



No Pain, No Gain? Prevalence, Location, Context, and Coping Strategies with Regard to Pain Among Young German Elite Basketball Players

by

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Pain among young athletes requires special attention given that symptoms occur during the ongoing development of the conditional, and in particular, the motor capacities, and while the musculoskeletal system is in a continuous process of growth. The purpose of this study was to evaluate prevalence, location, context, and coping strategies regarding pain among young athletes. We chose survey data of young elite athletes from the highest level national basketball leagues in Germany, as this meant that health implications may be observed earlier and in a more pronounced manner. The German 'Adolescents' and Children's Health in Elite Basketball study' (ACHE study), a quantitative survey, was conducted between April and June 2016. Analyses were based on elite basketball players between 13 and 19 years of age from 46 German teams (n = 182). Constant, and to some extent severe pain, was part of daily life of young elite basketball players: eight out of ten players in the highest German leagues suffered from pain at the time of the survey. Knee, leg, and back pain occurred most frequently. For most players, occasional or frequent consumption of analgesics was the norm, in some cases these were also taken "prophylactically". The consumption of multiple pharmaceutical substances, especially of cyclooxygenase inhibitors such as ibuprofen and diclofenac, is widespread among adolescent elite basketball players. Physicians involved in treating these athletes should address pain and its management preemptively. Coaches, sporting organizations and parents should be involved in this process from an early stage.

Key words: pain, athletes, adolescent, analgesics, basketball.

Introduction

Basketball is not only one of the most popular sports in the world, but it is also one of the most demanding sports with regard to the many complex skills involved. The International Olympic Committee lists basketball among those sports that pose a particularly high risk to health and have a high risk of injury (McKeag, 2003). This sport is popular among the youth in

particular. In Germany, almost every gym is equipped with a basketball hoop and public spaces boast countless basketball courts. The German Basketball Federation (DBB) currently has over 200,000 members (203,028 2017, Deutscher Basketball Bund, 2018). The youth division of the DBB is traditionally organized into regional leagues. At the highest level in the country, the best teams compete in three national

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leagues in the German championships. These categories are: male under-16s (U16) in the Youth Basketball League (JBBL), male under-19s (U19) in the Junior Basketball League (NBBL) and female under-17s (U17) in the Female Junior Basketball League (WNBL). As an increasing number of young players achieve very high performance levels and growing numbers of both players and spectators are being reported in the elite leagues, from a medical, scientific, and ethical point of view, it seems necessary to take a look at the health of these athletes.

In principle, physical exercise has numerous positive effects on the body (Neufer et al., 2015; Pate et al., 1995). In addition to the classic effects of training on physical condition (strength, speed, endurance, mobility and coordination including improved motor control and abilities; Foran and Pound, 2007; McKeag, 2008), other effects such as increased pain tolerance and a rise in sensitivity thresholds can also be observed (so-called 'exercise-induced hypoalgesia'; Koltyn, 2002).

Training that is too intense or carried out improperly or the use of incorrect techniques can lead to unphysiological strains and cancel out any positive effects on the perception of pain. In this case, pain can be an early indicator of a strain, as well as a result of or a predictor for tissue damage, micro-trauma, and consecutive injuries (Oliveira et al., 2017). The prevalence of pain among young athletes requires particular attention considering that discomfort occurs during the ongoing development of the conditional, and in particular, the motor capacities, and while the skeletal system is in a continuous process of growth (Oliveira et al., 2017). There is a range of potential consequences for youth athletes: with open growth plates, inappropriate physical strain can lead to deformities such as genu valgum ('knock-knees') or a femoroacetabular impingement (hip impingement) caused by bony outgrowths. These risks are particularly high in basketball, where the typical dynamics of the sport with swift directional changes, lateral movements, and explosive jumps put a lot of strain on the legs in particular. With respect to youth basketball players who spend many years training at high intensity, various issues have been detected, such as bone changes, including a cam-deformity at the

head-neck junction of the proximal femur (caused by bony protrusions resulting from stress on the growth plate, which can lead to restricted mobility; Siebenrock et al., 2011).

The particular relevance of pain among youth athletes in general is, however, not reflected in internationally available literature. While studies have investigated the incidence of sport injuries in adults and there are a growing number of studies looking at children and adolescents, nevertheless, there is still criticism of a worldwide deficit of studies on pain, both among adults and among youth athletes in particular (Jonasson et al., 2011; Kamper et al., 2016).

