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Medication use by athletes during the Athens 2004 Paralympic Games

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ABSTRACT

Objective: To examine the use of food supplements and pharmaceutical preparations by elite Paralympic athletes.

Design: Survey study.

Setting: Athens 2004 Paralympic Games.

Participants: Data obtained from two sources: (i) athletes' declaration of intake of drugs/supplements recorded on the Doping Control Official Record during sample collection for doping control; (ii) athletes' application forms for granting of a therapeutic use exemption.

Main outcome measures: Classification of declared food supplements according to the active ingredient and medications according to therapeutic actions and active compounds.

Results: 64.2% of the athletes tested for doping control declared use of medications or food supplements, and 81.3% of these athletes declared intake of fewer than four preparations. Non-invasive routes of administration dominated. Food supplements (42.1%) were popular, and drugs used to treat several pathological conditions noted. Non-steroidal anti-inflammatory agents and analgesics were commonly used (9.8% and 5.6%, respectively). The prevalence of inhaled β2-agonist use (4.8%) was higher than expected and exceeded that at the Athens Olympic Games.

Conclusions: This review, the first to examine elite Paralympic athletes, shows a more rational approach to the use of medication and food supplements, but a similar consumption pattern to that of athletes at the Athens Olympic Games. Because of the dearth of such studies, consumption trends among Paralympic athletes remain unclear. The need to counsel athletes with disabilities on their nutritional needs is confirmed, and close monitoring by healthcare professionals is recommended.

Although several publications have detailed patterns of medication/food supplement use at the Olympic Games,[1–3] there is a paucity of relevant published research on the Paralympic Games. Initially organised in 1960 only for athletes with spinal injuries, the Paralympic Games are held every 4 years. The International Paralympic Committee (IPC) is responsible for organising the Paralympic Games, which now include athletes with spinal cord injuries (SCIs), developmental disabilities or cerebral palsy, amputees and those who are visually impaired. At the Athens 2004 Paralympic Games, 3806 athletes from 136 nations competed in five categories; amputees, wheelchair athletes, cerebral palsy, visually impaired and les autres (others)—physical disabilities not conforming to any of the above. The category, intellectual disabilities, is currently suspended.

The purpose of this study was to review the data on medication use from athletes' declarations of medication/supplement use recorded on the Doping Control Official Record (DCOR) during sample collection for doping control and from athletes' application forms for Therapeutic Use Exemption (TUE) and Abbreviated TUEs (aTUEs) at the Athens 2004 Paralympic Games. When relevant, these data are compared with similar data from the Athens 2004 Olympic Games, based on a previously published paper from our group.[3]

METHODS

The IPC granted permission for us to obtain information from the DCOR and provided data on TUEs and aTUEs. Subjects consented to participation, and the study complied with the Declaration of Helsinki. For the first time, the DCOR included a statement requesting the athlete's permission to use his/her sample for research purposes and after the analytical procedure had been concluded; 81.9% of the athletes tested consented. No statistical correlation was found between consenting to research and any sport.

TUE approvals for the use of substances prohibited under the International Standard of Prohibited Substances (*the List*)[4] were evaluated by the IPC TUE Committee in accordance with the IPC Anti-Doping Code and approved or rejected. Under IPC rules, athletes are required to notify the IPC of the use of a substance necessitating an aTUE, using the same form as for TUEs.

This paper reviews the DCOR data from 680 athletes tested (mean (SD) age 34.3 (7.8) years, range 18–61) and 493 athletes' application forms for the granting of a TUE. Declared medications and food supplements were classified according to the active ingredient and its therapeutic action. Data on TUEs were categorised according to the active compound of the medication declared and, when relevant, compared with the results of the laboratory analysis of the respective urine sample collected for doping control.

Specific gravity was measured during urine collection for doping control according to the International Standard for Testing,[5] by digital refractometers calibrated against distilled water.

SPSS V12.0 was used to calculate means and percentages. Pearson product–moment correlation and χ^2 was used to identify possible statistical correlations between different variables and significant differences between medians for categorical variables, respectively. t Tests and one-way analysis of variance were used to detect significant differences between means.

