CONTENTS

Original Articles

The power of sports tradition and its influence on long-standing engagement of athletes in running races

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ABSTRACT

Analysis of the general role of tradition formed wider theoretical background of the paper. We used hermeneutic analysis to interpret this role. We attempted to formulate own definition of tradition using the term of social time. Well-known world competitions served as an example of power of tradition in the field of sport. Special attention was paid to the Olympic movement and two parallel but different inspirations from the heritage of the ancient Olympism in the case of the Sokol sports and social movement and the Modern Olympics.

In a longitudinal study we researched a group of runners who participated repeatedly in the 10K Czech race "Běchovice – Praha". It was founded in 1897 and has been held each consecutive year. Our aim was to illustrate how the tradition of one race can engage runners in lifelong physical activities. We found 322 runners who participated 20 times and more. Constancy of the route, non-stop organizing, engagement of the whole families, celebrations of anniversaries, and wider publicity were found to be factors in building loyalty to the race. We discussed some aspects of comparison with similar studies as well. Particular attention was paid to the Boston Marathon and especially to means of supporting loyalty of runners.

INTRODUCTION

Various academic disciplines use the word *tradition* in a variety of ways. According to the universally accepted definition of sociologist Edward Shils, "tradition is anything which is transmitted or handed down from the past to the present ..." (Shils, 1981, p. 12). A set of questions arises here: What exactly is this "anything"? What is the meaning of tradition in history? What is the role of tradition in our personal lives? How important role can tradition play in the field of sport? Searching for answers shaped motivation to arrange our research.

We decided to combine two approaches: a philosophical one interpreting the role of tradition both in general and in the field of sports, and a descriptive statistical one following a special group of runners participating at one race with a long tradition over a long period.

The 10K Czech road run named "Běchovice – Praha" was founded in 1897 and has been hosted consecutively each year, that is, 122 times (including the race in the year 2018). The number of participating runners has increased each year: a few individuals before World War I, numbers ranging between ten and one hundred between the World Wars, several hundred after World War II and several thousand since 1971. At the same time, there was an increase in repeated performances; runners wanted to continue in participating even after they had already reached their peak performances. In 1922 (the race's 25th anniversary) the first race for "veterans" was organized. This became a regular occurrence in the key anniversary years and since 1956, regular races for race veterans have been organized. Since this time, the run has opened for all levels of performance (the only limitation is a finish time under two hours). It is necessary to say that the route is very hilly and it is not possible to run it without good training ahead of time.

It was not long before reporters began to pay attention not only to winners but also to the runners who were able to finish multiple times. From the end of 1920's the participants with the most lifetime races run were specially recognized during the closing ceremony. In 1940 the first runner was recognized as having achieved 20 finishes; in 1956 the same runner achieved 30 finishes; in 1973 a different runner achieved 40 finishes; and in 1989 another runner achieved 50 finishes. This achievement drove researchers to collect the special group of runners who had participated 20 times or more, and we began to track their effort to gain the utmost number of finishes.

Yet another facet arose: the more ambitious among these loyal runners (they have founded their own "Club of Loyal Runners") are motivated not only to participate but also to show their best performance at a given time. From this we began to create special statistics and lists of records in relation to age through the lens of a life-long perspective. The first book about these and other aspects as well as the special "philosophy" of this run was published in 2011 (Bednář, 2011). We also aspired to influence the behavior of runners through their engagement in tradition, in other words, to join theory and practice.

It is evident that the long tradition of this road run plays an important role in motivating runners to participate. How strong is this role? Which features of the tradition are attractive for fans? What is especially important for the race's sustainment, establishment, continuation and development? More distant horizons emerged, revealing of studying wider contexts first.

METHODS

We used hermeneutic analysis to interpret the role of tradition both in general and in the field of sports. We especially tried to follow the wider context of investigated topics according to hermeneutic proposition that "the text without context is only pretext". Our own definition of tradition was one of results.

After gathering of all results rosters (122 rosters) we searched for runners who participated 20 times or more in "Běchovice – Praha" road race – it was done systematically for the time period of the last 25 years (digitization of the rosters was first implemented in 2016).

Further we examined this special group of runners, performing a descriptive statistical evaluation that factored age, performances and duration of involvement. We also created a particular statistical set measuring the participation of whole families to follow the branching of tradition. The output of this approach was the construct of two types of tradition.

TRADITION

The above cited definition of Edward Shils proclaims that tradition is "anything which is transmitted or handed down". What can be a valuable springboard strong enough to give birth to a tradition? Our answer is this: Tradition arises when *something that is important and meaningful* for some society is transferred[1] and anchored in its social practice. Yet more questions may arise; for example, what *concrete idea or practice* can be important and meaningful? Shils answers, speaking on the substance of tradition: "All accomplished patterns of the human mind, all patterns of belief or modes of thinking, all achieved patterns of social relationships, all technical practices, and all physical artefacts or natural objects are susceptible to becoming objects of transmission; each is capable of becoming a tradition" (Shils, 1981, p. 16). We cannot simply automatically agree with quoted claims; we must consider real substance, i.e. something physical that is capable of carrying a valuable legacy or message. It is necessary to research symbolic meaning or special significance as well.

After the birth of a tradition, there is the task to preserve it for the future. There is no small risk of traditions being lost, especially in times often identified as post-traditional. Which elements can ensure the preservation and continuation of tradition? Anthony Giddens, another sociologist, names several elements and especially *rituals* (Giddens, 1994). They are repeatable so that they can stabilize behavior in societies. Yet all traditions need own followers or "faithful custodians" as well: "*traditum* (what is transmitted) might have become altered from its earliest forms in many respects but not in those regarded as central by its custodians" (Shils, 1981, p. 14).

These custodians can be called pure traditionalists. Radical traditionalists are the second type – they keep the shield of tradition but don't regard any part as central and are ready to change any parts step by step. The well known "paradox of grandfa-

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[1]   The word "tradition" itself derives from the Latin *tradere*, what literally means to transmit, to hand over, or to give for safekeeping.

ther's axe"[2] could be their motto. We believe that a balanced position is optimal for the "survival" of tradition. It needs both *prolongation* within time and *development*. German philosopher Hans-Georg Gadamer pointed out that development of tradition isn't something spontaneous or mechanical, and needs engagement and care from followers (Gadamer, 2004).

There are very old traditions like the Jewish Shabbat, or Greek Olympic Games, yet there are also so called "invented traditions", introduced by Eric Hobsbawm. He said about this term: "It includes both 'traditions' actually invented, constructed and formally instituted and those emerging in a less easily traceable manner within a brief and dateable period ... and establishing themselves with great rapidity" (Hobsbawm & Ranger, 1992, p. 1).

Shil's definition references the transfer of a tradition from the past to the present. To follow this line of transfer is often the task for historians, using the wider concept of *historical time*. Yet we have also quoted sociologists and philosophers, and we are going to continue our research within one area of social activities, i.e. sport. It can be argued that studies of the temporal dimension of such activities and processes should be based on the concept of *social time*. Thus, Mark Elchardus, in his discussion of the new role of time in sociological theory, proposes to focus on social temporality (Elchardus, 1988). We mean that this approach can be a good framework for reflections concerning tradition.

We can conclude that tradition is a special continuity of social time, beginning with a certain valuable spring and carrying some legacy, message, symbolic meaning, or special significance, then taking shape within the social memory and historical consciousness. Tradition thus becomes a source for a better understanding of history which can help cement social practice.

Tradition in the field of sports

Are we living in a post-traditional *sports* society? We cannot share this attitude of Giddens, although the business imperative of constant innovation and revision has supporters amongst people involved in sports management. Their attitude is seen in the forced effort to change the route, distance or rules of the race each year. Yet we can see the opposite approach, using the power of tradition, as prevailing. The power of tradition is demonstrated in competitions like Wimbledon, the Tour de France, the Davis Cup, the Stanley Cup, the Super Bowl, the Boston Marathon, etc. While the first five named events are for elite athletes, the Boston Marathon is open to the entire population of runners[3] as is the case of the Czech "Běchovice – Praha". This is important for the sharing of a tradition which isn't formed only by the winners and their records. Participating runners can be a part of the annual "moveable feast" within "moveable tradition". Of course, direct spectators also share a concrete tradition in a particular second circle and another group of TV viewers and followers on social media are part

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[2] A man proclaims in the old ancient saying: "This is my grandfather's axe. My father replaced the handle and I replaced the head." It's about problem of identity: of the axe itself, and/or of its role.

[3] There is certain restriction of participation during the last years due to field size limitations, as well as a heightened interest of runners.

of a particular third circle. All these people – directly, or indirectly – support tradition and demonstrate its power.

A very special case is the Olympic Games with the duration of 1168 years in ancient times and 122 years in modern times. The Modern Olympics can be assigned to the aforementioned theoretical concept of "invented tradition". They may be further assigned to a subcategory of "half-invented tradition" because something new was born in an effort to rekindle the *spirit* of the Ancient Olympics of Greece, which had been abolished as a pagan cult practice in 393 A.D. The modern Olympic Games were initiated in the 1890's thanks to Pierre de Coubertin, a French educator, who introduced the plan to revive the Olympics. We cannot forget the inspiration of successful excavations of the Ancient Olympia, the site of the Olympic games in ancient times, especially those excavations led by Ernst Curtius in 1875–1881. Coubertin was heavily involved in all aspects of the Games' inception and presided personally over the Olympic Committee for some 30 years. He is responsible for writing the Olympic Charter and Protocol, the Athletes' Oath, and the guidelines for the opening and closing ceremonies of the Games. We can see a special mixture of old tradition and new ideas in these symbols and organisation documents.

The whole history especially of the Modern Olympics is well-known; we would like to add another – and different – case of following the old Olympic tradition: the Sokol sports and social movement. It was founded in Prague in 1862, especially by effort of Miroslav Tyrš. Within the first years the Sokol expanded beyond Prague, first into the Slovenian regions of the Habsburg empire but very soon also into the United States, where the first Sokol unit was formed in St. Louis in 1865 (Nolte, 2009). It is outside the scope of our investigation to follow further history of this organization, yet we can summarize that the Sokol played an important role both in the Middle European politics and in the area of physical culture.

Our task is having a look at a special philosophy of this organization. Tyrš was educator like Coubertin (he had a career as a teacher of aesthetics) and both were inspired with old Greek concept of *kalokagathia*, ideal of the complete human personality, harmonious in mind and body. The other key values of the Sokol were: health, integrity, well-being, strength, and military capacity. Tyrš took the last value just from the real life of ancient Greeks – it was expected that gymnastic training would contribute to national defense. All these values are still valid, except that the military dimension has been replaced with *tradition*. Today (after more than 150 years of history) the Sokol can be marked as a physical culture society, or an all-age gymnastics organization taking pride in massive gymnastics rallies. And here we can find basic differences when compared to the Olympic movement: the Sokol's "all-age categories" and "sport for masses" approach, versus the Olympics' "age of maximum results" and "elite" approach. Coubertin is connected to an oft-quoted motto that to take part is more than to win, but at the end of his life (1935) he pointed out something else in speaking about the philosophic foundation of modern Olympism: "The second characteristic (after religion) of Olympism is that it is an aristocracy, an elite ... Of course, this aristocracy is completely egalitarian in origin since membership is determined solely by the physical superiority of the individual ... Yet being elite is not enough. The elite must also be a knighthood" (Coubertin, 2000, pp. 580–581). The message is nevertheless obvious, and is confirmed by the development of elite sports through Olympism.

Time softened the sharp differences between both organizations: the IOC speaks more about mass commitment to sport; the Sokol became more competitive and did not stop its members from participating in the Olympic Games (several gymnasts in particular gained some gold medals for Czechoslovakia between 1924 and 1968). In any case we could see two parallel but different inspirations from the heritage of the ancient Olympism.

The question arises in the introduction to this article: What is especially important for sustaining, establishing, continuing, and developing tradition? A lot of answers could be gained from the great sports events named above; we tested the situation with the aforementioned "Běchovice – Praha" road race. Given that the route here has been the same since the race's inception, we can compare the best overall results. Furthermore, each runner can compare their own personal results over the course of their lifetime. Here lies the perfect area of comparisons of different types.

RESULTS

We have found 322 runners (including 12 women) who participated 20 times and more in history of the race.[4] They form our research cohort. In this cohort, 44 runners are deceased, having an average age 79.91 years old at time of death. The average age of the 278 living runners is 70.06 years old.

The participation aspect from the lifelong perspective
Nine of runners were able to run[5] 50 times and more; the leader is Vladimír Kříž (born 1943) who was able to run 56 times (1963–2018). He is also the leader of another ranking – most consecutive "Běchovice – Praha" runs completed. We have found 74 runners in history of the race capable of non-stop participation from 25 to 56 times (29 runners still continue). Věnceslava Pokorná (born 1948) is the only woman among these with 30 consecutive runs (she also leads the parallel list of faithful women runners with 37 completed runs between 1980 and 2018).

Continuing the list of runners who ran the race repeatedly, we can find:

40–49 times .... 34 runners

30–39 times ....121 runners (incl. 1 woman[6])

20–29 times ....158 runners (incl. 11 women)

A total of 136 runners are still active (defined as participating in the race in 2017 and/or 2018) from this "loyal group", indicating strong loyalty to the race.[7] This loyalty was built progressively especially after 1990. In this year, the first statistics booklet for the "Běchovice – Praha" run was published and at this point only 12 runners had at least 27 runs. Repeated publicity in the following years formed extrinsic motivation for "unknown heroes" to be part of this exclusive society – beside the intrinsic motivation of accomplishing[8] one's own running goals.

[4] All data are collected including the race in 2018.
[5] To run and to finish – we take into account (in the whole ranking) only successfully finished runs.
[6] Women could start only from 1972.
[7] Complete and current statistics concerning the road race "Běchovice – Praha" are available at https://www.ftvs.cuni.cz/FTVS-693-version1-bechbrozura18.pdf.
[8] We follow self-determination theory of motivation (Deci & Ryan, 1985).

Loyalty is also demonstrated in the years of significant anniversary when attendance sharply increases. It is seen especially in the 25th, 50th, 75th and 100th anniversary, noticeably in the first significant anniversary in 1922 and the last one in 1996:
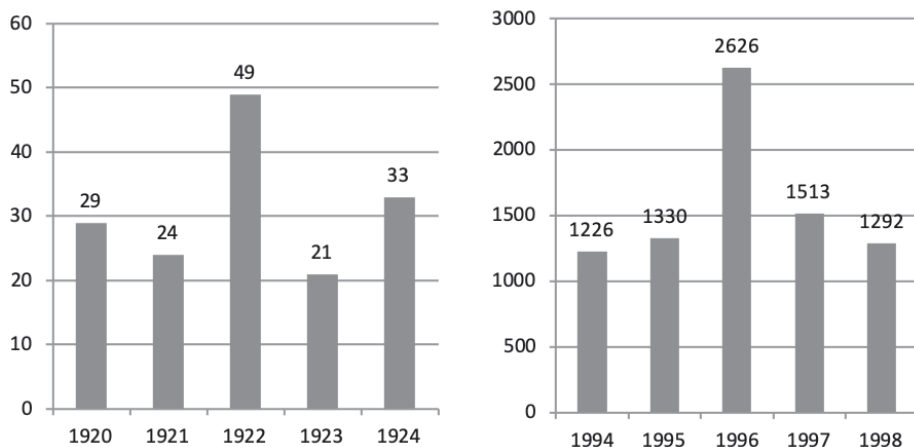

Figure 1 Demonstration of attendance increase in the years of significant anniversary (1922 and 1996)

This fact was emphasized in the 100th anniversary when the number of runners older than 40 was considerably higher than the number of younger runners (1503:911). A lot of older runners came to say goodbye to the race of their heart.