Notably, there are no studies available from the field of basketball to consider pain among youth athletes simultaneously in several localizations. Nevertheless, it is well-known that basketball injuries are typically concentrated on the lower extremities, as demonstrated in American or Brazilian basketball players (Borowski et al., 2008; Deitch et al., 2006; Vanderlei et al., 2013; Zelisko et al., 1982). Also among youth basketball players the most common injury is a strain or sprain of the ankle, followed by the knee (Dick et al., 2007; Randazzo et al., 2010). Specific pain studies available on adolescent basketball players are limited to individual localizations of pain. An American study on adolescent basketball players of varying performance levels exclusively examined anterior knee pain and found point prevalence of 25% (Foss et al., 2014). A study of 58 Brazilian youth basketball players illustrated 12 month prevalence of 47% for shoulder pain (Oliveira et al., 2017). In addition to this, a study from Germany was recently published that exclusively examined back pain. However, this study only included adult players. With regard to the 7-day and 12-month prevalence rates, the 21 elite basketball players reported rates of 91% and 67% respectively (Fett et al., 2017). Overall, it can therefore be seen that within the few available studies on the occurrence of pain in youth basketball, comparatively high prevalence rates were reported, which speaks in favor of a comprehensive investigation of this phenomenon.

Given this gap in research, the purpose of this study was to evaluate the prevalence, location, context, and coping strategies with regard to pain among youth elite basketball

players. To this end, we worked with the following research questions: in which parts of the body does pain occur most frequently and most intensely, which localizations are frequently affected together, can gender differences be observed with regard to pain and, finally, to what extent do athletes self-medicate to manage their pain.

For our sample, we chose young athletes from the three highest national basketball leagues in Germany, considering that, at this level, not only is high performance a factor, but physical and psychological strain also increases. Compared with amateur and recreational adolescent players, these young elite athletes are exposed to sport-specific strains, training methods, and overall conditions, earlier and more vigorously, so that resulting health implications can, in turn, be observed earlier and in a more pronounced manner.

Methods

Design and participants

Within the scope of the Adolescents' and Children's Health in Elite Basketball study (ACHE), conducted between April 2016 and June 2016, young elite basketball players from the three elite youth leagues in Germany (NBBL, JBBL and WNBL) were interviewed about their health, experiences of pain, consumption of medications, and social environment. For this purpose, the team officials responsible for these three leagues were contacted and informed about the study. The players were then informed about the independent study via an online link and invited to take part. Informed consent was obtained from all participating basketball players (or from their legal guardians when minors were concerned) and the rights of the subjects were protected. The study was carried out in accordance with the current version of the Declaration of Helsinki. The ethics committee of the ATOS clinics in Heidelberg, Germany, approved the study (AZ 4/16).

Measures

The ACHE study was conducted as an online survey with the help of a standardized questionnaire and the use of the SoSci software package. Question and item sets from a previously validated and tested questionnaire, a nationwide survey of professional junior athletes

from 51 Olympic disciplines (GOAL study; Thiel et al., 2011), were used where possible. The ACHE study's questionnaire was amended to include basketball-specific questions. An expert review and a traditional pre-test at a boarding school for basketball (Langen, Germany; $n = 22$) were also conducted.

Operationalization of the prevalence of pain

The survey targeted 15 pain regions, recording 7-day and 12-month prevalence. For example, the 7-day prevalence of shoulder pain was surveyed by means of the dummy variable: "Have you experienced pain in your shoulder over the last 7 days?" with the response categories "Yes" (1) and "No" (0). Operationalization was guided by ICD-10. The localization of currently dominant pain was also assessed. Here, each athlete was additionally required to indicate the subjective intensity of the pain using an 11-point numeric scale, based on the question (Fett et al., 2017) "How severe was this pain on a scale from 0 (no pain) to 10 (maximum imaginable pain)?" Each athlete was further asked whether they were currently fit to play or whether they could not engage in sport because of illness or injury.

Operationalization of medication

Junior athletes also provided details about their current use of medication. The questionnaire allowed for differentiation between types of analgesics (ibuprofen, diclofenac, acetylsalicylic acid, paracetamol and tramadol), complemented by questions concerning sedatives, anxiolytics, antipsychotics, benzodiazepines, and anti-depressants. Based on the aforementioned GOAL study, the ordinal scale ranged from: "I do not recognize this medication" to "I recognize this medication and never take it", "(...) and I rarely take it", to "(...) and I sometimes take it", "(...) and I take it often", and "(...) and I take it very often". The last four categories were defined as "at least occasional consumption" and the last three categories were defined as "frequent consumption", respectively. The detailed collection of data on a range of medicinal substances also made it possible to produce an account of the quantity of analgesics that were often consumed concurrently ("Consumption of analgesics in combination").

The ACHE study also yielded individual data on the context of the consumption of medicinal substances. The adolescent athletes

provided details about whether they commonly consumed medication in the absence of discomfort and whether they took analgesics in the absence of specific pain, i.e. "prophylactically". The medical context of the consumption of medication as well as the following aspects of the social environment, were recorded using field-tested sets of questions from the GOAL study.

