	4.2018
N	3.3	0.1	0.5	1.4	2	**4**	3	1	1	2	2	2	2
HM	0.7	0.1	0.3	1.1	1	**4**	1	0	0	2	1	0	0
HF	0.1	0.1	0	**0.4**	0	0	0	0	0	0	0	0	0
HM+MF	0.7	0.1	0.3	1.1	1	**4**	1	0	0	2	1	0	0

E. Analysis of S-GSG-P for N/year (Table V, Fig. 5)

Most N/year were: for N in 2010, 2011, 2015 and 2016; for HM and HM+HF in 2015; for HF in 2010. In the case of H, N/year: had the same value for HM and HM+HF in all the analyzed periods; had the same value for HM, HF and HM+HF during 1980-1989; had the lowest value for HF in all periods.

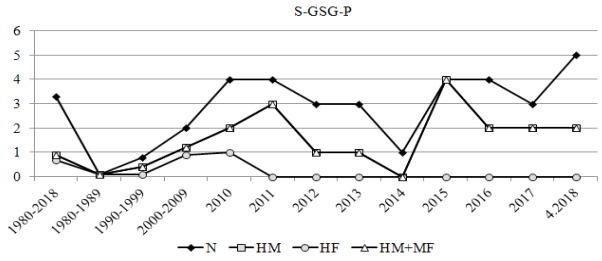

Fig. 5 – Analysis of S-GSG-P for N/year

F. Analysis of S-GSG-E for N/year (Table VI, Fig. 6)

Most N/year were: for N in 2011; for HM and HM+HF in 2011; for HF in 2000-2009. In the case of H, N/year: had the same value for HM and HM+HF in all the analyzed periods; had the same value for HM, HF and HM+HF during 1980-1989; had the lowest value for HF in all periods.

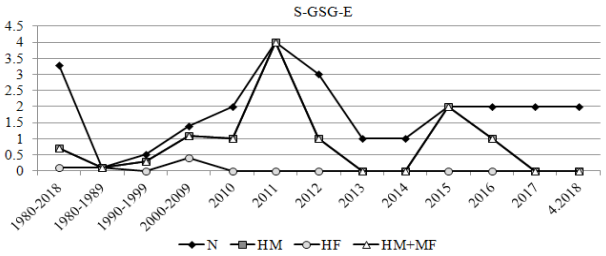

Fig. 6 – Analysis of S-GSG-E for N/year

Discussion

Dynamic evolution of S-GSG, S-GSG-F, S-GSG-P and S-GSG-E shows that between 1983-2018, so for a 35-year period, the number of studies including these subfilters was quite reduced.

There was no mention: a) of *S-GSG,* for HF in 2012; b) of *S-GSG-F:* for N in 2012; for HM, HF and HM+HF in 1980-1989, 1990-1999, 2011, 2012; in addition, for HF in 2013, 2017, 2018; c) *of S-GSG-P:* for HM, HF and HM+HF in 2014; in addition, for HF in 2011, 2012, 2013, 2015, 2016, 2017, 2018; d) *of S-GSG-E:* for HM, HF and HM+HF in 2013, 2014, 2017 and 2018; in addition, for HF in 2010, 2011, 2012, 2015, 2016.

From the combinations of the chosen words, the greatest interest of research was in S-GSG-P (57 publications) and HP subfilter (38.7%). The average number of publications per annum was the largest: A. For the combinations of the chosen words: a) for S-GSG in 2016; b) for S-GSG-F in 2016, 2017; c) for S-GSG-P in 2015, 2016; d) for S-GSG-E in 2011. B. From the chosen subfilters, for HM+HF: a) for S-GSG in 2011; b) for S-GSG-F in 2014, 2015, 2016; c) for S-GSG-P in 2015; d) for S-GSG-E in 2011.