We see how a "big" tradition can breed "smaller" traditions of individuals. Yet another type of loyalty was found: the loyalty of whole families. The loyal runners became good example for those in their surroundings and especially for their children, partners and relatives. As a result, there are eight families with 64–147 runs by individuals. Here are some of the leading families:

The Hák family, 147 runs (14 members beginning in 1965, 2 generations)

The Fiala family, 122 runs (13 members beginning in 1944, 3 generations)

The Bednář family, 117 runs (9 members beginning in 1947, 4 generations)

The statistical analysis measured married couples and other family relationships (3 brothers; grandfather, father and son, etc.) as well. From this we may address the *branching of tradition*.

The performance aspect from the lifelong perspective

Do older runners still have performance aspirations? Can older runners be engaged in the "Běchovice – Praha" tradition through appreciation of their performances as well? Our research and experiences say YES in both cases.

The age of living runners from our cohort is from 43 to 92 years (5 of them 90–92, 9 of them 85–89, 32 of them 80–84, etc.). The oldest man runner to reach the finish line is Jiří Soukup. He was able to finish the race at the age of 91 years and 3 months in the year 2018. The oldest woman runner was Dana Ellingerová at the age of 80 years, 7 months and 12 days in 2018.

The first step for formation of motivation was to arrange age categories and announce the winners (the three best runners received awards). This routine practice

began in 1956 for runners older than 40 years old. Later it was necessary to arrange more and more categories – now there are 9 categories at 5-year intervals, the last one is for men runners over 80. Women runners have a similar system, the last category being for women over 70.

Yet what about runners who do not have the chance to stand up on the winners' podium? Our experience has shown that in-depth statistics concerning performances from a long-term perspective can help every participant to find an appropriate competition, and thereby gain the motivation to continue. Wider publicity is also helpful here, of course. To publish rankings in the greatest possible span is desirable – almost every runner can find his name here.

To this end the special tables and rankings (in all time ranges) were completed during the last 30 years. Now we can offer these:
- 50 best performances for each age group (both men and women);
- 3 best performances for each age, year by year (starting from 40 and then each year consecutively up to age 87); the same for women (from 35 up to 72);
- how many times runners were able to run under 35, 40, 45, 50, 55, or 60 minutes (10–50 results for each item);
- which men runner had the best average of 2, 3, 4, up through 25 and 30, 35, 40 and 50 starts; the same for women up to 30 starts (1–10 results for each item);
- which runner had the best performance of the 1st, 2nd, 3rd up to 50th runs, comparing the results from personal rankings.

In other words, not only long-standing engagement but also long-standing performances are appreciated.[9] Runners confirmed that these aspects are important for their motivation to participate at this traditional race. They received the question: "What motivates you to repeatedly participate in 'Běchovice – Praha'?" Six possible answers were offered[10] and here is the ranking of the results:

The fact that the route is the same each year and so I can compare my performance in long-standing perspective (19.4%).
1. The "big" tradition of the oldest road race on the European Continent (19.0%).
2. The chance for an annual encounter with friends and fellow runners (18.4%).
3. The "small" tradition of individuals, families, or groups, of which I became part (14.9%).
4. The fact I can follow my progress in rankings of number of participations and/or of performance published from 1990 (14.8%).
5. It is a good test of the fight with age and even death (13.4%).

There could be a lot of interpretations from these results; we will mention only two. First, the most popular answer shows that the values of this race's runners are in clear opposition to the "obsessive innovators" school of thought. Second, the fight with age and death are not topics that lifelong runners see as important motivation.

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9   Some admirable results: 40:58 at 7; 37 times better than 40 minutes; 42:33 as average of 50 participations etc.
10   They could choose 1–2 answers, so that percentage is calculated from the sum of answers, not respondents.

There is also motivation for other types of runners to be part of this tradition. Furthermore, our long-standing monitoring of runners and continuous publishing of our findings had direct influence on runners' activities.

DISCUSSION

The theoretical part of our text was concluded with our own definition of tradition. We tried to embrace more facets of it and embed it in the concept of social time. Of course, this may be opened for further discussion and critique.

Further, we tried to determine the role of tradition in the field of sports. We spoke a lot of tradition of the Olympic Games and the differences in progression between the ancient traditions of Coubertin's Olympism and those of the Sokol. Yet another approach is shown in the Maccabiah Games, held in Israel starting in the year 1932. Every four years, the best Jewish athletes from throughout the world compete in them. Two differences are seen here from a cursory consideration. First, the heritage of Coubertin's Olympism is combined with the Jewish history. Second, the Games are arranged not only for elite athletes but also include Open, Masters, Juniors and Disabled competitions as well. The Maccabiah Games present an opportunity for further research.

However, optimism concerning the high role of tradition in the sports world may be tempered if we have a look at key values of sports organizations, important events or different approaches of sports theory. For example, Myles Brand, president of the National Collegiate Athletic Association in 2003–2009, named eight key values of the NCAA but did not mention Tradition (Brand, 2006). Furthermore, Scott Kretchmar named in his chef d'oeuvre four non-moral values and multiple moral values, but tradition was missing (Kretchmar, 2005). We can find tradition as an important value in the football club Bayern Münich. Here tradition is named alongside partnership, respect, responsibility and seven further values.

There is rather strange situation within Olympism: the Olympic Charter speaks enough about history of modern Olympism yet a link with the ancient tradition is missing in the text.

Surprisingly, tradition is the most often mentioned within sports business, where it is seen as an effective marketing tool. Experts from this area have recognized that to be joined with some traditional race or event can improve "brand awareness". This is the case both of great international sports events and of smaller running races in the Czech Republic whose history begins before 1945.[11] Two traditional Slovak races, the Košice Peace Marathon (from 1924[12]) and the National Race Devín – Bratislava (from 1921) ought to be mentioned as well. No organizer of these events forgets to mention how old the run is and which anniversary is being celebrated that year.

Tracking running activities through one traditional race has enabled us to understand how tradition can build and strengthen *motivation* to be active up to an older

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[11]   13 races of them still continue and were organized in 2018.
[12]   It is the oldest European marathon, organized annually with exception of the years 1938 a 1940.

age.[13] This lifelong perspective can also encourage former elite athletes to continue in their sports activities after retirement. Yet if we look at the numbers of elite versus non-elite repeat participants, the non-elite runners far outnumber the elites. On examining the list of 322 loyal runners, only six medalists of the main race were found.

A secondary question that arises is whether length of running career in running contributes to longevity. According to our special group of runners, this appears to be the case: deceased runners died at a higher average age than the lifespan of the average Czech male population. However, additional research is needed to examine this supposition. Is there some similar longitudinal study, or in-depth statistical processing of some concrete race as a possible base for such a study? Among the running races in the Czech Republic beginning their history before 1945, only one other pays tribute to loyal runners (having run the race 20 times and more) and publish ranking of them. They are rewarded with special starting numbers according this ranking (the runner with highest number of participations receives number 1).

Among international races there is a natural comparison with "the Everest of all marathons": the Boston Marathon. Also founded in 1897 ("Běchovice – Praha" is some weeks younger), there is no break during its history, and there has been a steadily increasing number of runners. Of course, the international fame has no comparison, and to be a finisher of a marathon (especially the Boston Marathon) is more appreciated than in the case of 10K. Concerning statistics, we can find complete results on the web pages of the Boston Athletic Association, as well as surveys of the number of participants, age groups, or nationalities. Personal statistics of individual runners are not published on these pages, but the legendary John A. Kelley, who won the race in 1935 and again in 1945, is mentioned among the race "milestones". His mention is not due to these two wins but because he started a record 61 Boston Marathons and finished 58. His final race came in 1992 at the age of 84. He symbolizes the tradition and spirit of the race. His running longevity and loyalty are strong inspiration for a lot of athletes, and not only runners. This is just what we want to promote as well.

Wider publicity was given to another remarkable running act – the record for most consecutive Boston Marathons completed by Bennett Beach (50 runs on April 17, 2017). What may be more interesting (having in view our effort to promote long-standing running activity) is the fact that Beach is a leader of the list of what Boston Marathon organizers call "streakers". These "streakers" were able to run the whole Boston Marathon at least 25 times in a row without break. They have a special club, the Quarter Century Club. It was first formed by Ronald Kmiec in 2001 and after the run in 2017, it boasts 129 members including 9 women (McGillivray, 2017).

Though the achievements of all members of the Boston Marathon Quarter Century Club are beyond question, we would like to dispute one questionable topic: isn't it dangerous to promote non-stop participation, and not "only" the sum of all personal entries, reached perhaps with some breaks? We are addressing hazards to athletes' health. Long-distance runners are strong-willed people – that classification applies twofold to "streakers". Yet this can be positive or negative. Sometimes our mind or will can be stronger than our body. Continuing to run the race at any price can lead to

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[13]   We focused on motivation and lifestyle of long-standing runners in (Bednář & Malinauskas, 2014).

collapse. We decided not to publish the full ranking of "Běchovice streakers" after the on-course death of one runner with a known motivation. We have rather decided to prefer the ranking of the sum of all participations for each runner.

In the field of sport science, we can see often analyses of elite runners, or comparisons of different aspects of the World Marathon Majors – e.g. (Maffetone et al., 2017), in which authors analyzed the race times of the top 10 male and 10 female finishers of all races in the WMM for the years 2005–2014. Closer to our aim to find factors leading to long-standing engagement of runners in traditional races is the research of (Burdina et al., 2017). They analysed (using the Boston Marathon data from 1970 to 2015) the effect of goal attainability on performance – and in fact on participation itself – across age groups. They examined the fact that performances are better at the point of entrance into the older age group. They argue that runners have better chance to fulfil the strict qualifying standards within the Boston Marathon, therefore their motivation and effort are stronger. We can confirm this the same phenomenon – that the performances at the top of ranking for age 40, 45, 50, etc. are better than those "around" those ages (at age 41, 44, 46, 49, 51, etc.), yet the motivation is different. The motivation becomes simply to reach a better position in rankings for the older age group ("Běchovice – Praha" has no qualifying standards).

Orientation on the oldest age groups was presented in (Ahmadyar et al., 2016). Authors followed-up performance of elderly marathoners (> 75 years) competing in the world's largest marathons between 1990 and 2014. Participation and performance trends were examined, yet relation to tradition was not mentioned.

The author of a study concerning the development of long-distance racing in Japan (Havens, 2015) aims to more closely evaluate connection between tradition and running. The author accomplishes this by using wide historical, cultural, social, and sports background. After 1912, the Japanese government used athletics as part of its project to achieve parity with the world powers and distance racing became a proper instrument in this effort. Later, commercial media companies promoting especially marathons and ekiden (long-distance relays) played an important part in building the new running tradition.

We could see that in all mentioned studies participation and performance *general* trends are investigated – we try to present personal running "stories in numbers" of one traditional race across its whole lifespan. During our longitudinal study we have also tried to influence runners using multiple statistics as competitions of their own type and instrument to join runners with tradition of the race. To the best of our knowledge, our approach is the first one of this type.

CONCLUSION

How to strengthen the role of tradition and building loyalty to it? We can summarize findings from the running area using research of one traditional race.
- To *keep the same route* – it can have the effect of a special *genius loci*; it enables comparison of performances in the whole active period of life.
- To *arrange competitions* – for all runners of any age. Arrange it and *publish* results.
    One way is to appreciate the number of starts – to publish regularly the list of loyal runners; to pay tribute to those who reached high number of participations. Another

way – for more ambitious runners with orientation on performance – is to administer special lists of the best results within the lifelong perspective.

- To arrange *special celebrations of anniversaries.*
- To support *branching of tradition* – we followed the case of loyal families; it could be extended for clubs, or special teams (colleagues from one organization, schoolmates, etc.).
- The *number of attendees* can be ambivalent factor. Organizers ought to find the *optimal* number: too small is dangerous for survival of tradition, too big a crowd (see some city marathons) can lead to loss of certain exclusivity, or of "magic" of the race or event. To offer preference to loyal athletes can be the good rule here.

Let's finish with words of Dave McGillivray, the race director of the Boston Marathon: "It's a personal honor to share this unique comradery (members of the Boston Marathon Quarter Century Club) ... They all are now deeply engrained in the history and tradition of the most prestigious marathon in the world" (McGillivray, 2017, p. 9).

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Options for studying human motion: neurophysiological program sLORETA

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ABSTRACT

Evaluation of motions is the basis for the diagnosis of human locomotor system disorders. Analyses are usually focused on the performance components of this system, i.e. on the skeleton and muscles. However, where comprehensive diagnosis is to be obtained, the motor system must be evaluated as a whole, without omitting any of its parts. So, evaluation of the control function is very important to body motion evaluation. The method that is normally used to evaluate the activity of brain is electroencephalography, which is superior to other brain activity-evaluating methods in many respects. However, EEG has also a major drawback, namely, it cannot precisely locate the activated and deactivated brain regions. This drawback can be avoided by using the sLORETA neurophysiological program, a tool that can transform EEG data to 3D brain images and finding application across a wide range of clinical branches of medicine – neurology, neurophysiology, psychiatry, physiotherapy and also in sports.

INTRODUCTION

Motion is one of the basic manifestations of human life. Movements can be classed into internal movements and external movements. Internal movements occur in the internal body organs and are responsible for body supply logistics. External movements are the result of activity of the locomotor system, serving an individual's self-care and satisfaction of basic human needs and enabling one's contact with the outer environment and communication. Breathing motions are transitory between the two types of motion, contributing both to internal supply logistics and external postural functions. So, movements are vital to humans (Véle, 2006; Kračmar et al., 2016).

In the motor ontogenesis of humans, the development of external movements begins with the simplest holokinetic movements of the newborn baby. They are reflective, general movements of serpent nature, very little differentiated, serving to familiarise the baby with its movement possibilities. Such movements develop slowly into ereismatic movements, more differentiated and serving largely for support. Ideokinetic movements constitute the highest stage, serving to make complex differentiated movements. They are closely related to communication motor activity. Ideokinetic movements are controlled teleologically by the central nervous system responding to stimuli from both the internal and external environment with a view to attaining a specific intended goal. Ideokinetic movements occur through a pyramidal path, are mainly controlled by the cerebral cortex and cerebellum and are dependent on cooperation with the postural-and-locomotor system ensuring preconditions for such movements (Véle, 2006; Kolář, 2009).

The basic human movement patterns are genetically determined in the CNS and serve as a support or building blocks for erection and motion forwards. The motional behaviour of an individual, however, develops and individualises during their whole life and is affected by a number of factors, internal as well as external. So, the motional behaviour of an individual reflects various somatic, mental, social as well as health effects. And conversely, repeated motional behaviour is mirrored by the overall body posture and ultimately also results in structural body changes. Hence, investigation and analysis of human motions is a basis for diagnosis and therapy of locomotor system disorders (Kolář, 2009; Vojta, 2010).

MOTION EVALUATION OPTIONS

The motor system can be divided into components: (i) supportive component, (ii) strength component, (iii) control component and (iv) logistic component. The supportive component provides mechanical support to motion and comprises the skeleton, bones and joints. The strength component is provided by muscles, transforming chemical energy into mechanical energy, thus serving as an energy source for the motion. The control component is provided by the nervous system, controlling the motion, while the logistical component is responsible for setting and maintaining the conditions for the internal environment. The performance part of the locomotor system comprises the supportive and strength components, i.e. the skeleton and muscles. It is onto those 2 components of the locomotor system that stress is laid in locomotor system disorder diagnosis. Still, all the locomotor system

components, including the logistic and control component, must be included in the analysis in order to obtain an accurate and comprehensive diagnosis of locomotor system disorders (Véle, 2006).