Operationalization of sociodemographic characteristics

Alongside age and sex of the athletes, information was also obtained about the school they attended. This, for one, made it possible to see whether the athlete was attending a school providing the highest level of qualification (e.g. a "Gymnasium") or another type of school, and also whether the school specialized in sports (e.g. a sports boarding school). Basketball players rated in the top four cadre levels were defined as "cadre athletes". Finally, the athletes specified their living situation and any career in competitive sports on the part of their parents or siblings.

Statistical analysis

The ACHE study was evaluated using traditional descriptive and inferential statistics. Bivariate associations were examined using χ^2 tests. Significant bivariate determinants of analgesic consumption were included in a multiple linear regression analysis. Each analysis was carried out with the assistance of IBM's software program, SPSS Statistics 24.0.0 (IBM Corp., Armonk, USA). Each test was conducted in an explorative manner, using the significance threshold at the level of $p \leq 0.05$.

Results

In total, 182 junior competitive athletes from 46 teams took part in the ACHE study. The participants had an average age of 15.5 ± 1.3 (min: 13; max: 19) years and 70.9% of participants were male. The vast majority of basketball players attended a school that would allow them to enter higher education (80.4%). Most players still lived with their parents (90.7%). It was frequently reported that at least one parent or sibling was currently or had previously been a competitive athlete themselves (63.2%).

Eight out of ten junior athletes reported currently suffering from pain (7-day prevalence rate: 82.1%), with a higher proportion of female basketball players (94.1%) being affected

compared to male basketball players (77.3%; $p = 0.008$). On average, in the event of currently prevalent pain, three (3.04 [min: 1; max: 11]) localizations were specified; 21.8% of all junior athletes surveyed indicated one localization of acute pain, 20.7% indicated two, 16.8% indicated three, and 23.0% reported four or more. A differentiated analysis of the 7-day prevalence in afflicted localizations shows that knee and leg pain occurred most frequently, followed by back pain, headaches, and neck pain (Figure 1).

This pattern remained almost unchanged upon analysis of the one-year prevalence of pain. Three-quarters of all junior athletes suffered from knee and leg pain over the period. Headaches were the only item to occur even more frequently over the course of the past year (Figure 1). Significant sex-specific differences in the occurrence of pain, to the disadvantage of female athletes, were shown in back pain (49% vs. 28%), headaches (47 vs. 26%), neck pain (42 vs. 20%), shoulder pain (34 vs. 16%), and lower abdominal pain (20 vs. 2%; all $p < 0.05$).

Figure 2 illustrates that pain often occurred in multiple instances; these were defined as cases of acute pain being reported in two or more areas. The arrows in Figure 2 illustrate the cases in which this occurred more frequently and was also reported by more than 10% of the study participants. It is striking that these patterns of pain most notably occurred along the axis of the body (head, neck, back, legs). Furthermore, there was a significantly more frequent co-occurrence of shoulder pain with leg pain, and of back pain with leg pain (Figure 2).

As young competitive athletes frequently experience pain in multiple areas, it is worth considering the area in which the pain experienced is most severe. At the time of the survey, 1 in 4 elite young basketball players reported knee and leg pain, while 1 in 6 specified back pain as the most dominant pain (Figure 3); 16% mentioned headaches and 13% cited foot pain. Enquiries regarding the subjectively perceived level of pain, however, also indicated other localizations. Pain in the wrist, knuckle joints, hip joints, and the chest rarely occurred in our sample, but those athletes affected by these types of pain reported comparatively more severe pain (Figure 3).

Almost all of the young elite basketball

players consumed analgesics at least occasionally (84.1%) and 4 out of 10 (40.1%) took them frequently. The most popular pharmaceutical substances were ibuprofen and diclofenac. Two-thirds (65.9%) of all players took ibuprofen, 47.8% took diclofenac, 31.9% took paracetamol, 25.3% took acetylsalicylic acids, and 2.7% took tramadol at least occasionally. In terms of frequent consumption, diclofenac was indicated more often (21.4%) than ibuprofen (15.9%). The remaining

pharmaceutical substances i.e. paracetamol, acetylsalicylic acid, and tramadol were specified less frequently, if at all, in reference to frequent consumption (6.6%, 6.6%, and 0.0%). Furthermore, 13.2% of all young elite basketball players reported taking medication even in the absence of discomfort and 4.9% answered "Yes" to the question: "Do you take pain medication prophylactically in order to prevent pain?".