RESULTS

In the Athens Paralympic Games, 64.2% of the athletes tested for doping control declared the use of medication or food supplements during the final 3 days before testing, and more than 80% of these declared the use of fewer than four preparations (fig 1). No statistically significant correlation was found between the number of preparations declared and the sport (mean (SD) consumption of preparations per sport 2.0 (2.3)) or the country of origin of the athlete. In 166 doping controls conducted out-of-competition (OOC), representing 24.4% of total controls, 304 medications were declared (21.7% of the total medications declared) from 32.0% of the athletes tested, showing that most of the athletes consumed preparations in-competition (IC), especially during the first week of the Games. A significant association was found between sport and the consumption of medication or food supplements IC or OOC ($\chi^2 = 14.0$, df = 1, $p<0.001$). More specifically, after correction for the number of tests conducted per sport IC or OOC, in sports such as cycling more than 70% of the preparations were used OOC, whereas in athletics and powerlifting the opposite preference was recorded. Similarly, the type of medication/food supplement used strongly correlated with the period of administration ($\chi^2 = 83.7$, df = 17, $p<0.001$). Non-steroidal anti-inflammatory drugs (NSAIDs) and analgesics were mainly consumed IC (85.4% and 80.0%, respectively), showing that most of the preparations used were not treating chronic inflammatory or pathological conditions. In contrast, drugs to treat chronic conditions, such as nervous disorders, were used equally IC and OOC.

From the DCOR, non-invasive routes of administration dominated, including oral administration (88.7%), inhalation (1.9%) and dermal application (1.7%). Injections made up 6.7% of the total and were mostly food supplements (n = 34), NSAIDs (n = 17) and local anaesthetics (n = 13). Injected food supplements included phosphocreatine (45%), vitamins mostly of the B complex (29%) and ATP (25%). A strong correlation was found between the route of administration and the type of medication used ($\chi^2 = 2385$, df = 102, $p<0.001$). Food supplements were mainly consumed orally; only 4.8% were injected into athletes. Analgesics and NSAIDs were mostly taken orally, and only 11.6% of NSAIDs were injected.

Most medications (95.6%) and food supplements (87.6%) used by the athletes during the Athens Paralympic Games were administered in less than three doses daily, indicating a conservative dosage scheme. The mean dose for NSAIDs and analgesics was 1.3 and 1.1 tablets per day, respectively. Food supplements were the most common preparation administered in more than four doses per day. Thirteen athletes declared use of certain preparations in more than 10 doses daily. The dosage scheme applied depended on the route of administration ($\chi^2 = 1834$, df = 132, $p<0.001$), with 86% of orally administered preparations being taken as a single dose, while inhaled drugs were prescribed in multi-dose regimens.

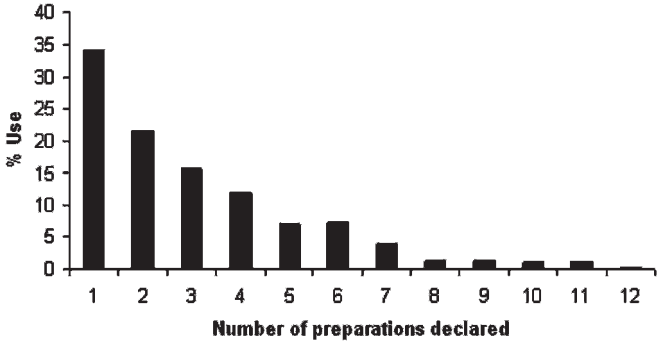

Figure 1 Number of medications/food supplements used by athletes in the Athens 2004 Paralympic Games.

No correlation was found between the volume, the specific gravity and the preparations declared. More than 80% of urine samples provided by athletes competing in wheelchair sports had a volume >135 ml and a specific gravity <1.015.

Figure 2 shows the classification of medications/food supplements declared on the DCOR per therapeutic category. Drugs used to treat several major pathological conditions were recorded, including disorders of the central nervous system (2.9%), cardiovascular system (2.2%) and the urinary tract (1.6%). Medications to treat cardiovascular disorders included antihypertensives (n = 11) antithrombotics (n = 3), agents to manage peripheral vascular disorders (n = 2), hyperlipidaemics (n = 1), β blockers (n = 3), in sports where their use is permitted, and 17 athletes from the four countries that previously constituted the USSR declared taking an anti-ischaemic agent, mildronate. Mildronate, developed in Latvia, inhibits carnitine biosynthesis and is alleged to benefit cardiac and neurological ischaemia, but is also stated to be used for physical overload and is claimed to assist recovery.[6 7] Of the drugs declared to treat cardiovascular disorders, 20% were used by athletes competing in powerlifting, 19% by athletes competing in judo, and 17% by athletes competing in athletics.