The motion analysis methods can be classed into instrumental methods and instrument-less methods. An instrument-less examination consists of routine clinical motion examination made within any examination of the locomotor system and providing information both on motion quantity and quality. Quantitative examination serves to evaluate both passive movements, informing us about the boundaries of the motor system, and active movements, informing us about the motor system performance. Passive movement examination includes goniometric measurement of the joint range and assessment of joint play. In fact, an adequate passive movement range in the joints is a precondition for normal movement function. In addition to the angular range of the movement, the nature of the resistance observed during the movement must also be assessed. Active movement measurements include the force each muscle is able to exert. The Janda muscle function test is most frequently used in practice, applying a six-point muscle strength scale. Muscle strength can also be evaluated with a dynamometer, the data obtained from this measurement, however, include only the total force exerted during the movement measured, not the force exerted by a single muscle (Janda, 2004; Véle, 2006).

As mentioned above, the quality of the movements must be measured as well because it is this parameter that ultimately governs the overall system performance. Movement quality includes muscle coordination, movement smoothness and movement tactics, metrics and strategy. Additional routinely used instrument-less methods of movement evaluation include aspect examination, movement stereotype examination, and other types of examination (Véle, 2006).

There exist a range of instrumental methods for movement evaluation, which have been enjoying development and modernisation lately owing to the development of physiotherapeutic approaches worldwide. Among frequently used methods are electromyography and kinematic analysis. Electromyography (EMG) is a routine electrophysiological diagnostic method enabling muscle activity to be objectively evaluated by measuring electrical activity. EMG is based on measurements of the action potential of activated motor units. This technique finds wide application in physiotherapy, allowing us to assess the extent of muscle activation, muscle behaviour in time, muscle coordination and muscle fatigue. Either surface EMG or needle EMG is used in practice. Surface EMG is a non-invasive technique measuring electrical signals from electrodes distributed over a reasonably large surface area of the muscle tissue, thereby enabling several muscles to be measured simultaneously. In this respect it differs from needle EMG, an invasive technique during which a needle electrode is introduced directly into a muscle to measure the activity of motor units in the immediate needle surroundings. Needle EMG is used in clinical practice mainly to measure muscle denervation or neuromuscular transmission disorders (Pánek, 2016; Roy et al., 2007; Lorencová et al., 2018; Krobot, 2011).

Kinematic analysis is a method describing the position of a point in a plane (2D) or in space (3D) in dependence on time. This method enables us to examine positions, speed, acceleration and angles between segments but not dynamic quantities such as momentum or energy. Angles between segments are measured with goniometers,

largely electronic (potentiometers), and the output is a continuous time development curve. The electrical output of the potentiometers can be converted to angles by a simple procedure. Acceleration is measured with accelerometers that are directly attached to the segment and are primarily used to measure sharp movements. A system of adhesive markers attached to the person's skin improves position determination accuracy for a point on the body. Markers can be passive, reflecting infrared radiation emitted from the direction of the cameras, or active, emitting the radiation rather than reflecting it. Kinematic analysis can be used to evaluate both simple movements including mere 1–2 movement segments in a plane, and more complex multi-segmental motions such as walk (Kračmar, 2016; Kolář, 2009; Svoboda, 2010).

BRAIN ACTIVITY EVALUATION

As mentioned, the control component is a highly important part of the motional system. Hence, evaluation of motions can also be viewed through brain activity evaluation. Among the amply used and routinely available diagnostic methods is electroencephalography (EEG), which is based on electrical activity measurements of the brain within a band. EEG is a non-invasive method providing highly valuable information about the condition of the central nervous system. The electroencephalogram is a time record of the electrical activity of the brain, predominantly generated by the synchronous synaptic activity of the pyramidal cells of the cortex. The brain activity is measured via surface electrodes embedded in specific EEG caps. A standard EEG cap accommodates 19 electrodes arranged in the international 10–20 system devised by H. Jasper in 1957. This system is based on the percent distribution of the segments for placing the electrodes. The basic method of EEG signal evaluation uses visual analysis, evaluating the occurrences of the various frequencies (alpha, beta, theta, gamma) with respect to the current vigilance conditions. Unlike the morphological methods such as MRI and CT, EEG can be used repeatedly over a reasonably long time span without posing any adverse burden for the patient – this is a major advantage. However, EEG is unable to precisely locate the activated/deactivated brain regions, which is a basic shortcoming of this technique. As to other methods to measure the activity of the brain, functional magnetic resonance imaging (fMRI), positron emission tomography (PET) and single photon emission computed tomography (SPECT) are usable: however, they are much more costly than EEG and exhibit a lower spatial resolving power (Pánek, 2016; Kamarádová, 2015; Faber, 2001).

sLORETA PROGRAM

sLORETA is an acronym for standardized Low-Resolution brain electromagnetic Tomography, a neurophysiological program enabling electrical activity of the brain obtained with EEG to be converted to 3D brain images with a minimal location error, thereby eliminating the basic drawback of surface EEG. The software, created by Roberto Pascual-Marqui of the University Hospital of Psychiatry in Zurich, Switzerland, was introduced in 2002. sLORETA is the standardised version of the initial LORETA code, introduced by the same author 8 years earlier. This

is the first method to solve the inverse problem, i.e. the problem of inability of correctly calculating the distribution and amplitudes of the sources from the observed potential. The solution is based on the assumption that adjacent neuronal sources exhibit synchronous activity. Attempts to solve this problem were made earlier by Hämäläinen and Ilmoniemi, who, however, arrived a correct calculation in their solution, referred to as the minimal norm solution, for surface signals only. The current density distribution is calculated in voxels, which are defined in the Talairach Atlas and the corresponding probabilistic brain atlas. In appropriate conditions, sLORETA determines current densities in 6239 voxels at a spatial resolution of 5 mm. sLORETA's major assets include low costs and safety, its spatial resolution, however, is poorer than that of MRI or CT. Among sLORETA's drawbacks is also the fact that it is limited to the cortical brain regions and hence, does not enable imaging of other structures, such as basal ganglia or the cerebellum. The software can be freely downloaded from the website http://uzh.ch /keyinst/loreta and hence, is widely accessible (Pascual-Marqui, 2002; Pánek, 2016; Pascual-Marqui, 1994; Cannon, 2012; Pánek, 2014; Kamarádová, 2015).
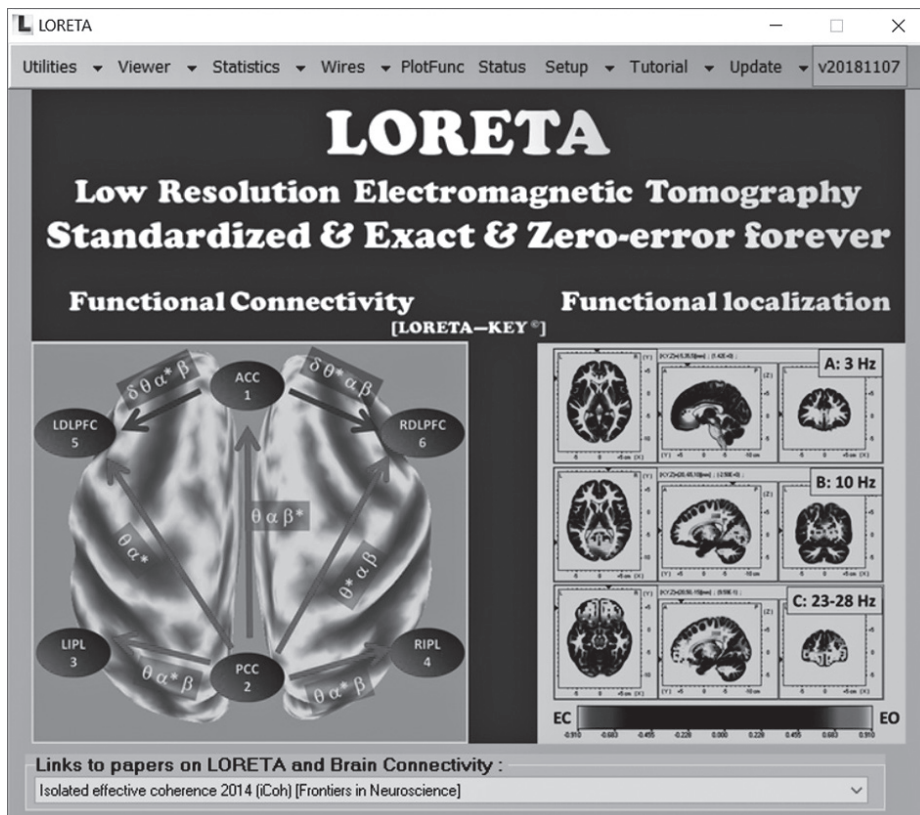

Figure 1 sLORETA program – homepage

sLORETA consists of 3 main modules – Utilities, Viewer and Statistics (Fig. 1). Utilities module enables EEG data to be transformed into files with the extension "slor" and hence, displayed visually in the Talairach cortical atlas. The EEG data are first used as input data for calculation based on a parametric model for multichannel EEG to obtain the mutual spectrum for all bands (delta, theta, alpha-1, alpha-2, beta-1, beta-2, beta-3, gamma). The mutual spectrum is then transformed to the desired .slor files by using a transformation matrix obtained by transformation of the electrode coordinates from the native EEG. The "Statistics" module provides statistical data processing, the "Viewer" module enables imaging of statistically significant current density changes in the various Brodmann areas / various frequency bands. The statistically significant differences can be viewed in 2D (Fig. 2), i.e. in the frontal, horizontal and transverse brain cuts, as well as in 3D (Fig. 3) (Pascual-Marqui, 2002; Pánek, 2016).

sLORETA has been used in a number of experiments since 2002. One of them was the study by Villafaina et al. (2019) examining the effect of depressions on brain activity in women with fibromyalgia. The enrolled 28 women with fibromyalgia were divided into 3 branches: (i) 9 women with depressions who were on antidepressants; (ii) 7 women with depressive feelings on no antidepressants; and (iii) 12 women with no depressive feelings. Electrical activity of the brain was measured by EEG and the data were processed by sLORETA. Hypoactivation of the left hemisphere was detected in the women with untreated depressions. sLORETA was also used in the study by Dvořáčková et al. (2019) examining brain activity changes during walk affected by visual or auditory cueing in Parkinson's disease patients. Electrical activity of the brain was recorded in 11 Parkinson's disease patients in 3 situations – normal walk, walk with auditory cueing and walk with visual cueing. Two paired groups were compared by the statistical module. The one paired group was processed to obtain comparison between walk affected by visual cueing and normal comfortable walk, the other paired group was processed to obtain comparison between walk affected by auditory cueing and normal comfortable walk. Statistically significant ($p \leq 0.05$) current density increase was found in Brodmann areas 9, 10 and 32 in the beta-3 frequency band in the former group (visual cueing vs. normal walk).
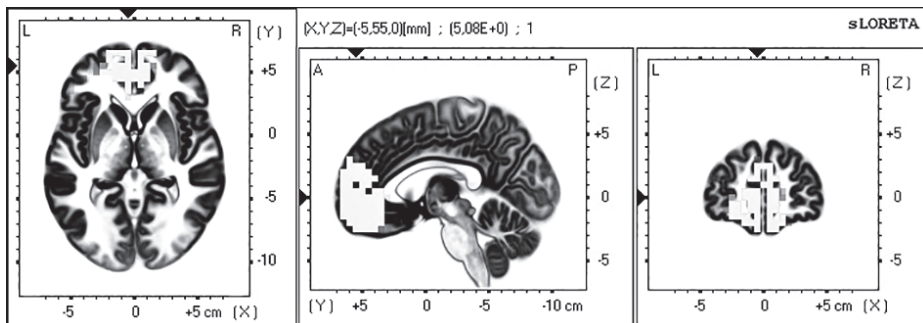

Figure 2 Statistically significant current density changes displayed in 2D by sLORETA software (illustrative picture)
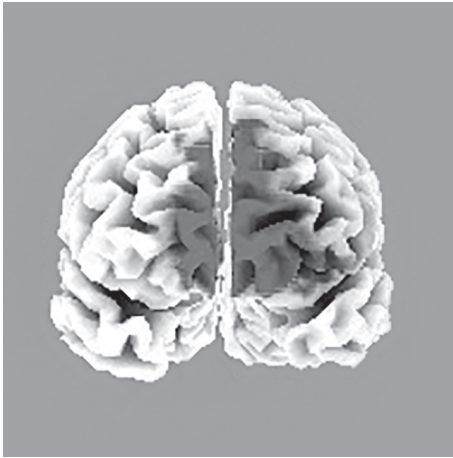
Figure 3 Statistically significant current density changes displayed in 3D by sLORETA software (illustrative picture)

DISCUSSION

As mentioned above, motion is a basic manifestation of humans and is indispensable for them. The motion of each individual is different and is affected by a number of internal and external factors. An individual's motion reflects their social and mental influences as well as health effects. Repeated motional behaviour affects the individual's posture and results in structural changes in the body. Analysis of motion is thus one of the basic tools in locomotor disorder diagnosis. Specific emphasis is frequently put on the condition of the myoskeletal system. However, comprehensive diagnosis requires all motional system components to be analysed, including the nervous system and the logistic function.

Electroencephalography is amply used to analyse the activity of the brain. This technique uses a system of surface electrodes embedded in specific EEG caps to measure electrical activity of the brain. The major assets of EEG include safety and availability, the main drawback is the inability to accurately locate the activated/deactivated brain regions. This drawback is eliminated in the neurophysiological program sLORE-TA, transforming EEG data into 3D images of the brain.

CONCLUSION

The neurophysiological program sLORETA, transforming EEG data into 3D images of the brain, allow changes in the source activity to be evaluated in various conditions, both at rest and in motion. It is a low-cost tool which is readily available and safe. The field of sLORETA applications is extremely wide, encompassing a broad range of clinical branches – neurology, neurophysiology, psychiatry, physiotherapy, as well as various sports.

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Comparison of basal metabolic rate in individuals with a spinal cord injury and Harris-Benedict equation: a systematic review

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ABSTRACT

Tables for calculating the energy expenditure of the physical activities of the general population cannot be used due to the different paralysis of the upper or lower limbs in people with spinal cord injury (SCI). The purpose of this review is to compare the differences in the values of basal metabolic rate (BMR), basal energy expenditure (BEE), resting energy expenditure (REE) and resting metabolic rate (RMR) the values evidenced in the literature, observed values vs predicted values using the Harris-Benedict equation. We realized the background research from the time period from 1985 to 2018. We searched in PubMed, Web of Science and Scopus databases for articles addressing the relationship between BMR and people with SCI. We compared the parameters of BMR, BEE, REE and RMR according to Harris-Benedict (HB) equation for persons with SCI. The study confirmed that the energy expenditure of persons with SCI could not be evaluated correctly by the Harris-Benedict equation.

KEYWORDS

indirect calorimetry; lean tissue; predicted values

INTRODUCTION

BMR measurement in humans attracted considerable interest during the early part of the 20th century. They were primarily used for the diagnosis of hypo- and hyperthyroidism. BMR tests marked a new era in clinical medicine (Henry, 2005). The first record of this method to estimate the energy expenditure was described in 1985 Food and Agriculture Organization/World Health Organization/United Nations University Joint (FAO/WHO/UNI). The FAO nutrition studies No. 1513 published in 1957, entitled Calorie Requirements, represented a landmark both in approach and analysis. These simple linear equations to predict total energy requirements bear close resemblance to the linear equation used to predict BMR today (Food and Agriculture Organization of the United Nations,1957). It is usually expressed as heat production or oxygen consumption per unit of body size. BMR is the daily rate of energy metabolism an individual needs to sustain in order to preserve the integrity of vital functions. It must be measured under conditions, which, as far as possible, avoid the influence of the external environment (Henry, 2005). Persons with chronic SCI have been reported to have a reduction in metabolic rate (Mollinger, Nyulasi, Collier, & Brown, 1985; Spungen, Bauman, Wang, & Pierson, 1993). Lean tissue is the most metabolically active body tissue, and muscle mass, a predominant component of lean tissue, appears to be lost over time in those with SCI at a rate exceeding that of the able-bodied population (Spungen, Wang, Pierson, & Bauman, 2000; Spungen et al., 2003).