Table 1
Predictors for the average number of different kinds of analgesics frequently taken by adolescent elite basketball players of the highest German leagues.

| | Arithmetic mean (\pm standard deviation) | p | Regression coefficient [95% confidence interval] | p |
|--|---|-------------|--|------|
| Age | | | | |
| 17 years and over | 2.17 (\pm 1.098) | $\leq .001$ | .741 [0.234/1.247] | .004 |
| 16 years | 2.02 (\pm 1.031) | | .530 [0.067/0.994] | .025 |
| 15 years | 1.51 (\pm 1.184) | | .118 [-0.319/0.555] | .596 |
| 14 years and under | 1.35 (\pm 1.027) | | Reference category | |
| Sex | | | | |
| Female | 2.13 (\pm 0.921) | $\leq .001$ | .543 [0.180/0.905] | .004 |
| Male | 1.57 (\pm 1.164) | | Reference category | |
| Type of School | | | | |
| Higher educational level ("Gymnasium") | 1.81 (\pm 1.133) | .068 | | |
| Lower educational level | 1.41 (\pm 1.043) | | | |
| School specializing in a sport | | | | |
| Yes | 1.73 (\pm 1.018) | .974 | | |
| No | 1.74 (\pm 1.174) | | | |
| Performance level | | | | |
| Cadre athlete | 1.81 (\pm 1.241) | .546 | | |
| No cadre athlete | 1.70 (\pm 1.094) | | | |
| Housing situation | | | | |
| Boarding school or own apartment | 2.41 (\pm 0.795) | .009 | .541 [-0.042/1.124] | .069 |
| With one or both parents | 1.67 (\pm 1.133) | | Reference category | |
| Professional athlete parent or siblings | | | | |
| Yes | 1.67 (\pm 1.145) | .296 | | |
| No | 1.85 (\pm 1.091) | | | |
| Severe pain in the last 4 weeks | | | | |
| Yes | 1.84 (\pm 1.098) | .244 | .167 [-0.161/0.496] | .316 |
| No | 1.64 (\pm 1.141) | | Reference category | |
| Currently taking a break from sports because of illness or injury | | | | |
| Yes | 1.82 (\pm 1.357) | .645 | | |
| No | 1.72 (\pm 1.072) | | | |

Note: Frequent consumption included the categories "I sometimes take it", "I take it often", and "I take it very often". Bivariate χ^2 tests and multiple linear regression.

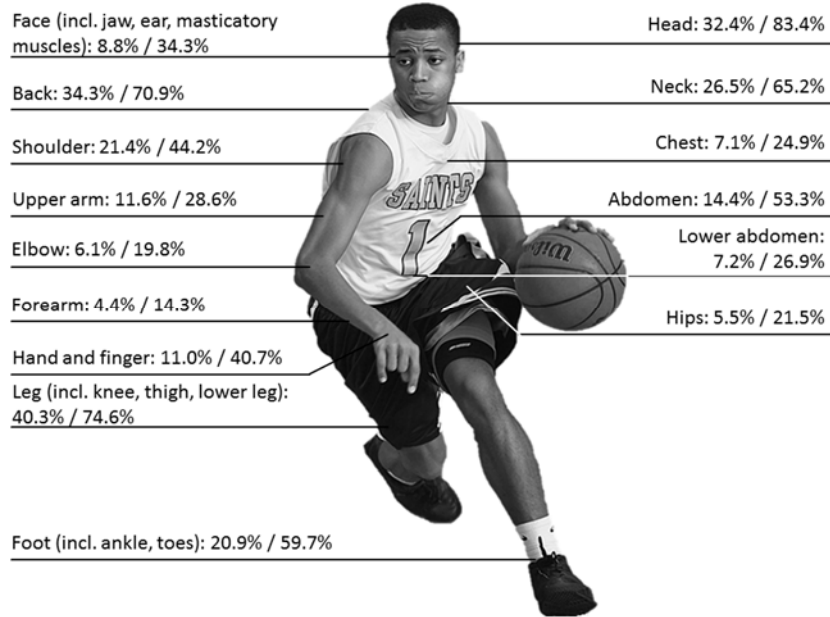


Figure 1

7-day and 12-month prevalence rates of pain in 15 localizations, among adolescent elite basketball players of the highest German leagues.

Note: Multiple responses possible. Data for both sexes; by way of illustration, a male player has been depicted.