Strong association was noted between the type of medications/food supplements used and the age of the athletes ($\chi^2 = 96.7$, df = 51, $p<0.001$), as well as their sport ($\chi^2 = 650.9$, df = 357, $p<0.001$). Athletes aged 30–40 years used more NSAIDs and analgesics than younger athletes, who took more food supplements.

Food supplements made up 42.1% of supplement use, with vitamins (43.5%), minerals/electrolytes (16.1%) and proteins/amino acids (10.5%) being the most popular. The use of vitamins was distributed relatively evenly over all the Paralympic sports, with greatest use in athletics, powerlifting and judo. Use of proteins/amino acids was declared in seven of the 22 Paralympic sports, with athletics and powerlifting accounting for 62.3% of total consumption. Other classes of food supplements used by more than 1% of the athletes tested for doping control in the Athens Paralympic Games were creatine and various enzymes and coenzymes (9.1% and 1.3%, respectively).

NSAIDs and analgesics were also widely used in the Athens Paralympic Games (9.8% and 5.6%, respectively). More than 40% of the athletes participating in six Paralympic sports (judo, 59%; goalball, 50%; wheelchair basketball, 45.8%; powerlifting, 43%; archery, 40%; table tennis, 44.4%) declared use of NSAIDs on the DCOR. In the Athens Paralympic Games, 5.1% of users consumed more than one NSAID concurrently, perhaps in the mistaken belief that they may be synergistic. One NSAID preparation contained oxycodone, banned as a narcotic under Hellenic Law 3459/2006. Concomitant use of NSAIDs and analgesics was observed in 4.5% of NSAID users. The most widely used NSAIDs were diclofenac (31.7%) and ibuprofen (15.2%), an acetic acid and a propionic acid derivative, respectively. A large variety of active compounds was noted, with 22 different NSAIDs being declared compared with 15 in the Athens Olympic Games. Cyclo-oxygenase 2 (COX-2) inhibitors (COXIBs) were preferred by only 4.9% of the Paralympic athletes.

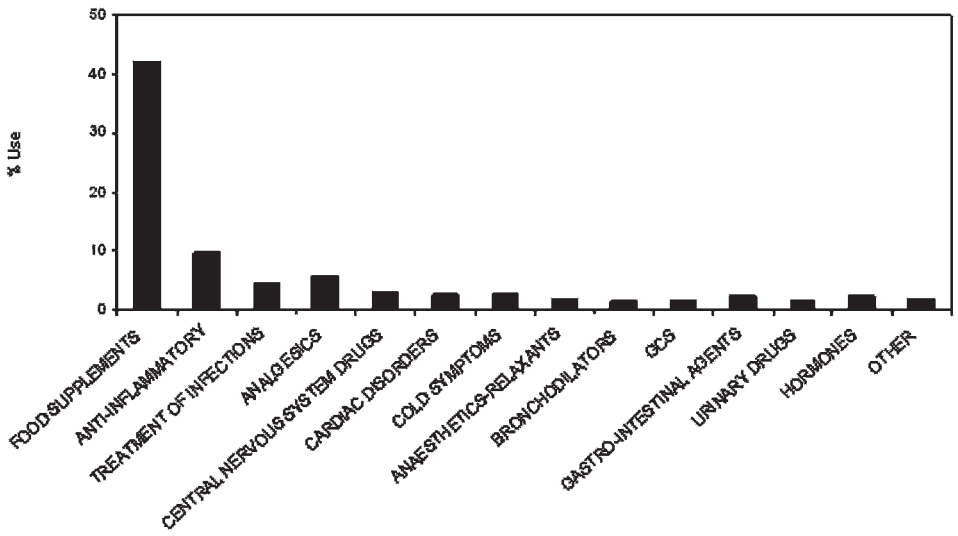

Figure 2 Classes of medications/food supplements used by athletes in the Athens 2004 Paralympic Games. GCS, glucocorticosteroids.

A total of 493 TUEs were approved by the IPC TUE Committee.[8] These comprised 184 inhaled β2 agonists, 279 glucocorticosteroids (GCSs), 11 diuretics, 11 peptide hormones and eight miscellaneous. Eight TUE applications were rejected: three for β blockers in archery and shooting because significant enhancement of performance would result, three for narcotics, one for a diuretic, and one for GCSs. Six athletes competing in judo, powerlifting and swimming declared use of insulin for the treatment of type 1 diabetes mellitus.