MATERIALS AND METHODS

The methods for the article selection and inclusion criteria were based on the procedures for systematic reviews producer by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses according to the PRISMA guidelines (Moher et al., 2015). Ethical approval for this study was obtained from the Faculty of Physical Education and Sport at the Charles University Prague (No. 172/2014).

Eligibility Criteria
We evaluated controlled, cross-sectional studies on the BMR, BEE, REE and RMR of people with SCI. Studies were considered eligible if they addressed voluntary strategies aimed at measurement of basal metabolic rate (BMR), basal energy expenditure (BEE), resting energy expenditure (REE), resting metabolic rate (RMR), spinal cord injury (SCI) and paraplegia. The primary outcomes of interest were values energy expenditure measurement by indirect calorimetry. It was restricted to studies on human subjects. English language review, that examined energy expenditure of SCI persons with injury between the vertebrae segments from C4 to S5. SCI was defined as someone with a mobility impairment reliant on wheelchair motion. The search included report about with SCI aged comparison of Basal Metabolic Rate in individuals with a spinal cord injury and Harris-Benedict equation 4–72 years old, time of injury 7 days to 25 years with complete and incomplete SCI. If not otherwise stated, all the studies reviewed fulfil the following criteria: exclusion of patients with tracheostomy, active infections, thyroid dysfunction, heterotopic ossification, respiratory dysfunction, diabetes, Crohn's disease, renal disease, heart disease, cauda equine syndrome, amputation, and non-traumatic spinal cord injury.

Descriptors were select using the MeSH (Medical Subject Headings) database. The following expressions were used: basal metabolic rate (BMR), basal energy expenditure (BEE), resting energy expenditure (REE), resting metabolic rate (RMR), spinal cord injury (SCI), tetraplegia, paraplegia.

The search strategies used in electronic bibliographic databases including PubMed, the Scopus database (Table 1), Web of Science and the Central Library of our University. Records published between January 1985 and January 2018.

Table 1 Search strategies used PubMed and Scopus database

Scopus (n = 20)	PubMed (n = 12)
ALL (basal AND metabolism) AND TITLE-ABS- KEY (energy AND expenditure) AND TITLE-ABS- KEY (resting AND metabolism) AND TITLE-ABS- KEY (spinal AND cord AND injury) AND TITLE-ABS-KEY (tetraplegia) AND TITLE-ABS-KEY (paraplegia)	("energy metabolism"[MeSH Terms] OR ("energy"[All Fields] AND "metabolism"[All Fields]) OR "energy metabolism"[All Fields] OR ("energy"[All Fields] AND "expenditure"[All Fields]) OR "energy expenditure"[All Fields]) AND ("rest"[MeSH Terms] OR "rest"[All Fields] OR "resting"[AllFields])AND("metabolism"[Subheading]OR"metabolism"[All Fields] OR "metabolism"[MeSH Terms] OR "metabolism"[All Fields] OR "metabolic networks and pathways"[MeSH Terms] OR ("metabolic"[All Fields] AND "networks"[All Fields] AND "pathways"[All Fields]) OR "metabolic networks and pathways"[All Fields]) AND ("spinal cord injuries"[MeSH Terms] OR ("spinal"[All Fields] AND "cord"[All Fields] AND "injuries"[All Fields]) OR "spinal cord injuries"[All Fields] OR ("spinal"[All Fields] AND "cord"[All Fields] AND "injury"[All Fields]) OR "spinal cord injury"[All Fields]) AND ("quadriplegia"[MeSH Terms] OR "quadriplegia"[All Fields] OR "tetraplegia"[All Fields]) AND ("paraplegia"[MeSH Terms] OR "paraplegia"[All Fields])

Data extraction

We aimed to evaluate and compare out all studies that measured parameters BMR, BEE, REE, RMR in persons with SCI against the results of Harris-Benedict equations. Anthropometric data were substituted into the equation from the average values. The Harris-Benedict equations BMR:

for men = 88.362 + (13.397 × mass in kg) + (4.799 × height in cm) − (5.677 × age in years)

for women = 447.593 + (9.247 × mass in kg) + (3.098 × height in cm) − (4.330 × age in years) (Harris & Benedict, 1918).

RESULTS

Basal metabolic rate

BMR is the amount of energy needed to sustain the involuntary activities of the body at rest after a 12-hour fast. Most of these involuntary activities are regulated by the autonomic nervous system and include maintaining muscle tone, body temperature, and proper functioning of the heart, lungs, and gastrointestinal tract (Yilmaz et al., 2007). The main difference between BMR and RMR lies in the resting and fasting time before measurements.

Many variables such as age, height, body mass, ethnicity, and body surface area, body composition, diet-induced thermogenesis and recent physical activity may influence the prediction of RMR (Buchholz, Rafii, & Pencharz, 2001). BEE by our definition, was the energy expended by an individual when initially waking in the morning while lying supine in bed at normal body and ambient temperatures after at least a 12 hour fast. REE was defined as the energy expended by an individual when seated at least 4 hour post-prandial at normal body and ambient temperatures (Bauman, Spungen, Wang, & Pierson, 2004).

Method measurement by indirect calorimetry

Principle of indirect calorimetry is the usual method of measuring energy expenditure. Measurement of the amount of heat (energy) produced by a subject by determination of the amount of oxygen consumed and the quantity of carbon dioxide eliminated (Fujii & Phillips, 2002). It is easier to carry out than direct calorimetry and provides information about the metabolic fuel that the body is using (Mann & Truswell, 2002).

These studies used the indirect calorimetry method for BMR, BEE, REE and RMR measurement with different medical device and body position (sitting or lying).

According to Herring, Molé, Meredith, & Stern, (1992) the underlying principle for indirect calorimetry is that oxygen is needed for the production of energy and carbon dioxide is release as an end-product metabolism. Thus, the rates of oxygen (VO_2) consumed and carbon dioxide (VCO_2) production is measured in breath samples. Samples can be measured in a respiration chamber or by an open circuit ventilated hood system, which is the most common. For this assessment, breath samples are collected from a subject lying in supine position in a comfortable environment for about 30–40 minutes. At least 12 hours of fasting is required so that there is no energy required for digestion and absorption of ingested food. Athletes also should avoid exercise for 48 hours prior to the measurement to eliminate the effects of acute activity because exercise can increase RMR up to 39 hours post-exercise.

All studies are made with the persons called in resting state. Studies definition resting state as:

- The subject be fasted for at last 4 to 14 hour before the measurements are taken.
- The subject be minimum of 24 hours post-exercise.
- The subject as well as to abstain from caffeine or alcohol intake, no smoke the last 24 hours.
- The environment in which the measurements are taken be thermo-neutral (22–26°C) so that there is no thermoregulatory effect on heat production.
- he subject be completely rested, both before and during the measurements. It could be lying or seated and fully awake.

Medical device indirect calorimetry

The metabolic cart

The metabolic cart essentially measures the oxygen consumed and the carbon dioxide produced by the patient and then calculates (using the modified Weir equation) the energy expenditure for the patient (Fujii & Phillips, 2002).

Med Gem
Hand-held calorimeters such as the MedGem™ and BodyGem™ (Microlife, 2019) have been developed to measure energy expenditure (Hipskind, Glass, Charlton, Nowak, & Dasarathy, 2011). While traditional indirect calorimeters measure both VO_2 and VCO_2, the hand-held devices measure only VO_2 where RQ is assumed to be 0.85 (Microlife, 2019).

Douglas bag
This is a large bag impermeable to gas, usually of volume 100 liters. The subject wears a nose clip and breathes out into the bag via a tube containing a valve which separates inspired from expired air (Mann & Truswell, 2002).

Respiration chambers
The subject's respiratory gas exchanges are measured by continuous analysis of well-mixed samples of air from the chamber. From differences in oxygen and CO_2 content between the air going in and the air coming out the respiratory exchange is calculated and from this the energy expenditure of the subject (Mann & Truswell, 2002).

Predicting equations for people with SCI
According to Harris & Benedict (1918), Mifflin et al. (1990), Nightingale & Gorgey (2018) in clinical practice, BMR is often predicted using equations which feature variables that are easily measured: body weight, stature, and/or age. However, a recent review reported that such equations, derived from able-bodied populations, over predicted BMR by 4–92% in persons with SCI.

To date, no studies in persons with SCI have sought to assess the improvement in the prediction of BMR with the addition of simple anthropometric measurements that can be easily obtained. In non-disabled individuals, the addition of fat free mass (FFM) to a regression equation using the predictors of mass, height, and age increased the associations between predicted and criterion BMR from $r^2 = 0.71$ (SEE = 125 kcal/d) to $r^2 = 0.80$ (SEE = 103 kcal/d) (SEE – Standard Error of the Estimate). In the study thirty men with chronic (>1 year) motor complete and the results of this current study demonstrate that the addition of anthropometric measurements to FFM (Table 2, model 3) explains an additional 8% of the variance in BMR. For researchers/clinicians without access to expensive scanning equipment (DXA), a final prediction algorithm was generated (Table 2, model 4), with the FFM predictor variable removed. This explained the least variance in criterion BMR ($r^2 = 0.57$) (Table 2). SEE was also calculated to determine the accuracy of these prediction models. The accuracy of commonly used BMR prediction equation remains to be assessed in a cohort only representative of men with chronic (> 1 year) SCI.

In the predicted equations there were not observed significant differences in BMR between paraplegic (1497 ± 148 kcal/d) and tetraplegic (1467 ± 178 kcal/d) participants. According to Nightingale & Gorgey (2018) previous studies have demonstrated increased BMR in paraplegic compared with tetraplegic participants of (370 and 224 kcal/d), whereas other researchers have shown there to be no difference.

Table 2 Generated BMR prediction models using FFM and anthropometric measurements

Model Name	BMR (kcal/d) Prediction Algorithm	R^2	SEE (kcal/d)
1. FFM alone	$= 23.469 \times$ FFM (kg) $+ 294.330$	0.69	93
2. FFM plus circumferences and diameters	$= 23.995 \times$ FFM (kg) $+ 6.189 \times$ SAD (cm) $+ 6.384 \times$ TAD (cm) $- 6.948 \times$ THIGH CIRC (cm) $+ 275.211$	0.73	90
3. FFM plus anthropometrics	$= 19.789 \times$ FFM (kg) $+ 5.156 \times$ weight $+ 8.090 \times$ height $- 15.301 \times$ calf (cm) $- 860.546$	0.77	84
4. Anthropometrics alone	$= 13.202 \times$ height (cm) $+ 11.329 \times$ weight (kg) $- 16.729 \times$ TAD (cm) $- 1185.445$	0.57	112

Note: SAD – sagittal abdominal diameter; TAD – transverse abdominal diameter; THIGH CIRC – thigh circumference; SEE – Standard Error of the Estimate; FFM – fat free mass; BMR – basal metabolic rate.

DISCUSSION

The parameter BMR for normal population is commonly evaluated by Harris-Benedict equation. For persons with spinal cord injury this method is not taking into consideration the muscle atrophy under the spinal lesion. According to Nash & Gater (2007) the authors recommend estimation of baseline energy expenditure using indirect calorimetry to avoid inaccurate applications of non-validated energy prediction equations. Similarly, activity tables previously determined for energy expenditure in non-SCI adults markedly overestimate the caloric expenditure required for persons with SCI. In the early phase rehabilitation that patients with SCI require up to 54% fewer calories than would be predicted by standard formulae (Cox et al., 1985).

In this review there are results of people time of injury 7 days to 25 years with and in the age 33.78 ± 16.73 years. One of the factors which influenced the parameter BMR for person with SCI is FFM. Deitrick, Whedon, & Shorr (1948) reported an average 7% reduction in BMR for healthy subjects whose lower extremities were immobilized in plaster casts, indicating that immobilization of a large muscle mass alone can lower BMR. Evidently, part of the reduction in BMR found in patients with spinal cord injury was due to the imposed immobility of their paralyzed limbs.

According to Gorgey et al. (2010) body composition may vary widely among individuals with SCI as a result of the level of injury, years after injury, and extent of physical activity. The dramatic muscle atrophy in patients with acute SCI is clearly related to the degree of paralysis and immobilization (Bauman et al., 2004; Kalani, Brismar, Fagrell, Ostergren, & Jorneskog, 1999). Persons with SCI have body compositional changes that are similar to those reported in the elderly, with loss of lean tissue and relatively increased adiposity (Alexander, Spungen, Liu, Losad, & Bauman, 1995; Evans, 1995) although the anthropometrical distribution of muscle mass may differ (Bauman et al., 2004). Strong correlations between altered body composition and the level of SCI have been observed, with successively higher, more complete spinal cord lesions associated with decreased FFM and body cell mass (Nuhlicek et al., 1988).

Tetraplegia is associated with significantly lower rates of BEE than paraplegia (Munakata et al., 1997; Cameron, Nyulasi, Collier, & Brown, 1996; Mollinger, Nyulasi, Collier, & Brown, 1985; Spungen, Bauman, Wang, & Pierson, 1993) largely due to greater muscle denervation found in those with cervical lesions (Buchholz, McGillivray, & Pencharz, 2003b). According to Spungen, Wang, Pierson, & Bauman (2000) and Spungen et al. (2003) the lean tissue is the most metabolically active body tissue, and muscle mass, a predominant component of lean tissue, appears to be lost over time in those with SCI at a rate exceeding that of the able-bodied population.

In comparison with nondisabled controls, BMR is significantly reduced by 14–27% in persons with SCI, although values were comparable between groups when adjusted for FFM (Buchholz, et al., 2003b). Reductions in BMR after SCI are primarily driven by skeletal muscle disuse atrophy below the level of the injury (Spungen, Wang, Pierson, & Bauman, 2000).

A major disadvantage of equations that use body weight to predict BMR is that this variable is unable to distinguish between FFM and fat mass (FM). FFM has been shown to explain most of the variance in BMR, with other studies demonstrating an independent, secondary contribution of FM (Nightingale & Gorgey, 2018).

To date, the progress towards developing a validated predictive energy equation targeted for SCI has been slow and unsuccessful, and indirect calorimetry remains the only accurate assessment of REE for health practitioners working with individuals after SCI (Nevin, Steenson, Vivanti, & Hickman, 2016).

Spungen et al. (1993) reported the relationship between measures of lean body tissue and energy expenditure. In our sample group total body potassium (TBK) was reduced by about one third. Because approximately 98% of the TBK is located in lean tissue (viscera and skeletal tissues), TBK is a surrogate for the FFM, and a change in FFM should be associated with a concomitant change in REE. Mollinger et al. (1985) reported that in 16 subjects with high paraplegia (T1 through T10) and in 5 subjects with low paraplegia (below T10), percentages of predicted basal metabolic rates were reduced, at 12% and 15%, respectively. The resting energy expenditure is reduced in proportion to the loss of lean body tissue, which is determined by the degree of muscle atrophy below the level of lesion.