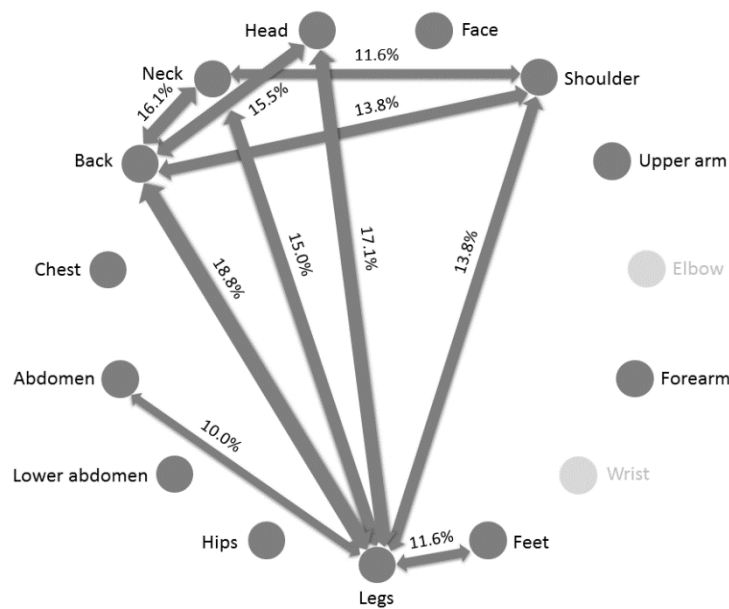
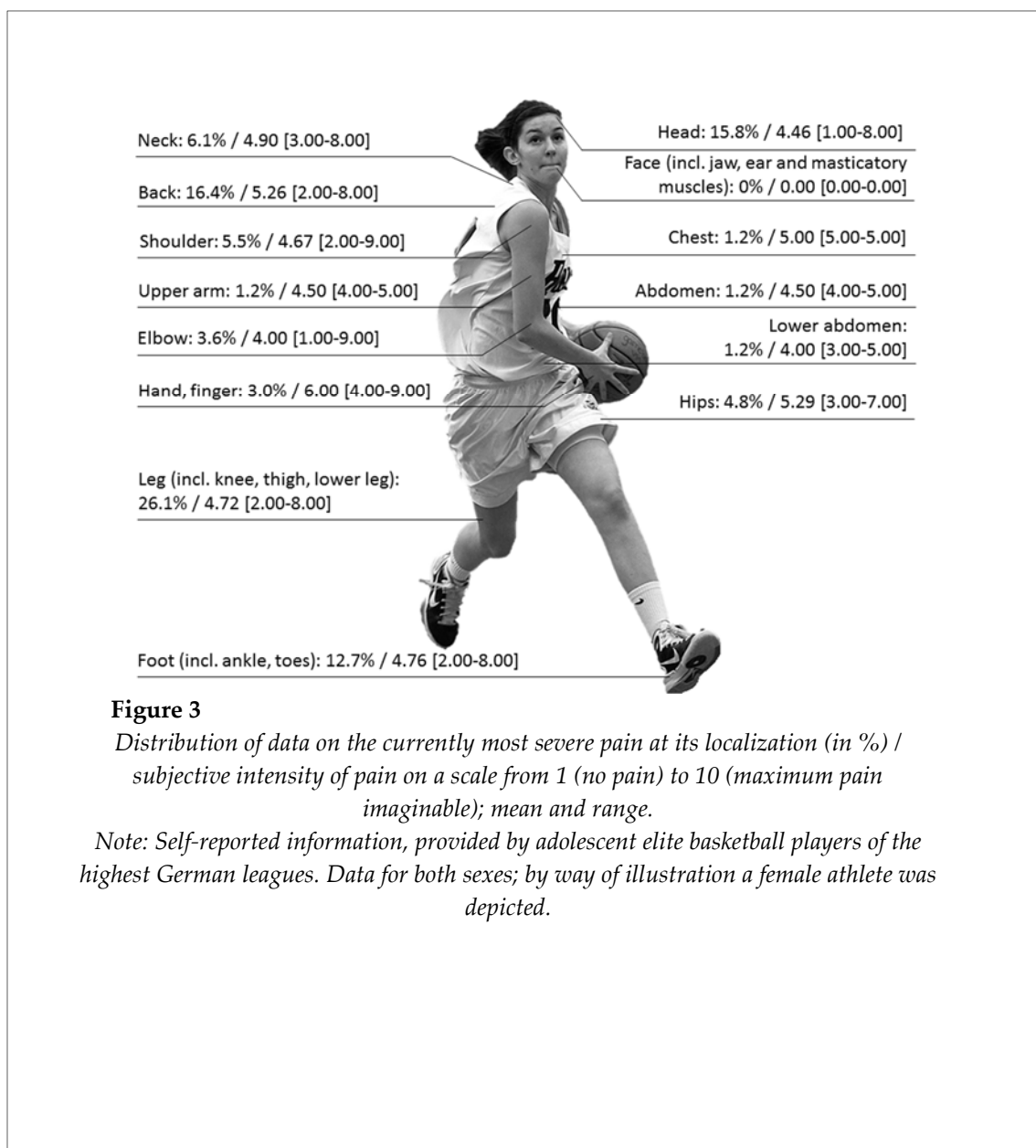


Figure 2

Localizations, in which pain was experienced simultaneously in the last 7 days.