S-GSG-F

Although GSG is considered an important anti-fatigue remedy, S-GSG studies are so far few (25 in 35 years). However, in the current year, 2018, there are already 3 publications by April. We mention below some important references:

Fatigue can be a normal and important response to physical activity, emotional stress, boredom, or lack of sleep (1). In patients with idiopathic chronic fatigue, Panax ginseng significantly reduced the visual analogue scale score, reactive oxygen species and malondialdehyde, and increased total glutathione content and glutathione reductase activity (Kim et al., 2013). Ginseng treatment provided effective adaptation to fatigue and increased endurance in both male and female mice, in the fatigue stress of forced swim test; and in locomotor activity tests, ginseng did not depress motility (Banerjee & Izquierdo, 1982). Also, ginseng has anti-fatigue properties in moderately trained individuals (Talbott & Hughes, 2007). Ginseng improves fatigue resistance through cortisol stimulation (Ahuja et al., 1992). Ginseng oligopeptides possess anti-fatigue effects, which may be attributed to the inhibition of oxidative stress and the improvement of mitochondrial function in skeletal muscles (Bao et al., 2016). Ginseng polysaccharides inhibit fatigue indicators, creatine phosphokinase, lactic dehydrogenase and malondialdehyde in the forced swim test (Wang et al., 2010). Thus, supplementation with American ginseng for 4 weeks prior to exhaustive aerobic treadmill running reduces leakage of plasma creatine kinase during exercise (Hsu et al., 2005). Also, Korean ginseng reduces creatine kinase and blood urea nitrogen (BUN) in serum; it has regulatory effects on the serum metabolic profile, which could reflect in its anti-fatigue effect (Yan et al., 2018).

In the case of our research, only 16.5% of S-GSG was related to fatigue.

S-GSG-P

Performance is a very important aspect in sports. This is also proven by the fact that S-GSG-P publications were much more numerous than S-GSG-F and S-GSG-E (57 in 33 years). We mention below some important references:

Ginseng has been used in exercise and sports, with ergogenic effects, to improve physical *performance* in cycling or running endurance (Chen et al., 2012). Also, the use of standardized Asian ginseng extracts of dried root improved exercise *performance* and muscle strength, maximal oxygen uptake, work capacity, serum lactate and heart rate (Bucci, 2000).

The importance given to the study of GSG in relation to sport performance is evidenced by the fact that in the case of our research, S-GSG-F represented the largest proportion of S-GSG, 37.7%.

S-GSG-E

Modulation of endurance is a concern in sport. Studies on S-GSG-E, although relatively few (37 in 33 years), are proof of this. We mention below some important references:

Ginseng saponin complex is effective in improving exhaustive cycling test performance in humans (Yeh et al., 2011). Changbai Mountain ginseng extract administration before an acute exercise challenge increases muscle weight, grip strength and endurance swimming time; decreases fatigue parameters – the levels of serum lactate, ammonia,

creatine kinase, blood urea nitrogen (Ma et al., 2017). Also, ginseng extract (GS) administration before prolonged swimming exercise increases the biochemical capacity of skeletal muscles to oxidize free fatty acids (FFA), through a decrease in lactic acid, pyruvic acid and plasma FFA (Avakian et al., 1984). Ginsenoside-Rb1 (G-Rb1) administered before swimming exercise-induced oxidative stress in male mice could prolong the exhaustive swimming time and improve the exercise endurance capacity of mice, increase blood lactate clearance and decrease serum CK activities (Qi et al., 2014).

In the case of our research, 24.5% of S-GSG was related to endurance.

The evaluation elements for sport and ginseng by analyzing the combination of these two keywords with fatigue, performance and endurance, although numerically reduced compared to all S-GSG related publications, are important through the role granted to these parameters.

Conclusions

1. The average number per year of PubMed publications for S-GSG is 4.2, and the number of publications for 2018 is 7.

2. Of S-GSG, most of the publications were for S-GSG-P.

3. Most M publications were for S-GSG-E, and most F publications were for S-GSG-P.

4. Studies on the S-GSG relationship, although numerically reduced, are still increasing in recent years, covering the areas of interest F, P and E.

Conflicts of interest

Nothing to declare.

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