Table 3 compares the differences between the parameter BMR (overestimate 25% and underestimate 35%), BEE (overestimate 18% and underestimate 0%), REE (overestimate 26% and underestimate 2%) and RMR (overestimate 36% and underestimate 4%) for persons with SCI. Selected studies used the different medical devices (Table 3), Metabolic cart and Hand-held calorimeters MedGem, BodyGem are used as indirect calorimetry medical devices. According to Hipskind et al. (2011) results from a hand-held calorimeter were similar to those obtained from metabolic cart studies. The hand-held device was compared to metabolic carts in 9 studies with mixed results. The predictive equations (Harris-Benedict, Mifflin St. Jeor and FAO/WHO equations) were found to over-and/or underestimate RMR compared to the MedGem. The Harris-Benedict equation was found to overestimate the RMR by 3–11%.

Table 3 Comparison of BMR, RMR, BEE and REE values from the literature: observed values vs. predicted values using the Harris-Benedict equations

	First author (year)	Subjects	Age range (y)	Male	Female	Total	Methods, position	Medical device	% difference
1	Mollinger et al. (1985)	C4–6	19–48	14		48	BMR/L	Metabolic Cart	+21
		C6–Th1	19–48	13			BMR		−26
		Th10–S4	19–48	16			BMR		−47
		Th4–L1	19–48	5			BMR		−52
2	Sedlock & Laventure (1990)	Th4–L1	29–31	4		4	RMR/L	Metabolic Cart	+16
3	Kearns et al. (1992)	Mixed Race				10		Douglas Bag	
		C4–Th10	16–72	7			REE/L		+10 (males)
		C4–Th10	16–72		3				−2 (females)
		C4–Th10	16–72	7			BEE/L		No difference
		C4–Th10	16–72		3				−12 (females)
4	Spungen et al. (1993)	Th1–S4	39–46	12		12	REE/S	Metabolic Cart	No difference
5	Alexander et al. (1995)	NPS, Th1–S4	47–53	24		24	RMR/S	Metabolic Cart	−14
		PS, Th1–S4	47–53	14		14	RMR/S		+1
6	Alexander et al. (1995)	NPS, Th1–S4	47–54	24		24	BMR/S	Metabolic Cart	+1
		PS, Th1–S4	47–54	14		14	BMR/S		+1
7	Monroe et al. (1998)	C6–L3	22–49	10		10	RMR/L	Respiration Chamber	−4
8	Jeon et al. (2003)	C5–7	35–45	7		7	RMR/L	Metabolic Cart	+23
9	Buchholz et al. (2003a)	Mixed Race				27		Metabolic Cart	
		Th1–S4	22–57	17			RMR/L		+6 (males)
		Th1–S4	24–41		10				+6 (females)
10	Bauman et al. (2004)	Mixed Race				13		Metabolic Cart	
		C5–L2	25–47	9			BEE/L		+18 (males)
		Th7–L1	21–49		4				+6 (females)
		C5–L2	25–47	9			REE/S		−2 (males)
		Th7–L1	21–49		4				−14 (females)

#	Author	Race/Group	Level	Age	n (males)	n (females)	N	Measure	Device	Value
11	Liusuwan et al. (2004)	Mixed Race					27		Metabolic Cart	
			C4–S5	10–21	18			RMR/L		+12 (males)
			C4–S5	10–21		9				+7 (females)
12	Patt et al. (2007)	Mixed Race					59		MedGem	
			C4–L3	4–20	31			REE/S		+15 (males)
			C4–L3	8–21		28				+10 (females)
13	Yilmaz et al. (2007)	Mixed Race					20		Metabolic Cart	
			C4–S5	16–50	13			BMR/L		+18 (males)
			C4–S5	17–50		7				−2 (females)
14	Gorgey et al. (2010)	Spastic, Mixed Race					10		Metabolic Cart	
			C6–Th11	18–45	8			RMR/L		+27 (males)
			C6–Th11	18–45		2				+17 (females)
15	Perret & Stoffel-Kurt (2011)	Mixed Race					12		MedGem	
			C5–Th12	22–46	9			REE/L		+21 (males)
			C5–Th12	22–46		3				+12 (females)
16	Tanhoffer et al. (2012)	Mixed Race					14		Metabolic Cart	
			C4–Th12	23–65	13			BMR/L		+19 (males)
			C4–Th12	23–65		1				+7 (females)
17	Buchholz et al. (2003b)	Mixed Race					28		Metabolic Cart	
			S4–S5	20–57	17			RMR/L		+6 (males)
			S4–S5	20–57		11				−4 (females)
18	Nightingale & Gorgey (2018)		C5–L1	19–61	30		30	BMR	CosMed	+42 (males)

Note: Position: L – lying; S – seated; Spastic group – ASIA classification A, B; PS – pressure sores, NPS – no pressure sores.

LIMITATION

According to Patt, Agena, Vogel, Foley, & Anderson (2007) many facilities and practitioners do not have access to full metabolic cart analysis. Measuring an accurate height may be challenging in those with SCI due to their scoliosis and lower extremity contractures (Liusuwan, Widman, Abresch, & McDonald, 2004).

According to Adams & Hicks (2005) is spasticity due to an upper motor neuron disorder that affects 70% of patients with chronic cervical and thoracic level injuries

1 year after injury. Spasticity is a complex phenomenon of exaggerated muscle tone, reflexes, and clonus that affects the skeletal muscles below the level of injury. Despite its negative influence, spasticity could be viewed as expressing positive features. For example, spasticity has been shown to improve ambulation and peripheral circulation.

According to Alexander et al. (1995) the patients with paraplegia and pressure sores were found to have significantly greater resting energy expenditure per kilogram of body weight and percent predicted energy expenditure than those with paraplegia without pressure sores. Pressure sores may also be expected to increase the resting metabolic rate. It has been reported that patients with complete lesions have the highest incidence and most severe pressure sores.

Spasticity related alterations might occur at basal energy requirements. On the other hand, another factor that may help spasticity to alter BMR it is contribution to lean tissue mass. Periodic recruitment of large skeletal muscle mass could result in high energy expenditure and defend against increase in FM after SCI (Gorgey et al., 2010). In accordance with recent findings (Yilmaz et al., 2007) spasticity was not directly related to the RMR. However, successfully maintaining FFM resulted in increased RMR, respiratory exchange ratio, and substrate utilization, as documented by increased fat oxidation. Knee extensor spasticity positively decreases the ratio between FM to FFM in legs, trunk, and whole body. The increase in FM relative to FFM can be simply attenuated by provoking spasticity in both lower extremities (Gorgey et al., 2010).

There are results of energy expenditure in the Table 3. The persons with the pressure sores had 1% higher results, the spastic male patients had 27% higher and spastic female patients 17% higher results vs. Harris-Benedict equation ones.

Gorgey et al. (2010) had found that spasticity improves glucose homeostasis, insulin sensitivity, and lipid profile by primarily maintaining FFM. Additionally, maintenance of FFM has been shown to positively influence the RMR and hence the basal metabolic profile. According to Stjernberg, Blumberg, & Wallin (1986) Sympathetic nervous system (SNS) activity has been shown to be lower in persons with spinal cord injury than in control subjects. The individuals with lower SNS activity may be at greater risk for weight gain because of a lower metabolic rate (Monroe et al., 1998). According to Yilmaz et al. (2007) the relationship between energy expenditure and autonomic nervous system is controversial. Positive correlations were reported between daily energy expenditure and sympathetic activity. However, some studies showed that β-adrenergic blockade did not affect daily energy expenditure. On the other hand, the influence of sympathetic nervous system on BMR was reported to be relatively small. After SCI, autonomic nervous system dysfunction is a common complication mostly seen in patients with T6 or upper level injuries. However, the effect of this autonomic nervous system dysfunction on BMR in persons with SCI remains unclear.

Anti-spasticity medications commonly prescribed in SCI have been shown to suppress REE in non-injured populations and common secondary complications such as pressure injuries and urinary tract infections may increase energy needs (Nevin et al., 2016).

According to Silverstein (1992) cigarette smoking may have a hindering effect on pressure ulcer healing due to vasoconstriction and reduced blood flow to the skin, resulting in tissue ischemia.

Cigarette smoking has been found to increase energy expenditure in the general population. It is of interest to note that more individuals who had pressure sores were current smokers than in either the NPS (no pressure sores) – Para or control groups (Alexander et al., 1995).

As it is demonstrated in the table 3 the methodology of the studies is not completely uniform. Studies in this review used the different position of body during and Medical device of the measurement. Compher et al. (2006) states that certain postures require increased muscle tone and may influence the measurement of RMR. In 24 adults with a weight range of 48 to 109 kg, group mean RMR measured while sitting upright motionless was 70 kcal/d higher than supine RMR (3.7–6.3% increase). A recent review reported that predicted values by SCI for resting energy expenditure overestimate actual values by between 5% and 32% (Buchholz & Pencharz, 2004).

CONCLUSIONS

There are many factors that affect the whole value of the BMR in people with SCI. The indirect calorimetry method looks like the most accurate one among the available methods determining BMR in people with SCI. Our study has confirmed that the predictive Harris-Benedict equation cannot be used for the calculation of BMR in people with SCI. Indirect calorimetry can be an essential method that dietetics professionals can use to build a reduction diet in people with SCI. It is also very important to have respect for the limitations of this particular group of people. According to Nevin et al. (2016) investigating the feasibility of introducing indirect calorimetry into standard care of SCI and pursuing lower cost alternatives to current equipment needs is warranted.

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Most frequent injuries
in female handball players

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ABSTRACT

Objectives. The main objective of this work was to assess the most frequent injuries in female handball players who played the premium Czech competition – *MOL League Women* – and the 3rd highest competition – *2nd League Women* – during the 2017/2018 season. The objectives also included ascertaining whether preventive and compensation exercises are included in the teams' training units.
Methods. The questionnaire method was selected. A non-standard questionnaire was sent out to all players in the two competitions. A total of 112 questionnaires were analysed.
Results. Injuries in the ankle area were found to the most frequent type of injury, reported by 56.3% respondents. Injuries in the hand and knee areas followed, concerning 50.9% and 46.4% respondents, respectively. Recovery and compensation procedures were found to be inadequately used in the handball players' regime.

KEYWORDS

handball; recovery and compensation in sports; injuries of athletes; injuries in handball; prevention; physiotherapy in sports

INTRODUCTION

Handball is a team sport in which the aim is to get the ball into the opponent's goal. Either of the two opponent teams has 6 players (three centre backs, two wings, one pivot) plus the goalkeeper. The players are active both in the offense and in defence so each of them has two tasks. The team that scored more goals is the winner, a draw being permissible. The rules permit one and the same person to be the goalkeeper and an offense player during a match (Tůma, 2017). Handball is a very vivid and variable game, motion changes, fast and short sprints and jumps being frequent. So a top-level player must have a well-developed athletic versatility. A player runs 2–6 km in average during a 60-minute match, the pivots and wings being most stressed from this aspect. Heart rate lies above 80% of the maximum. Lactate levels measured after a match reach up to 10 mmol/L, so the VO_{2max} data are above the average both in men (60 ml/kg.min) and in women (50 ml/kg.min). Anaerobic performance (strength, power, agility, speed) predominates during the match. Strength and speed of the throw rather than physical fitness are decisive in female players (Grasguber, 2008). Since handball is a very dynamic and contact sport, the incidence of injuries has been increasing during the past years, particularly due to contacts with opponents (Isaković, 2016).

This work was stimulated by previous studies that led us to point to the increasing number of injuries in this sport. This is particularly important because it suggests that more attention should be paid to adequate prevention in sports, specifically recovery and compensation exercises which should be an integral part of the training unit. Sprained ankle was among the most frequent diagnoses in the 1980s and 1990s (Radvanský et al., 2011). This is supported by current studies showing that the incidence lower limb injuries is higher than the incidence of upper limb injuries, sprained ankle being the most frequent injury: its incidence is 1.5 injuries per match, over one-half of the injuries resulting from contacts with opponents (Langevoort, 2007; Bere, 2017; Luig, 2011; Radic, 2013; Engebretsen, 2013; Giroto, 2017; Olsen, 2006).

OBJECTIVE

The objective of this paper, which is based on our long-term survey (Ragulová, 2018), was to analyse the most frequent injuries in female handball players who played the highest Czech competition, *MOL League Women*, and the 3rd highest Czech competition, *2nd League Women*, in 2017/2018, and to assess the level of recovery and preventive procedures in players in the two competitions.

METHODS

The study included eight *MOL League Women* teams and eleven *2nd League Women* teams. The data were obtained from the players by using an anonymous non-standardised questionnaire that was sent out among all *MOL League Women* and *2nd League Women* teams. Apart from questions targeting injuries, the questionnaire also contained questions concerning the inclusion of preventive and compensation procedures in the training unit. 48 (30%) from among the 160 returned questionnaires were excluded because they failed to meet the criteria set. Hence, 112 questionnaires (70%)

were included in the study: 56 from the *MOL League Women* players and 56 from the *2nd League Women* players, hence in the 50 : 50 proportions. The IBM SPSS Statistics 25 software was used to process the data obtained and provide the percent fractions of the answers. The chi square test confirmed or refuted postulated hypotheses at a significance level $p = 0.05$. The Microsoft Excel 2010 application was employed to set up graphs of the dependences observed.

From the questionnaires it was found that 89.3% of all the 112 players in the two competitions ever suffered injury during their player's career, which is a fairly high figure. Equally in the *MOL League Women* and in the *2nd League Women*, 50 respondents had ever suffered a player's injury whereas 6 had not.
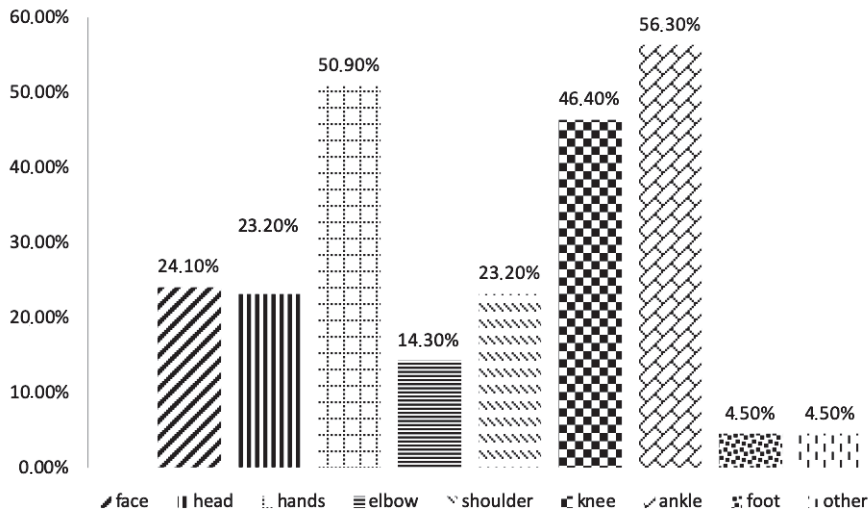

Graph 1 Locations of the player injuries in the 2 competitions irrespective of age. Percent data (n = 112)
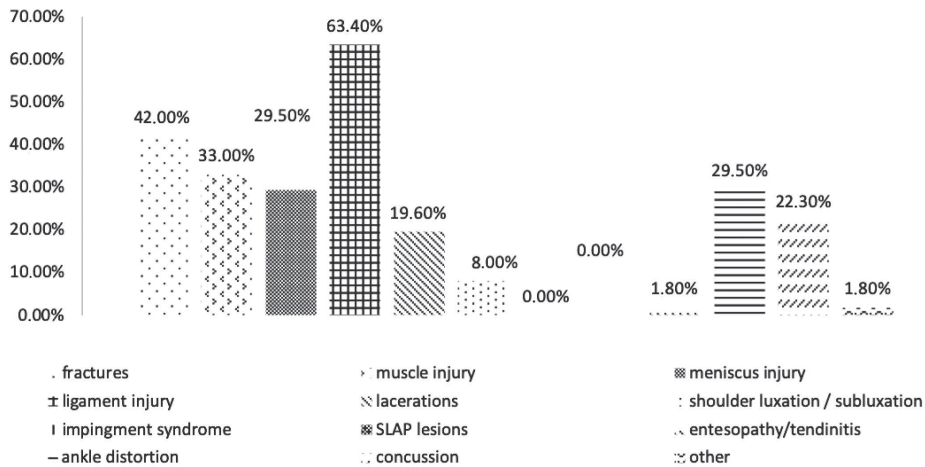
Graph 2 Player injury types in the 2 competitions irrespective of age. Percent data (n = 112)

Among the respondents, had 92% suffered their injuries during a match, poor foot strike being the most frequent mechanism (57.1%) of the injury.