Unlike for the Athens Olympic Games, the IPC Medical Committee did not require bronchodilator or bronchial provocation test evidence of asthma and/or airway hyper-responsiveness to permit the use of inhaled β2 agonists. In total, 184 athletes (4.8%) from 15 sports submitted an aTUE for inhaled β2 agonists, salbutamol and terbutaline (short-acting preparations) and formoterol and salmeterol (long-acting preparations).[8] Salbutamol was inhaled most commonly (78.9% of aTUE) and noted on the DCOR (54.2%). Cycling (12.2%), equestrian sports (11.6%) and swimming (9.8%) had the highest prevalence of β2-agonist use. Data from the DCOR revealed that 18 of the athletes tested for doping control inhaled β2 agonists, but no adverse analytical findings on β2 agonists were reported. Only one athlete who admitted β2-agonist use on the DCOR declared concomitant use of GCSs.

At doping control, 1.6% of athletes declared use of GCSs. In all, 280 applications for GCS use were submitted to the IPC TUE Committee and one was rejected. These were inhaled (155 (55.6%)), topical (93 (33.0%)), oral (15 (5.4%)) and injected (17 (6.1%)). The most commonly declared GCS was prednisolone, whereas from TUE applications, budesonide was the most commonly requested. Three cases that resulted in an adverse analytical finding (two prednisolone, one budesonide) were disregarded because of the presence of a TUE.[8]

Medication use declared that may reflect athletes' disabilities included eight athletes taking anti-epileptic drugs, two using gabapentin (which may have been for epilepsy but more likely for neuropathic pain), and nine using muscle relaxants. The declared use of benzodiazepines (diazepam, alprazolam, lorazepam), zopiclone and zolpidem in the Athens Paralympic Games as anxiolytics and hypnotics warrants comment. Although not prohibited in sport, they are banned as narcotics, according to Hellenic Law (3459/06). Finally, in 16 cases, athletes declared the use of haemoderivatives, 11 of which (68.8%) were actovegin; 44% of its use was in anaerobic power sports, such as judo and powerlifting.

DISCUSSION

More than 81% of athletes who participated in the Athens Paralympic Games granted permission for his/her urine sample to be used for research purposes compared with only 63% at the Athens Olympic Games. Thus, Paralympic athletes appeared more inclined to cooperate and assist to advance science and perhaps were more confident in the management of the doping control processes than Olympic athletes.

Surprisingly, fewer Paralympic athletes declared using medications or food supplements than their able-bodied counterparts in 2004, and, in general, fewer Paralympic athletes than Olympic athletes used a high number of medications.[3] The pattern of supplement use was similar at both 2004 Games, although the reported use of creatine was higher at the Paralympic Games (9.1% vs 5.1%).

Athletes with disabilities did not appear to have a significantly greater overall risk of injury than their able-bodied counterparts.[9 10] The prevalence of NSAID use was marginally less at the Paralympic Games (9.8%) than at the Olympic Games (11.1%) in Athens, although analgesics were used more frequently (5.6% vs 3.7%). COXIBs are reported to be well tolerated and have a lower incidence of gastrointestinal bleeding,[11] but there are concerns over their prothrombotic activity on the vasculature.[12] Only 4.9% of Paralympic athletes reported taking COXIBs compared with 16.5% of Olympic athletes at Athens. As expected, wheelchair athletes, who place a heavy workload on their upper limbs as do athletes in power sports, used more NSAIDs.[13 14] Similarly, in the Athens Olympic Games, the highest prevalence of NSAID use was in sports involving extensive use of the upper and lower limbs, fencing, softball, volleyball, tennis and baseball.[3] This is in agreement with previous findings[9 15 16] and may indicate a higher rate of chronic and overuse injuries in these sports.

SCIs influence the capacity and function of the bladder. Neurogenic bladder is a common result of SCI use and predisposes to urinary tract infections from incomplete voiding, raised intravesical pressure and/or catheter use.[17] However, the rare use of drugs to treat urinary tract disorders (1.6%) indicates that, generally, Paralympic athletes at the Athens Games managed their dysfunctional bladders well.