Note: At the localizations marked with an arrow, pain was experienced by more than 10% of all participants in the last 7 days, and the frequency of this was significantly noticeable (χ^2 test; $p < 0.05$). The pain localizations highlighted in light gray (elbow and wrist) did not present simultaneous occurrence to any other localization.



Among the athletes who frequently used analgesics (40% of the overall sample), 2.07 types of medicinal substance [range: 1 - 5] were ingested on average. This resulted in an average of 1.74 medicinal substances [range: 0 - 5] across the whole group. The bivariate analysis of risk groups revealed particularly high consumption among older age groups, female athletes and athletes who no longer lived at home, but who instead lived at a sports boarding school or in their own apartment (Table 1). It is therefore possible to observe an association between the consumption of pain medication and the current status of pain, as well as the current status of injury and fitness.

Refining this bivariate analysis using a linear regression analysis did not change these results, even when adjusting for the current status of pain (Table 2).

Discussion

Key findings

Constant and, to some extent, severe pain is already part of daily life of young elite basketball players. Eight out of ten players in the highest German leagues reported suffering from pain at the time of the survey. Knee, leg and back pain occurred most frequently. Acute and multiple instances of pain, i.e. acute pain in

several localizations, were the norm. For most players, this was associated with the occasional or frequent consumption of analgesics, which were also taken “prophylactically” in some cases, according to the information provided. The consumption of several different medicinal substances, especially of cyclooxygenase inhibitors such as ibuprofen and diclofenac, was widespread among adolescent elite basketball players.

Integration into the current state of research

There are no comparative studies internationally and certainly not nationally, that consider pain among young athletes simultaneously in several localizations. However, individual studies have reported slightly different outcomes within similar sample groups:

Upon consideration of studies primarily concerned with adolescent athletes, an up-to-date overview of adolescents in various collectives for recreational sports reported a one-month prevalence rate between 20 and 40% for both musculoskeletal and back pain (Kamper et al., 2016). By comparison, significantly more of the adolescent elite athletes that we surveyed, were affected by musculoskeletal pain and back pain.

In addition to the small number of basketball-specific studies cited in the introduction, there are two studies on adult populations that are worth noting. Firstly, a Swedish study on adult competitive athletes detected consistently lower prevalence rates in the same localizations that were of interest here, than we found in adolescent competitive athletes. The only exceptions to this and only areas in which pain occurred more frequently, were elbow pain, back pain, and hip pain (Jonasson et al., 2011). The second study was carried out in the USA using comparable methods. It showed that manual occupations predominantly performed outdoors (e.g. landscaping, agriculture, façade work, and assembly) reported prevalence rates and patterns of musculoskeletal pain in adults that were similar to the ACHE study. However, elbow pain and hip pain were more widespread in this group of adult manual laborers than in the adolescent competitive athletes included in the ACHE study.

Young elite players use pain medication to counter this, to some extent quite pronounced, phenomenon of pain. The concurrent intake of several analgesics, and of cyclooxygenase

inhibitors in particular, was widespread within our sample group. While the slightly more frequent consumption shown among female elite athletes may in part be attributed to typical menstruation pains, the lack of social control for those living alone (e.g. at a sports boarding school) and among older athletes, seemed to facilitate increased consumption of analgesics.

Adolescent elite players who took analgesics more frequently, favored diclofenac over ibuprofen. Studies looking at professional football, triathlon, and marathon running have shown that both of these substances (especially diclofenac) are very frequently used for self-medication by adult team athletes and endurance athletes (Dietz et al., 2016; Gorski et al., 2011; Küster et al., 2013). Comparative studies concerning adolescents are scarce. A Brazilian study on adolescent basketball players and other ball sport athletes found that the prevalence of pain, at least for the phenomenon of shoulder pain, increased between the ages of 10 and 19, just as it did in our sample. The study also found that pain usually occurred without injury and that approximately one third of those affected by pain self-medicated (Oliveira et al., 2017).

Pharmacologically, every one of the analgesics used by these adolescents puts a strain on the mucous membrane of the gastro-intestinal tract, even when we refer to prophylactic consumption. They also have a negative effect on kidney function (Brune et al., 2009a) and cause electrolyte disorders, especially during the extensive endurance performances typical to basketball; this could, in the worst case scenario, lead to hyponatremia (Brune et al., 2009b). Considering the increased risk of asthmatic reactions for already vulnerable athletes and the increased tendency to bleed in the days following, it is also worth noting that a quarter of all athletes consumed acetylsalicylic acids at least occasionally. What is also striking is the consumption of higher doses of paracetamol, which are comparatively less effective as well as harmful to the liver (Brune et al., 2009a). In this respect, even prophylactic consumption is of considerable concern. Finally, the expectations of a synergistic effect in combined consumption, as well as that of instantly appeasing any pain that may occur during games or training, are both inherently wrong (Nieman et al., 2006;

Tsitsimpikou et al., 2009).