Handball has been enjoying rapid developed recently, particularly in speed and hardness, and so the incidence of injuries has been growing, regrettably starting from schoolchildren categories. So, body recovery and injury prevention should be in the focus of the trainers and physiotherapists starting from the athletes' early age.
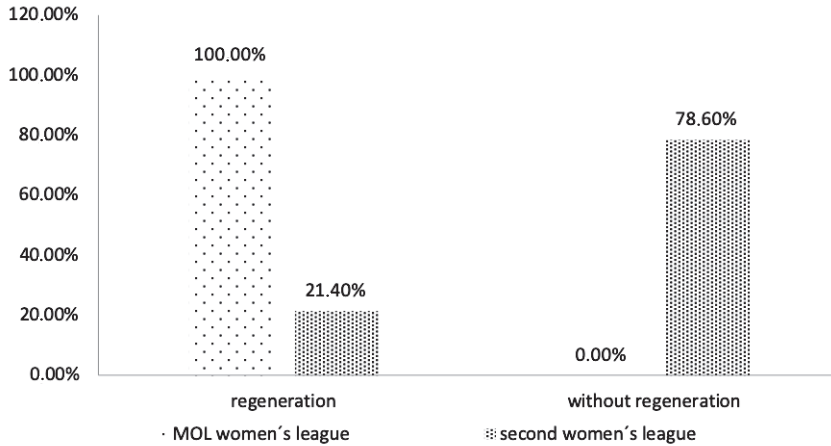
Graph 3 Comparison of MOL League players (n = 56) and 2nd League Women players (n = 56) in dependence on recovery, percent data

All the 112 respondents, irrespective of the competitions they were engaged in, answered that their most frequent recovery methods included sauna (50.9%) and massage (40.2%).
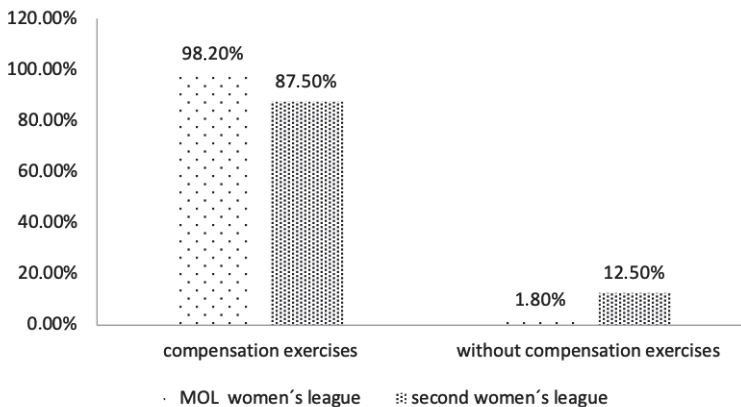
Graph 4 Comparison of inclusion of compensation exercises for MOL League players (n = 56) a 2nd League Women players (n = 56), percent data

The most frequent compensation exercise included short jogging before (67.9%) and after (63.4%) the training unit, and stretching before (75.9%) and after (66.1%) the training unit.
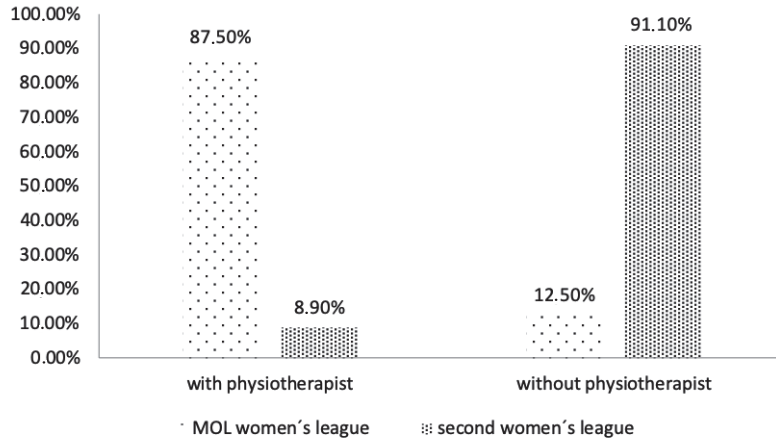
Graph 5 Presence of physiotherapists in the competitions – the MOL League (n = 56) and the 2nd League Women (n = 56), percent data

We feel that the reason why the ankle is the most frequent injury site is that inadequate attention is paid to compensation exercises targeting stability of this body point, which might help reduce the incidence of this type of injury. Trainers and physiotherapists assisting the players should increase their focus on stability exercises, such as sensomotor exercises with labile platforms.

This research supports findings from previous studies concerning the incidence of injuries in female handball players. The ankle area is the most frequent site of injury in the players. Over one-half of the players had injuries on both lower limbs. As to the upper limbs, it was hands that were most frequently injured (stubbed or broken fingers). The most frequent typical injuries in the respondents included injuries of the ligaments; bone fractures and muscle injuries followed. The most frequent circumstance was poor foot strike and the injuries occurred most frequently during matches.

Although the survey included a low number of respondents, the incidence of injuries in female handball players appears to be alarming – 100 out of the 112 respondents had had one or more injuries during their player's career. Injury cannot be predicted but it can be prevented by applying appropriate preventive measures – by including correct compensation and recovery exercises. Not all respondents in the survey practise recovery and compensation exercises in their training units, and this may be a factor contributing to their injuries. Also important is the presence in the team of a physiotherapist who should see to it that correct injury prevention strategies are practised. Czech handball teams rather seldom include physiotherapists, and as a result, are not pushed to apply preventive procedures, and this may be one of the adverse factors contributing to the players' injuries.

DISCUSSION

Injuries in handball players include both acute injuries and chronic injuries as a consequence of overload of a body segment or the whole body. If an athlete has suffered injury, he or she is partly or completely excluded from the training unit, whereby their athletic development is slowed down.

Our survey showed that the ankle area is the site that is most frequently injured (56.2%, n = 63) among Czech female handball players. Also frequent are injuries of the hand (50.9%, n = 57) and knee (46.4%, n = 52). The most frequent injury types included ligament injuries (63.4%, n = 71), bone fractures (42%, n = 47) and muscle injuries (33%, n = 37). This is in line with the findings by Beré published in the paper *Injury and illness surveillance during the 24th Men's Handball World Championship 2015 in Qatar* (2017). Beré recorded 132 injuries, in this 58.3% affecting the lower limbs, largely the ankle (n = 21). Langevoort (2007), in his article *Handball injuries during major international tournaments* compared injuries that occurred during 6 matches and also found that ankle injuries were among the most frequent injuries (8%), only head injuries being still most frequent (14%). From among the 478 injuries, lower limb injuries were most frequent (n = 197, 42%). In his study *Incidence and risk factors of injuries in Brazilian elite handball players* (2017), Giroto compared injuries between Brazilian male (n = 156) and female (n = 183) handball players from a total of 21 teams. Among the total of 339 players, injuries of the ankle (19.4%) and of the knee (13.5%) were the most frequent acute injuries while shoulder was the most frequent site of chronic injury (44%). The most frequent acute injury types included muscle injuries (27.1%), sprained ankle (24.3%) and contusions (19.9%), while tendinitis (91.8%) was the most frequent chronic injury type. Olsen (2006) in his study *Injury pattern in youth team handball: a comparison of two prospective registration methods* examined the incidence of injuries in Norwegian male and female handball players. He divided the study groups into two subgroups. The one subgroup was denoted "Match report registration", which included injuries that occurred during a match within one playing season (90 teams registered, 49 injuries recorded). The other subgroup, referred to as "Coach report registration", was used to compare injuries from the long-time perspective (7 months) and occurring both during a match and during training (97 players were included in the study and 118 injuries were identified). Most frequent were ankle (26%) and knee (24%) injuries in both groups, sprain and contusions were the most types of injury.

CONCLUSION

This survey gave evidence that, like in other countries, ankle is the most frequently injured part of the body in Czech female handball players. We also found that compensation exercises targeting ankle stability are inadequately included in the players' training units, and we suggest that this fact may be among the important factors contributing to the incidence of the injuries. We recommend that physiotherapists and trainers of handball teams should pay more attention to the application of preventive and compensation exercises and focus on stability training, for instance through simple sensomotor exercises with labile platforms.

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Effects of sports personalities in marketing communication on the purchasing preferences of Generation Y

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ABSTRACT
This research determines what effect if any the use of sports celebrities in companies' marketing commu-nications has on the purchasing preferences of Generation Y. The survey is based on the original American version from authors Bush, Martin, Bush (2004). The questionnaire-based survey involves 416 respondents who study at Prague secondary schools and universities. Group discussions with four groups comprising a total of 41 respondents are also used. The results of the research show that the use of sports celebrities in marketing communication for generation Y does not have a proven effect on positive word of mouth or on switching and complaint behavior. This communication tool may have an indirect positive effect in the form of an increase in the brand/product awareness, attractiveness of a communication message and thereby increased options and tendency to try a product and a first purchase, even despite higher prices than the competition.

INTRODUCTION AND THEORETICAL BACKGROUND

The combination of famous sport celebrities and a company's brand or product is now already considered a traditional communication tool, which companies use to achieve various marketing, sales and communication objectives. These objectives may include increasing the volume of product sales as well as changes or boosting and building of the image of a brand, company and product. There may be many objectives in marketing communication, and therefore the selection of a sports celebrity attracts significant attention. Since the use of a sports celebrity is a costly item in the budget for marketing communication, the selection of an optimal sports celebrity is a demanding process. The effect and impact of such sports celebrity can then be seen in the perceived quality of the particular product, the transfer of the sports celebrity's reputation to the particular brand or a general increase in competitive advantages compared to other brands in the industry. Therefore, it depends on the subjectively perceived benefits for consumers.

The final consumer, like in overall marketing, is the reason for using sports celebrities in marketing communication. Men and women are constantly compared with the so-called reference groups, such as family, work colleagues, classmates, male and female friends as well as successful people in the surroundings, celebrities in culture and in sports, politicians, etc. Through constant comparison and an attempt to get close to these perceived ideals, consumers adapt their preferences and behavior during selection and purchasing of products of specific brands. In this manner, consumers attempt to be members of such a reference group, to belong to a certain social group, which the particular celebrity is also in. Purchasing behavior and preferences of consumers, however, are a complicated process, which is dependent on many factors. This process aims with the use of sports celebrities to influence certain brands more or less and to get a sports celebrity close to its customers, at least through its products. Of course, this influence will be different for each customer and consumer, strong for some and none for others.

One interesting group of consumers is that of young people who grew up during numerous marketing campaigns, particularly in the form of communication and advertising messages of various types. These ranged from television advertising to various forms of outdoor advertising to omnipresent marketing communication via the Internet. This group is currently entering an economically productive age, and it is one of the main groups targeted by companies. This group, or generation of consumers, otherwise referred to as "Generation Y", consists of individuals born in the 1980s and 1990s. Those were the periods when information and communication technology, with which we are familiar today, began fully developing. Generation Y learned how to use these technologies to a full extent and made them an essential part of their lives. Thanks to the omnipresent communication media, this generation of consumers instantly knows what kinds of golf clubs Tiger Wood uses, in what spikes Usain Bolt achieved a world record in running, what shoes Lionel Messi plays in, what skis Aksel Lund Svindal uses in competitions, as well as non-sports products, such as what kind of hair gel David Beckham uses for his fashionable hair styles, what watch Lewis Hamilton wears, what tattoos Mike Tyson has and a lot of other information about sports

celebrities all over the world. All of these examples can influence what consumers buy, to be at least a bit like their favorite athletes.

The influence of reference groups to which sports celebrities belong is an integral part of all basic and new models of purchasing behavior of a consumer (McCarthy, Perreault, 1993; Koudelka, 1997; Erasmus, Boshoff, Rousseau, 2001; Jacoby, 2002; Shiffman, Kanuk, 2004; Tomek, Vávrová, 2008; Darley, Blankson, Luethge, 2010; Vysekalová et al., 2011; Martin, Morich, 2011). Reference groups are one of the effects that more or less influence the behavior of consumers, as is shown by the models of consumer behavior.

The effect of a reference group on consumer behavior can vary. Some authors (Schiffman, Kanuk, 2004; Stafford, 1966) specify two types of influences – *normative* (influence on behavior) and *comparative* (level of aspiration). However, currently many authors (Koudelka, 2006; Kotler et al., 2007; Kotler, Keller, 2007; Carmen, 2008; Escalas, Bettman, 2003; Bearden, Etzel, 1982; Chuang, Cheng, Hsu, 2012; Yang, He, Lee, 2007) specify three types of influences, which have been classified and tested with research by Park, Lessig (1977) – *information based, use based and value-expressive.*

For marketers, reference groups are highly beneficial tool for communicating with customers. Creative marketing communication makes it possible to combine adequate reference groups so that the target group for communication messages reacts based on defined communication objectives. Koudelka (1997) specifies three ways of using reference groups in marketing: media effects on reference groups, word-of-mouth communication and opinion leadership.

Celebrities are an integral part of today's marketing and regular life of consumers. How is this term defined, and who exactly is a celebrity? Certain definitions are presented here for clarification of the term.

Masood (2011, p. 7): "A celebrity is a person who is well known among the public and has a reputation based on professional knowledge in a selected area."

Miller, Laczniak (2011, p. 499): "Celebrities are well known individuals who receive significant attention from the media. They include actors, athletes, musicians, models and even chefs, authors, journalists and politicians. They are created, supported, promoted and sold to us via mass media."

It can be stated that a celebrity is a person who, thanks to communication via mass media, is generally known to the public or in a certain group of people. Sports celebrities used to be only sports heroes, but with gradual professionalization and media coverage of sports they have also earned the status of celebrities (Stevens, Lathrop, Bradish, 2003) and/or sports stars (Nicholson, 2007). Indeed the image of sports celebrities created by the media is considered the main difference between a sports hero and a sports celebrity. While a sports hero is known and admired thanks to real successes and sports performance, a sports celebrity is basically a creation of media presentation (Stevens, Lathrop, Bradish 2003; Nicholson, 2007).

Celebrity endorsement
Celebrity endorsement is today already a regularly used advertising technique across all industrial sectors. The comprehensive definition for marketing support using celebrities can be the following in this context:

Celebrity endorsement is the mutual combination of a publicly known, famous and renowned individual in a certain sector and companies and/or organizations who involve such individual integrally in their marketing and especially in their communication tools.

The fact is expressed here that a combination of a company with a celebrity and/or a sports celebrity influences not only the company's promotion policy but also the overall marketing strategy and its tactical and operative tools (product, price, distribution, marketing communication, etc.). In relation to the product itself, Lim (2005) comments that just the very essence of the combination with a celebrity is used to improve a product. In the sports sector, this applies more than usual, because athletes also receive significant attention from the media and fans, which increases their visibility and intensifies the product profile of a particular company (Schlossberg, 1996). Companies are very well aware of this fact, and they spend large amounts of money in connection with sports celebrities.