The prevalence of insulin-dependent diabetes mellitus (6/3806 or 1/634) was higher than in able-bodied athletes at the Athens Games (1/1173) and subsequent Games (Torino Winter Olympics 2006 (1/1256) and Beijing 2008 (1/1081)). An additional five athletes declared the use of oral antidiabetic agents on the DCOR. Although physical inactivity secondary to SCI may predispose to disorders of carbohydrate metabolism,[18] studies on athletes and others with SCIs have shown that physical activity can maintain insulin sensitivity similar to that of active able-bodied persons.[19–22]

The prevalence of the use of inhaled β2 agonists at the Athens Paralympic Games (4.8%) was higher than expected and exceeded that at the Olympic Games, where 4.6% of athletes applied for a TUE and 4.2% were approved on the basis of their test results. The Athens Olympic Games was the first Summer Games at which athletes were required to demonstrate the presence of current asthma and or exercise-induced asthma.[23] The fact that the use of β2 agonists by Paralympic athletes is so high and presumably this prevalence of asthma and/or exercise-induced asthma may reflect the amount of endurance training performed by elite Paralympic athletes. There is evidence that the prevalence of asthma and bronchial hyper-responsiveness in elite athletes is related to their volume of endurance training, especially if performed in environmental conditions that are conducive to bronchial hyper-responsiveness, such as breathing chlorine derivatives in indoor swimming pools or polluted air from vehicle emissions while cycling on roads.[24]

Sound knowledge of nutrition and hydration is important to all athletes, but especially to athletes with disabilities, many of whom are wheelchair-bound. In addition, SCI athletes must contend with altered thermoregulation due to loss of autonomic control of vasomotor and sudomotor responses below the level of the spinal cord lesion. This results in them being more susceptible to hyperthermia during endurance wheelchair races.[25] Athletes with tetraplegia are particularly vulnerable because of the absence of, or markedly reduced, sweating capacity.[26] Yet there is little published information on the nutritional requirements of, and level of awareness for, disabled athletes. One of the few published studies was carried out on Iranian athletes, most of whom had SCIs. It confirmed the lack of knowledge and the need to counsel athletes with disabilities on their nutritional requirements.[27]

At the Paralympic Games in Athens, supplement use varied considerably between sports, with power competitors in sports such as powerlifting, judo, and track and field athletics using most, which is similar to the situation in the Olympic Games.[3] Even though research on the effect of creatine on performance of wheelchair athletes did not show any improvement over placebo,[28] a greater percentage of Paralympic athletes (9.1%) than Olympic athletes (5.1%) ingested creatine at the Athens Games.

With hydration of SCI athletes critical, especially in competitions conducted in hot and humid conditions as occurred in Athens during the Paralympic Games, >80% of wheelchair athletes provided a large volume of dilute urine at doping control. Dilute urine would presumably reflect adequate hydration, although the large volume may be because of catheter use or perhaps because some athletes may have been engaging in induced autonomic dysreflexia or ''boosting''. This procedure is prohibited by IPC because it can enhance performance,[29] but was not monitored at the Athens Paralympic Games.

Use of cardiovascular drugs, especially antihypertensives, was declared five times more often at the Athens Paralympic Games than the Athens Olympic Games. Aerobic endurance training has a beneficial effect on blood pressure[30]; however, many daily activities necessary for wheelchair-based athletes include components of isometric exercise, which may constitute an antecedent factor in the prevalence of hypertension in the Athens Paralympic athletes and provide less protection against ischaemic heart disease.[31 32]

What is already known on this topic

- There is lack of knowledge about the nutritional needs of athletes with disabilities and an imperative need to counsel them.
- Wheelchair athletes, who place a heavy workload on their upper limbs, use more non-steroidal anti-inflammatory drugs.

What this study adds

- This is the first study to report the use of medications and food supplements in Paralympic Games.
- Paralympic athletes appeared more inclined to cooperate and assist to advance science compared with their Olympic counterparts.
- Fewer Paralympic athletes declared the use of medications and food supplements and, in general, a more rational intake pattern was recorded than for Olympic athletes.

CONCLUSIONS

Fewer Paralympic athletes declared the use of medications and food supplements and, in general, a more rational intake pattern was recorded than for Olympic athletes. Drugs used to treat several pathological conditions were recorded, with a higher prevalence of drugs for insulin-dependent diabetes mellitus than in recent Olympic Games. The prevalence of inhaled β2-agonist use at the Athens Paralympic Games was higher than expected and exceeded that at the Athens Olympic Games.

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Patient consent: Obtained.

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