Limitations and strengths of the study

Upon interpreting the ACHE study, it is important to consider the selectivity of the collective studied, a potential social desirability bias, as well as the methodological limitations of recording pharmaceutical drug consumption.

As with any epidemiological study, there is always a question of the selectivity of the collective studied; in this regard, the approximate structural equality of our sample with the overall collective of all players from the three leagues concerned is gratifying. The sample varies neither in terms of its regional distribution (Western states – the former Federal Republic of Germany, FRG versus Eastern states – the former German Democratic Republic, GDR), nor its distribution of age (under 15 versus 15 and older), from the actual structure of the leagues ($p > 0.05$). Only the sex ratio could not be replicated as closely (proportion of male players in the league structure: 81% vs. ACHE study: 71%, $p \leq 0.05$). However, the slightly larger sample size of female players facilitated sex-specific comparisons.

Second, with regard to questionnaire-based studies, it is not possible to completely eliminate the typical social desirability bias. Socially desirable response behavior should be considered when interpreting genuine subjective (pain) and behavioral (use of medication) outcomes. The software package SoSci Survey, however, already audits the logical plausibility of numerical answers while the questionnaire is being filled out, thus preventing accidentally or deliberately incorrect entries. Furthermore, no logical abnormalities or discrepancies were identified during the data analysis phase.

The third restriction pertains to the fact that when the data on analgesic consumption was recorded, this did not include questions about the specific reasons behind individual incidences of consumption. It would hardly have been possible to produce useable mapping of such specifications regarding individual doses, given the apparent widespread consumption of all kinds of compounds, in part over long periods of time and in various combinations. The risk of side effects is naturally independent of reason for consumption and therefore seems to be highly relevant, particularly for this physically-strained collective.

The strengths of this study lie in the differentiated findings of a nationwide sample concerning an apparently widespread, but hitherto rarely-examined phenomenon in competitive sport. To this effect, the ACHE study also constitutes an exception, in that it looked at 15 different localizations, whereas previous clinical studies have been restricted to one or two localizations (Auvinen et al., 2009). The focus of this study on adolescent competitive athletes further highlights the ethical necessity of a study of this kind.

Conclusions

Eight out of ten basketball players in the elite German youth leagues suffered from pain, with a higher proportion of female basketball players being affected. Pain in the back and in the lower extremities was the most commonly reported. Adolescent basketball players in the elite German leagues often took analgesics, 'prophylactically' in many cases, without a prescription from a physician. The consumption of multiple pharmaceutical substances, in particular, the cyclooxygenase inhibitors ibuprofen and diclofenac, was widespread among top level adolescent basketball players. Physicians should address the issue of pain and its management in a preventive manner. When pain occurs, coaches, clubs and above all parents should be involved in the process from an early stage. Educating physicians and implementing training-specific measures to prevent pain and injury could work to counteract the consumption of nephrotoxic painkillers and the misguided notion of preventative analgesia.

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References

- Auvinen JP, Paananen MV, Tammelin TH, Taimela SP, Mutanen PO, Zitting PJ, Karppinen JI. Musculoskeletal pain combinations in adolescents. *Spine J*, 2009; 34(11): 1192-1197
- Borowski LA, Yard EE, Fields SK, Comstock RD. The epidemiology of US high school basketball injuries, 2005-2007. *Am J Sport Med*, 2008; 36(12): 2328-2335
- Brune K, Niederweis U, Kaufmann A, Küster-Kaufmann M. Misuse of analgesics in marathon runners: Every second athlete takes a painkiller before the race. *MMW Fortschr Med*, 2009; 151(40): 39-42
- Brune K, Niederweis U, Küster M, Renner B. Amateur and competitive sport: No longer possible without painkillers? *Dtsch Arztebl Int*, 2009; 106(46): 2302-2305
- Deitch JR, Starkey C, Walters SL, Moseley JB. Injury Risk in Professional Basketball Players: A Comparison of Women's National Basketball Association and National Basketball Association Athletes. *Am J Sports Med*, 2006; 34(7): 1077-1083
- Deutscher Basketball Bund eV. Development of membership numbers of the DBB, 2018. Available at: <http://www.basketball-bund.de/dbb/ueber-uns/mitgliederentwicklung>; accessed on 09 April 2018
- Dick R, Hertel J, Agel J, Grossman J, Marshall SW. Descriptive Epidemiology of Collegiate Men's Basketball Injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 Through 2003-2004. *J Athl Train*, 2007; 42(2): 194-201
- Dietz P, Dalaker R, Letzel S, Ulrich R, Simon P. Analgesics use in competitive triathletes: its relationship to doping and on predicting its usage. *J Sport Sci*, 2016; 34(20): 1965-1969
- Fett D, Trompeter K, Platen P. Back pain in elite sports: A cross-sectional study on 1114 athletes. *PLoS One*, 2017; 12(6): e0180130
- Foran B, Pound R. *Complete conditioning for basketball*. Human Kinetics, 2007
- Foss KD, Myer GD, Magnussen RA, Hewett TE. Diagnostic Differences for Anterior Knee Pain between Sexes in Adolescent Basketball Players. *J Athl Enhanc*, 2014; 3(1): 1814
- Gorski T, Cadore EL, Pinto SS, da Silva EM, Correa CS, Beltrami FG, Krueel LF. Use of NSAIDs in triathletes: prevalence, level of awareness and reasons for use. *Br J Sport Med*, 2011; 45(2): 85-90
- Jonasson P, Halldin K, Karlsson J, Thoreson O, Hvanberg J, Sward L, Baranto A. Prevalence of joint-related pain in the extremities and spine in five groups of top athletes. *Knee Surg Sport Tr A*, 2011; 19(9): 1540-1546
- Kamper SJ, Henschke N, Hestbaek L, Dunn KM, Williams CM. Musculoskeletal pain in children and adolescents. *Braz J Phys Ther*, 2016; 20(3): 275-284
- Koltyn FK. Exercise-induced hypoalgesia and intensity of exercise. *Sports Med*, 2002; 32(8): 477-487
- Küster M, Renner B, Oppel P, Niederweis U, Brune K. Consumption of analgesics before a marathon and the incidence of cardiovascular, gastrointestinal and renal problems: a cohort study. *BMJ Open*, 2013; 3(4): e002090