In order for companies to invest such large amounts of money into association of their brands with celebrities, including sports celebrities, it is necessary for these investments to bring about certain results. The long-term objective of various companies is, of course, financial profit, but this is achieved in various ways using various objectives. However, celebrities are not only used in marketing communication by companies but also by non-profit organizations, which have different objectives than just financial gain. The use of sports celebrities in marketing communication then forms a tool, which can fulfill various objectives and bring about various effects. The main objectives expected from the use of sports celebrities include (Martin, 1996):

- to attract the attention of consumers,
- to boost reminders of the brand name,
- to boost the image of a product,
- to increase the trustworthiness of a message,
- to increase the attractiveness of a product,
- to increase the popularity and messages of advertising,
- to increase the likelihood of a purchase.

However, the effects that have been proved, or which have appeared and been discovered, include financial and economic effects (Agrawal, Kamakura, 1995; Lear, Runyan, Whitaker, 2009; Elberse, Verleun, 2012; Clark, Horstmann, 2013), effects connected with the brand image (Lagae, 2005; Choi, Rifon, 2007; Seno, Lukas, 2007; Carroll, 2009; Simmers, Damron-Martinez, Haytko, 2009; Ranjbarian, Shekarchizade, Momeni, 2010; Temporal, 2010; Spry, Pappu, Cornwell, 2011; Keel, Nataraajan, 2012; Bhatt, Jayswal, Patel, 2013; Chan, Ng, Luk, 2013; Čáslavová, Višněvský, 2016), and effects related to purchasing behavior of the consumer.

Even despite the specified financial and economic effects and the effects connected with the image of the brand, the most important from the point of view of companies remains the actual purchasing behavior of customers and/or consumers. They namely generate revenue for companies, which leads to profit as the main objective of all companies.

Bush, Martin, Bush (2004) revealed through their research that the use of sports celebrities positively influences adolescents in their communication with peers, or the so-called W-O-M (word-of-mouth) communication and, further, their loyalty to

a supported brand. The use of such celebrities is important when a consumer is selecting a brand of product that the consumer wishes to buy and when a consumer talks about it with other people. The same research was repeated by Dix, Phau, Pougnet (2010), and they arrived at the same conclusions and even discovered an influence on alternating of brands and products depending on the used sports celebrity, which was not confirmed in previous research. Shuart (2007) also pointed out the positive influence of using sports celebrities, particularly in this case a sports hero, on the purchasing aims of consumers.

However, Alnawas (2010) in his study denies the fundamental influence of celebrities on purchasing behavior or on the aims of consumers when selecting and purchasing products. He adds also that much greater influence comes from tools to support sales, such as discounts, coupons, events, etc. Nonetheless, the study has shown a partial influence when a supported product is used by one or more celebrities themselves as part of their work, activities and careers, or if a brand or product relates to an environment in which a particular celebrity is known and excels. This is referred to as the so-called match-up effect, or the celebrity-product congruence. However, even this effect cannot be clearly confirmed in the sports environment, as is indicated by Koernig, Boyd (2009). Their research has shown that there is no difference between the effectiveness of use of a sports celebrity for a sports brand or a non-sport brand. Moreover, they also confirm that the use of a celebrity does not have a major influence on purchasing behavior. This results in a rather more positive and increasing awareness and value of the brand of the sports celebrity.

Sliburyte (2009) states that the purchasing aims are integrally connected with the trustworthiness of a celebrity used in marketing communication through the perception of their expertise, attractiveness and popularity, in the same way as with the match-up effect. However, the previously specified research studies do not support this claim. According to Lafferty, Goldsmith (1999), the trustworthiness of a celebrity also does not have a significant influence on the purchasing intentions of consumers. On the contrary, they claim that the characteristics of the product are what matter in the end.

Pringle (2004), unlike in all of the specified research studies, specifies a whole range of case studies of advertising campaigns in which a celebrity has been used for marketing support, which have resulted in smaller or higher growth of sales, revenue, market share, profit, etc. These studies are supported by the financial results of individual companies. It can be deduced from this that although respondents in many research studies deny the influence of celebrities on their purchasing behavior, the opposite is true. Kaser, Oelkers (2005) add that many practical case studies have shown that consumers prefer more often to buy a product that is supported by a celebrity. This may also be the result of the fact that marketing support by sports celebrities influences the desire to try a particular product or brand (Chan, Ng, Luk, 2013).

These studied effects (whether or not confirmed by research) depend, however, on other aspects of the use of sports celebrities as specified by Simmers, Damron-Martinez, Haytko (2009). These authors prepared "The Endorser Sexpertise Continuum" when certain characteristics for the use of celebrities in marketing communication apply for individual sides of the continuum in relation to purchasing behavior of a consumer.

On one side of the continuum, the consumer is more involved and engaged in product purchasing, interested in its specified attributes and functional properties, and then acquires and uses information gradually "piece by piece". Therefore, it is desirable here to use sports celebrities due to their professionalism and trustworthiness in view of the supported product, which relates to the professionalism of the particular sports celebrity. On the other side of the continuum, the consumer is much less involved in the purchasing of products and perceives it in its wholeness and integrity. The customer is interested in the symbolic properties of the product and selects the product rather emotionally. In this case, it is not important whether or not the product relates to the sports celebrity's professionalism but the attractiveness of the sports celebrity matters more.

As the authors have already mentioned in the introduction, the work and overall research is focused on the young generation of consumers, which in current marketing is referred to as *Generation Y*. This label stems from the generational typology of consumers where the affiliation to a generation of people born in a certain time period is the main segmentation criteria.

Generation Y is a target group with huge economic potential. Nowadays, companies spend large amounts of money on marketing support involving celebrities. The mutual interconnection of these factors leads to the question of whether the use of celebrities in marketing communication aimed at Generation Y has an effect. Morton (2002) states that celebrities and sports celebrities have the greatest effect on Generation Y, and their impact is even greater than advertising. However, it remains questionable when a celebrity is used in advertising. Van Den Bergh, Behrer (2012) describe this strategy as problematic, since young people are very critical of it. They state literally:

> From their point of view, support from a celebrity means that the brand does not have enough awareness to have its own images, and they interpret this as a weakness of the brand. This shows that the brand does not have an actual personality, and it must buy a cool image for itself using cool persons. Therefore, celebrity endorsement pays off only under certain circumstances, such as when the segment of a product is associated with the natural environment and skills of a particular celebrity. When sports celebrities like Michael Jordan and Tiger Woods are the actual faces of the Nike brand. (Van Den Bergh, Behrer, 2012, p. 124)

They cite the condition of the already mentioned match-up effect. An interesting finding among Chinese members of Generation Y (Chan, Ng, Luk, 2013) is the fact that they expect a celebrity to be able to refuse an offer for support of a brand or product that would not fulfill the level of their image, quality and performance. It illustrates differing perceptions of this form of marketing communication among various groups of young people.

Bush, Martin, Bush (2004) discovered in their study that sports celebrities have a strong positive influence among Generation Y in the USA on the positive word-of-mouth communication and brand loyalty. However, the effect on product or brand switching and complaint behavior has not been proved. These authors' study was later repeated by Dix, Phau, Pougnet (2010) who confirmed the positive effects on the word-of-mouth communication and brand loyalty. In the Australian young generation,

sports celebrities have a significant effect also on brand switching and complaint behavior. The result of these studies shows the expectation that the use of a sports celebrity can influence young consumers when they choose a product, may influence their tendency to speak positively about these brands and may seek recourse for their dissatisfaction with a product directly with the particular brand instead of boycotting it.

RESEARCH AIM

The main objective of this research is to determine what effect if any the use of sports celebrities in companies' marketing communications as reference groups has on the purchasing preferences of Generation Y.

METHODS

For the research, the authors selected both quantitative and qualitative methods. For quantitative survey, they used questionnaires. For qualitative research, they used group discussions.

Research question
Does the use of sports celebrities as opinion leaders in marketing communication have a positive effect on the consumer preferences of members of Generation Y?

Research sample
The basic research sample is formed by part of Prague's population of Generation Y members. Even despite the definitive lack of a clear definition of this generation, the authors selected, for the purposes of the research, students who attend educational institutions in Prague in person between the ages of 15 and 28. The authors selected the educational institutions with the help of available selections from a preprepared database. Cooperation with the specified educational institutions is used for questioning groups in the 15 to 19 age range (secondary school students) and the 20 to 28 age range (university students). Within these institutions, the authors selected whole classes of respondents (students) using the technique of suitable opportunity (availability). For each selected level of educational institutions, the authors selected three of them (3 secondary schools, 3 universities).

When determining the size of the sample for the questionnaire-based survey, the authors looked at a combination of multiple approaches (Kozel, Mynářová, Svobodová, 2011; Andrew, Pedersen, McEvoy, 2011) and studies conducted with the use of the questionnaire (Bush, Martin, Bush, 2004; Dix, Phau, Pougnet, 2010). The resulting size of the sample for the conducted questionnaire-based survey was 416 respondents.

The selection of respondents for the group discussion is based on the technique of suitable opportunity (or availability). The total number of respondents within the scope of group discussions is 41, specifically 27 men and 14 women. The structure of the group discussions is derived from the defined operationalization of the problem examined. For basic dimensions, the authors added comments and discussions regarding feelings, stances, opinions, reactions, and changes in buying preferences when sports celebrities were used in companies' marketing communication.

Table 1 Structure of respondents

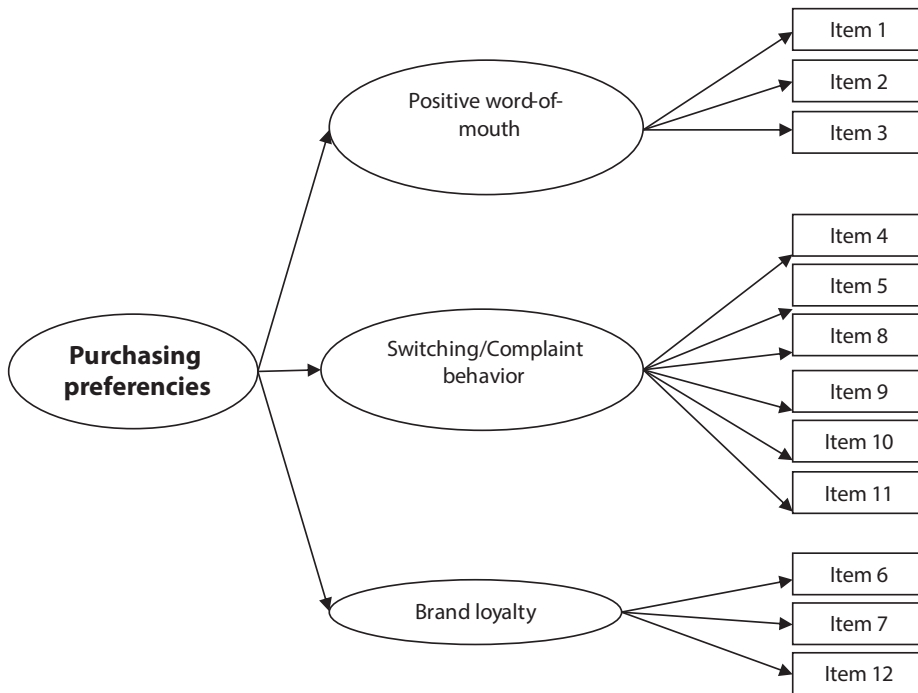| Criterion	Variants	Absolute size	Relative size (%)
	Male	205	49.28
Gender	Female	211	50.72
	Total	416	100
	Secondary school	280	67.31
Educational institution	University	136	32.69
	Total	416	100
	Prague	265	63.70
Residence	Outside of Prague	151	36.30
	Total	416	100

Figure 1 Defined operationalization of the problem examined. Source: Own processing according to Bush, Martin, Bush (2004, p. 112)

Questionnaire survey

The used questionnaire contains a series of claims, which respondents evaluate using a 7-point "strongly disagree" to "strongly agree" continuum (Likert scale). The original version of the standardized questionnaire of the specified American research by authors Bush, Martin, Bush (2004) is the sample for the questionnaire. The authors selected the model, since it was used successfully in two research studies that brought relevant results to the examined problem (Bush, Martin, Bush, 2004; Dix, Phau, Pougnet, 2010). For clarity, figure 1 shows the used structural model as the defined operationalization of the problem examined. All items are presented in the Appendix.

Like in the case of the original two research studies on this topic (Bush, Martin, Bush, 2004; Dix, Phau, Pougnet, 2010), the authors used a confirmative approach and, thus, the use of the confirmatory factor analysis. The confirmatory factor analysis here uses the Structural equation modeling (SEM).

The authors tested the model with the help of Mplus in two variants. The first variant shows data of ordinal character to which the use of an evaluation scale corresponds (hereinafter M1). The second variant shows (in view of the details of the evaluation scale) data of a continual (interval-based) character (hereinafter M2). The model has been tested in 3-factor form based on the specified operationalization. Table 2 shows the resulting values of fit indexes of the two tested models, including required values for the model acceptance.

Table 2 Fit indexes

Model	X^2	Number of degrees of freedom	CFI	TLI	RMSEA	WRMR/SRMR
M1	770.336	51	0.841	0.794	0.184	2.126
M2	501.749	51	0.750	0.676	0.146	0.094
FIT – ord.	as small as possible with the highest as possible number of degrees of freedom		> 0.95	> 0.95	< 0.08	< 1
FIT – int.			> 0.95	> 0.95	< 0.08	< 0.05

The specified values of the fit indexes indicate the inability to accept the used model in the form in which it is tested. Even though the value of the Chi-squared using M2 has decreased, not one of the fit indexes reaches the required values specified in table 2. For M2, although the values of the indexes are closer to the required values, and this seems to be more advantageous, it is still not possible to consider the used model to be a well fitting one. During closer examination of the results of the structural equation modeling, the authors assessed the standardized parameter estimates of individual items in view of the measured dimensions of the model. These standardized parameter estimates are specified in table 3.

Table 3 Standardized parameter estimates of individual items

Item	Factor – M1			Factor – M2		
	WOM	SWITCH/COMP	LOYA	WOM	SWITCH/COMP	LOYA
Item 1	0.847			0.824		
Item 2	0.846			0.828		
Item 3	0.791			0.699		
Item 4		0.864			0.718	
Item 5		0.114			0.056	
Item 6			0.798			0.736
Item 7			0.775			0.684
Item 8		0.231			0.144	
Item 9		0.444			0.316	
Item 10		0.590			0.437	
Item 11		0.436			0.332	
Item 12			0.764			0.700

During assessment of standardized parameter estimates, it is apparent that the dimensions of positive W-O-M and brand loyalty are adequately measured by the selected indicators. The standardized parameter estimates range from 0.764 to 0.847 for M1 and from 0.684 to 0.828 for M2. These particular items significantly indicate latent factors based on the model used. In this respect, the SWITCH/COMP dimension is significantly problematic. Items 5 and 8 report very weak standardized parameter estimates for both variants of the model. Items 9, 10 and 11 report medium strong standardized parameter estimates and only item 4 strongly measures the particular latent factor. It is just this dissimilarity which indicates insufficiency in measuring the model's fit. Table 4 also shows the standardized parameter estimates during analysis of a higher level, both for M1 and M2. It is apparent from the values that the SWITCH/COMP dimension reports major differences in values between the measured models.

Table 4 Standardized parameter estimates of model dimensions

Model M1			
	Purchasing preferences	WOM	SWITCH/COMP
WOM	0.94		
SWITCH/COMP	0.76	0.72	
LOYA	0.95	0.89	0.72
Model M2			
	Purchasing preferences	WOM	SWITCH/COMP
WOM	0.9		
SWITCH/COMP	0.9	0.74	
LOYA	0.98	0.85	0.79

RESULTS

Positive word-of-mouth

The results show that the use of sports celebrities in marketing communication has a small effect on the examined sample. Respondents do not have a tendency to spread or disclose information or to talk with others about products or brands that are supported by sports celebrities.

Like in the case of item 1, item 2 also indicates that the effect of sports celebrity endorsements is small, at least according to the specified results. Therefore, it can be expected that if anyone asks for assistance, advice or a recommendation for a brand or product from a member of Generation Y that member will not primarily recommend products or brands that are endorsed by sports celebrities. In addition, that Generation Y member when making recommendations will prioritize and take into consideration other aspects (such as experience, price, quality, etc.) rather than sports celebrity endorsement.

Persuasion within mutual communication between the member of Generation Y and his/her other relatives or friends is not common for the examined sample, as far as products or brands endorsed by sports celebrities are concerned. The persuasion function therefore remains in companies' own communication tools and elements.

It is apparent from group discussions that, in the case of spontaneous communication between members of Generation Y, the use of sports celebrities in marketing communication of companies does not have a significant effect. In a situation when respondents are asked for advice from someone during selection of a product or brand, the respondents positively orient themselves according to their own experience and satisfaction with the particular product or brand. Whether or not the product is endorsed by a sports celebrity is unimportant. However, six respondents across all of the discussion groups admit the influence of sports celebrities in the case of these athletes' own brands. As far as persuasion of other individuals is concerned, respondents positively reject any effect of a sports celebrity endorsement. Persuasion then always depends on the recommender's own satisfaction with a product or brand.

Switching/Complaint Behavior

The use of sports celebrities in marketing does not dissuade respondents too much from purchasing other companies' products or brands. A total of 63.94% of respondents provided disagreeing responses to this statement as compared to only 19.48% who provided agreeing responses to it; the remaining respondents were neutral in their responses. This means that only every fifth respondent admits the influence of sports celebrity endorsement in refusing to purchase a product from a different company without such celebrity support.

Item 5 reveals the potential fundamental factor influencing purchasing preferences of the young generation of consumers. That factor is the price. The most responses were neutral (23.80%). 44.23% of respondents provided one of the agreeing response variants, while only 31.98% gave disagreeing responses. The variability of responses is quite considerable; that is why no clear conclusion can be deduced from these results.

A total of 46.16% of respondents said they agreed with the presented claim that if dissatisfied with a product of a particular brand they would switch to the competition

regardless of whether or not the original product or brand is endorsed by a sports celebrity. However, the percentage of respondents who said that even despite dissatisfaction they would not switch to a competing brand, 37.02%, is not insignificant. It shows lucrative potential for companies using sports celebrities.

The Generation Y members addressed in the survey do not have a tendency to dissuade other customers if they are dissatisfied from a brand endorsed by a sports celebrity. The fact that social media nowadays enable these individuals to communicate quickly and to a large audience would otherwise represent a major threat of loss of customers.

Most of the respondents regarded as a last resort the option of contacting an external institution involved in consumer protection, business inspection authorities, etc. in the event of dissatisfaction with a product or brand. The results reflect this. Only 9.62% of respondents said they were more or less likely to contact one of these institutions.

Whether, in the case of dissatisfaction with a product or brand, respondents would contact the company itself or its employees, is a desirable response from a customer for companies. This gives the company feedback with which it can continue to work and strive to increase customer satisfaction with a product. It cannot be clearly stated whether this would be significantly aided by a sports celebrity endorsement, as the results show. A total of 56.97% of respondents gave a response in the disagreeing range of the evaluation scale. On the contrary, 28.85% gave an agreeing response, and although that is not an insignificant amount of respondents, there is still an apparent disagreeing tendency of responses. For companies using sports celebrities in marketing, the results indicate that in this case a certain effect can be achieved at least among some of the individual members of Generation Y addressed in the survey. Each piece of feedback from a customer brings valuable information for the company and will help it with constant improvement of the quality of its products as well as customer satisfaction.

Like in the questionnaire-based survey, in the group discussions as well, the price seems to be a more important factor than a sports celebrity endorsement. Respondents from a secondary school (discussion groups 1 and 2) also mention major limits in their purchasing expenditure and budget. Therefore, they would prefer to choose a less expensive product with comparable quality. It has also been shown that a sports celebrity endorsement itself gives an impression of a certain level of product quality. It is just this expected product quality combined with the price that creates a decisive element during selection of a particular brand of product.

In the case of respondents' dissatisfaction with a product of a certain brand, reactions in purchasing behavior are quite varied; however, they lead to switching to a competitor's brand in most instances. Feedback given directly to employees of a particular company is not exploited, except for standard complaints. Contacting institutions involved in consumer defense and protection, business inspection authorities, etc. is not exploited either. Overall, the respondents exclude the effect of a sports celebrity endorsement on a change of exploited responses when expressing dissatisfaction with a product or brand.

Brand Loyalty

The results show that the price is a very important factor for respondents. A total of 66.34 % of respondents gave a response in the disagreeing range of the evaluation scale. This means that the effect of the exploitation of a sports celebrity for support of a brand or product is less significant than focus on the price of a product for nearly two thirds of individuals from the research sample. The increase in price is compensated by a sports celebrity endorsement for 18.03% of respondents only. The importance of the price for respondents corresponds to the typical price sensitivity of a Czech consumer. For individuals from Generation Y, it can be assumed that this characteristic will not change significantly, at least based on the information obtained from the responses. The use of sports celebrities for marketing support in this case is effective if it does not in any way significantly increase the price of a product compared to the competition. A famous athlete will then represent added value and a competitive advantage for the company.

However, it is necessary to point out the fact that for 19.71% of respondents, a famous sports celebrity endorser represents a significant added value, which will retain the particular customer with a brand even despite less expensive competition. Sports celebrities used in marketing therefore do not have a major effect within the sample of respondents on greater brand loyalty; however, the opposite is true for a part of them.

A total of 42.79% of respondents said they would not be motivated by a sports celebrity's endorsement to buy a certain brand. However, 37.02 % of respondents admit that such an effect would have influenced them. The remaining 20.19% gave a neutral response (value 4), which was also the most frequent value.

Table 5 Conducted and original research averages comparison

Item	Research n = 416		Bush, Martin, Bush (2004) n = 218	
	Men n = 205	Women n = 211	Men n = 118	Women n = 100
Item 1	3.3951	3.1659	3.96	4.81
Item 2	3.4439	3.0853	3.80	4.59
Item 3	2.6732	2.3270	3.26	5.07
Item 4	2.9902	3.0379	3.53	3.45
Item 5	4.0634	4.2654	3.73	3.64
Item 6	3.0878	2.7536	3.45	3.63
Item 7	2.9366	2.4502	3.18	3.45
Item 8	4.1854	4.0900	3.56	3.69
Item 9	3.2878	3.1327	3.20	3.29
Item 10	2.1073	1.9573	3.19	3.15
Item 11	3.4293	3.1706	3.33	3.42
Item 12	3.9561	3.6825	4.02	4.75

It is apparent from the group discussions that within the scope of brand loyalty, respondents agree on the primary influence of a combination of price and satisfaction with a product or brand. A sports celebrity endorsement is only an added value for them but does not have as much of an effect as the specified satisfaction/price combination. Nonetheless, at least when a particular type of product is first purchased, there is a willingness to pay a higher price for a product promoted and presented by a sports celebrity among 18 of the 41 total respondents across all discussion groups.

Other effects

Within the scope of other effects, the respondents state that the use of a sports celebrity endorsement significantly increases the attractiveness of a used communication message particularly in tools such as advertising and PR. Communication messages are conveyed by a known real celebrity with sports success, rather than an anonymous actor or individual only. Such marketing communication can be decisive during selection of a product when a first purchase is made.

Another factor that respondents perceive when using a sports celebrity endorsement is the consideration of whether the particular sports celebrity has anything to do with the supported product or brand. In this case, the respondents thus assess the *match-up* effect, as mentioned in the theoretical part of this work.

The results of group discussions to a great extent are confirmed by the data obtained from the questionnaire-based surveys, despite the results from the confirmatory factor analysis of the Bush-Martin-Bush model used.

DISCUSSION AND IMPLICATIONS

For the questionnaire survey as a diagnostic tool, the authors used a questionnaire which originated from studies of authors Bush, Martin, Bush (2004) and Dix, Phau, Pougnet (2010). Both original studies proved good usability of the questionnaire, particularly with respect to a quality structural model. In their case, the fit indexes of the measured models reported values representing good fit models. The model of purchasing preferences contains three dimensions: positive word-of-mouth; brand/product switching and complaint behavior; brand loyalty.

Testing of the structural model in our case points to unsatisfactory values of fit indexes of both variants of models: ordinal data and the considered interval data. During detailed examination, items 5 and 8 seem the most problematic. The authors refuse exclusion of these items, due to the need to maintain content validity of the questionnaire. For any future research, it will therefore be necessary to reformulate the claims and, if need be, to reverse the significance of the evaluation scale so that the agreeing part supports the positive effect of exploiting sport celebrities for a given reaction. In the original research (Bush, Martin, Bush, 2004), there are no problematic items, and the standardized parameter estimates of all items range from 0.75 to 0.93. Within the scope of this research, the standardized parameter estimates range from 0.114 to 0.864 (in the case of ordinal data) and 0.056 to 0.828 (in the case of interval data). The values of standardized parameter estimates are then fully reflected in the values of fit model indexes.

For further use of the questionnaire, it is necessary to make major changes to the structural model itself, particularly to the dimensions related to the brand/product switching and complaint behavior. It seems to make more sense from the authors' point of view to use the original Zeithaml-Berry-Parasuraman model (Zeithaml, Berry, Parasuraman, 1996), or eventual use of the modified five-dimensional Zeithaml-Berry-Parasuraman model (Zeithaml, Berry, Parasuraman, 1996).

The specified results from the questionnaire-based surveys cannot be considered representative, since the selection of respondents is realized based on the principle of availability. Therefore, it does not involve a representative technique for selection of respondents. Even so, the results bring valuable information about marketing communication and its tools, such as sports celebrity endorsement. The sample of the questionnaire-based survey contains 416 respondents, which is a satisfactory number for marketing research.

The results and interpretation of data from questionnaire surveys indicate that, compared to research conducted in the USA (Bush, Martin, Bush, 2004) and Australia (Dix, Phau, Pougnet, 2010), the sample of respondents from Prague's secondary schools and universities differs. Therefore, the results do not support the examined effect. A large number of respondents reject the effect of sports celebrities in marketing communication of companies on their purchasing preferences, namely for all three dimensions. However, the American respondents admit and confirm the examined effect of positive word-of-mouth and brand loyalty. The Australian respondents confirm the effect also in relation to the brand/product switching and complaint behavior. Both studies show that purchasing preferences of women from Generation Y are more influenced by the effect of using sports celebrities than those of men. However, this research also shows a tendency for women to be even less influenced by the examined effect than men.

So the quantitative part of the research supports authors Alnawas (2010), Koernig, Boyd (2009), Lafferty, Goldsmith (1999) but on the contrary does not agree with the results of studies by authors Bush, Martin, Bush (2004), Dix, Phau, Pougnet (2010), Shuart (2007), Pringle (2004), Kaser, Oelkers (2005). In particular, there is an interesting conflict with real case studies to which an entire publication by author Pringle (2004) is devoted and further with many other Internet sources monitoring the market environment of sports, such as SportsRevolution (online, 2016), Yutang Sports (online, 2015), SportTechie (online, 2016), SportBiz (online, 2011–2014), and the general marketing environment (including sports), such as Forbes (online, 2016), Marketing Week (online, 2016), The Drum (online, 2016), etc. Companies are investing large amounts into cooperation with sports celebrities. This will clearly bring about certain benefits for companies from the sale of products.

However, group discussions bring additional results, though without the ability to generalize in relation to the entire basic sample. Groups are selected based on their availability and include a total of 41 respondents representing the qualitative part of the research. The combination of the brand/product with a sports celebrity is seen as a guarantee of product quality, which is confirmed by author Čáslavová (2009). Other respondents state preferences supported by the brand during the first purchase of the product and its first try out, even despite the higher price of such product. A similar effect is described by authors Chan, Ng, Luk (2013) in their study.

The respondents in group discussions also mention other effects, which are not directly related to purchasing preferences but which can also influence them indirectly. The clear increase in the attractiveness of the communication message, which can increase the tendency to buy a endorsed product when a first purchase is made, is one such effects. Increasing of the attractiveness of the communication message is specified mainly by authors Martin (1996), Sliburyte (2009) and Ranjbarian, Shekarchiza-de, Momeni (2010). The perception of the *match-up* effect, when respondents assess whether a sports celebrity has anything to do with the particular product besides just marketing endorsement, is the second mentioned effect. This effect is pointed out by authors Alnawas (2010) and Sliburyte (2009). At the conclusion of the discussion, it is necessary to answer the defined research question:

Does the use of sports celebrities as opinion leaders in marketing communication have a positive effect on the consumer preferences of members of Generation Y in Prague?

Based on the results of quantitative and qualitative parts of the research, it can be stated that for positive word-of-mouth the use of sports celebrities in marketing communication does not have the desired positive (or even a negative) effect. A relevant effect is also neither demonstrated nor proven in relation to the brand/product switching and complaint behavior.

Brand loyalty of approximately 20% of respondents in the questionnaire-based survey is influenced by the examined effect. The group discussions then show that marketing endorsement by a sports celebrity is used or perceived particularly for quality products with a greater likelihood of customer satisfaction and subsequent brand loyalty. Furthermore, a sports celebrity can support a tendency to try out a product or for a first purchase thanks to awareness and attractiveness of the communicated message. The first purchase or try-out in combination with satisfaction with the perceived quality of a product can lead to customer loyalty. Therefore, the examined effect can be confirmed but it is just indirect.

CONCLUSION

The use of sports celebrities in marketing communication of companies nowadays is already the standard tool of many brands from the most prestigious and most valuable to less valuable ones. Companies invest large sums of money into cooperation with famous and successful sports celebrities. The practical use of the discovered findings can be in the form of base materials for creation of a communication strategy of companies whose target group (or one of whose target groups) is Generation Y. Use of sports celebrities in marketing communication is often a very expensive business. The effects stemming from such cooperation can be summarized based on the results of research as follows:

- increased awareness of a product/brand,
- increased attractiveness of a communicated message,
- increased awareness of a communicated message,
- support for trying out a product/brand,
- support during an initial purchase of a product/brand,
- an indirect increase in brand loyalty, assuming that there is adequate product quality,
- reduction of price sensitivity during the first purchase or try-out of a product.

If companies have these effects as the goals of their marketing communication and have enough funds to invest in a suited sports celebrity, then it is an effective tool. However, the combination of the price and perceived quality or satisfaction with the product still remains in first place. If this is supplemented by an attractive marketing communication embodying a well known sports celebrity, it becomes an important competitive advantage in the current highly competitive market environment.

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APPENDIX

Measures of Constructs

The opinions of my favorite athlete influence me to ...

1. say positive things about products or brands to other people.
2. recommend products or brands to someone who seeks my advice.
3. encourage friends or relatives to buy certain products or brands.
4. buy fewer products from certain companies.
5. take some of my purchases to other businesses that offer better prices.
6. continue to do business with a certain company even if it increases its prices.
7. pay more for products at one business even though I could buy them cheaper elsewhere.
8. switch to a competitor if I experience a problem with a company's service.
9. complain to other customers if I experience a problem with a company's service.
10. complain to an external institution involved in consumer protection, business inspection authorities, etc., if I experience problems with a company's service.
11. complain to a company's employees if I see a problem with that company's service.
12. buy certain brands.