- McKeag DB, ed *Handbook of Sports Medicine and Science, Basketball*. Malden MA, Oxford, Carlton South VIC, Berlin: Blackwell Publishing; 2003. McKeag DB, ed.
- Neufer PD, Bamman MM, Muoio DM, Bouchard C, Cooper DM, Goodpaster BH, Booth FW, Kohrt WM, Gerszten RE, Mattson MP, Hepple RT, Kraus WE, Reid MB, Bodine SC, Jakicic JM, Fleg JL, Williams JP, Joseph L, Evans M, Maruvada P, Rodgers M, Roary M, Boyce AT, Drugan JK, Koenig JI, Ingraham RH, Krotoski D, Garcia-Cazarin M, McGowan JA, Laughlin MR. Understanding the cellular and molecular mechanisms of physical activity-induced health benefits. *Cell Metab*, 2015; 22:
- Nieman DC, Henson DA, Dumke CL, Oley K, McAnulty SR, Davis JM, Murphy EA, Utter AC, Lind RH, McAnulty LS, Morrow JD. Ibuprofen use, endotoxemia, inflammation, and plasma cytokines during ultramarathon competition. *Brain Behav Immun*, 2006; 20(6): 578-584
- Oliveira VMA, Pitangui ACR, Gomes MRA, Silva HAD, Passos M, Araujo RC. Shoulder pain in adolescent athletes: prevalence, associated factors and its influence on upper limb function. *Braz J Phys Ther*, 2017; 21(2): 107-113
- Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C, Buchner D, Ettinger W, Heath GW, King AC, Kriska A, Leon AS, Marcus BH, Morris J, Paffenberger RS, Patrick K, Pollock ML, Rippe JM, Sallis J, Wilmore JH. Physical activity and public health - A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA*, 1995; 273: 402-407
- Randazzo C, Nelson NG, McKenzie LB. Basketball-related injuries in school-aged children and adolescents in 1997-2007. *Pediatrics*, 2010; 126(4): 727-733
- Siebenrock K, Ferner F, Noble P, Santore R, Werlen S, Mamisch T. The cam-type deformity of the proximal femur arises in childhood in response to vigorous sporting activity. *Clin Orthop Relat Res*, 2011; 469: 3229-3240
- Thiel A, Diehl K, Giel KE, Schnell A, Schubring AM, Mayer J, Zipfel S, Schneider S. The German Young Olympic Athletes' Lifestyle and Health Management Study (GOAL Study): design of a mixed-method study. *BMC Public Health*, 2011; 11(1): 410
- Tsitsimpikou C, Jamurtas A, Fitch K, Papalexis P, Tsarouhas K. Medication use by athletes during the Athens 2004 Paralympic Games. *Br J Sport Med*, 2009; 43(13): 1062-1066
- Vanderlei FM, Bastos FN, de Lemes IR, Vanderlei LC, Junior JN, Pastre CM. Sports injuries among adolescent basketball players according to position on the court. *Int Arch Med*, 2013; 6(1): 5
- Zelisko JA, Noble HB, Porter M. A comparison of men's and women's professional basketball injuries. *Am J Sports Med*, 1982; 10(5): 297-299

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