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Attention-deficit/hyperactivity disorder (ADHD) in gymnastics: preliminary findings

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Doping

Abstract
Background: Athletic performance without benefit from performance-enhancing substances is essential in amateur sports; yet, prohibiting specific medications creates discrimination against competitors with a medical illness. To avoid such inequalities, the World Anti-Doping Agency (WADA) adopted international standards for therapeutic use exemptions (TUE). Attention-deficit/hyperactivity disorder (ADHD) treatment within the athletic population is a unique challenge. Stimulants, first-line treatment for ADHD, are prohibited unless alternative, non-prohibited medications have first been tried and found ineffective. The world prevalence of ADHD is 5.3%; however, there are no ADHD prevalence studies in sports. This paper addresses ADHD in a boys' gymnastics team, implications for further research with a proposed survey-questionnaire to measure prevalence of ADHD with behavioral effects of gymnastics, and ethical considerations.
Method: Preliminary ADHD prevalence in a boys' gymnastics team is presented with complementary literature review and a proposed survey-questionnaire to estimate actual ADHD prevalence in gymnastics populations with behavioral effects.
Results: The parents of boys in a gymnastic reported that 5 of 7 (71.4%) boys were either diagnosed with ADHD in the past or had been treated with stimulant or non-stimulant medications for inattentive/hyperactive/impulsive behaviours. Parents described gymnastics as effective "behavioral therapy" in controlling/improving ADHD symptoms, with this effect extending into other environments (home/classroom). Only one parent was aware of WADA stimulant prohibition.
Conclusions: A surprisingly large ADHD prevalence is reported in one boys' gymnastic team. Further research is required to verify this high ADHD prevalence and behavioral effects in gymnastics. A proposed survey-questionnaire to measure both ADHD prevalence and behavioral effects in gymnastics is presented.

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PALABRAS CLAVE
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Autorización de uso terapéutico (AUT);
Dopaje

Trastorno de déficit de atención/hiperactividad (TDAH) en gimnasia: resultados preliminares

Resumen:
Antecedentes: En el deporte amateur es esencial alcanzar un rendimiento deportivo sin el beneficio de sustancias que lo mejoren. Sin embargo, la prohibición de determinados fármacos genera una discriminación a los competidores con determinadas enfermedades. Para evitar esas desigualdades, la Agencia Mundial Antidopaje (AMA) aprobó las normas internacionales para la autorización de uso terapéutico (AUT). El tratamiento del trastorno de déficit de atención e hiperactividad (TDAH) supone un desafío único en el deporte. Los estimulantes, el tratamiento de primera línea para el TDAH, están prohibidos a menos que haya medicamentos alternativos que hayan sido previamente evaluados y declarados ineficaces. La prevalencia mundial del TDAH es del 5,3%; sin embargo, no existen estudios de afectación de esta enfermedad en los deportistas. Este artículo aborda el TDAH en un equipo masculino de gimnasia, las consecuencias para investigaciones futuras utilizando una propuesta de encuesta-cuestionario para medir la prevalencia de este trastorno y sus efectos sobre el comportamiento en los gimnastas y sus consideraciones éticas.
Método: La prevalencia del TDAH preliminar en el equipo de chicos de gimnasia se presenta con la revisión de la bibliografía complementaria y una propuesta de encuesta-cuestionario para estimar la afectación real de TDAH entre los gimnastas con trastornos de comportamiento.
Resultados: En un equipo de gimnasia masculino, los padres informaron que 5 de 7 chicos (71,4%) en el pasado habían recibido un diagnóstico de TDAH o habían sido tratados con medicamentos, estimulantes o no estimulantes, por falta de atención y comportamientos hiperactivos e impulsivos. Los padres describieron la gimnasia como una eficaz ″terapia del comportamiento″ en el control y mejora de los síntomas del TDAH; este efecto también se obtuvo en otros ámbitos (hogar/aula). Sólo uno de los padres era consciente de la prohibición del consumo de estimulantes por parte de la AMA.
Conclusiones: Se detectó una prevalencia sorprendentemente alta de TDAH en el un equipo de gimnasia masculino. Se requiere más investigación para verificar esta alta prevalencia del TDAH y los efectos sobre el comportamiento de los gimnastas. Se presenta una propuesta de encuesta-cuestionario para medir la prevalencia de trastorno de déficit de atención e hiperactividad en la gimnasia.

Introduction

The concept that all athletes compete on ″an even playing field″ without the benefit of performance-enhancing substances is essential to the existence of amateur sports. Unfortunately, too often, performance-enhancing substances have tainted international competitions. For that reason, the World Anti-Doping Agency (WADA) with associated World Anti-Doping Code (WADC) was created with far-ranging sanctions inclusive of simple warnings, competition disqualifications, and lifetime suspensions[1,2]. A substance or method will be included on the Prohibited list if WADA determines that two of three major criteria are met: 1) substance or method results in actual/potential performance enhancement, 2) substance or method is actually/potentially dangerous to the athlete, and 3) substance or method violates the spirit of sport (WADC 4.3.1); further, a substance or method will be included on the Prohibited list if it could serve to mask the use of another prohibited substance or method (WADC 4.3.2)[2]. Fundamental to the WADC is the concept of strict liability (WADC 2.1.1 and Comment 2.1.1)[2]. The athlete takes personal responsibility for any and all substances that might enter his body whether or not he knowingly ingested such. If the athlete tested positive for a prohibited substance, whether the athlete took such intentionally or not, and even if that substance would not have enhanced the athlete's performance, so long as that substance is listed as prohibited, the athlete committed a doping offense and must suffer the consequences[2,3]. This is a critical issue for Olympic athletes have been disqualified and lost their medals secondary to receiving relatively innocuous cold preparations from coaches or trainers. The most telling case, which is pertinent to the findings in this article, concerns a 16-year-old Romanian gymnast who was stripped of the Sydney 2000 Olympic Games women's all-around gold medal when she tested positive for pseudoephedrine after taking OTC cold tablets[3–5]. Though she was unaware of the presence of a prohibited substance (given by her team doctor), and though it made her dizzy and further though expert opinion felt that she had not gained competitive advantage (i.e., the prohibited substance did not enhance her performance), the Court of Arbitration for Sport (CAS) confirmed that the gymnast had committed a doping offense[3–5]. The CAS held and commented: 'The IOC's decision was upheld and the application dismissed. Doping is a strict liability offence. The mere presence in the urine sample of a prohibited substance or a relevant substance at a prohibited concentration is sufficient to establish the offence. It is

not necessary in establishing the offence to demonstrate that the athlete secured a competitive advantage. The subjective elements argued in the attack on the finding of doping were only relevant to the assessment of any disciplinary sanction[5].″

″The system of strict liability of the athlete must prevail when sporting fairness is at stake. This means that, once a banned substance is discovered in the urine or blood of an athlete, he must automatically be disqualified from the competition in question, without any possibility for him to rebut this presumption of guilt. So the CAS firmly upheld. The Anti-Doping Code had to be enforced 'without compromise.' That the applicant had taken Nurofen for a cold, not to gain a competitive advantage was irrelevant. As was expert opinion that she had obtained no such advanatage[5].″

Prohibition of specific medications might create novel discrimination against medically ill competitors[6–9]. In order to avoid such inequities, an international standard for therapeutic use exemptions (TUE) has been adopted by WADA and is utilized in specific circumstances[10]. Two key aspects of this international standard are: 1) ″The Athlete would experience a significant impairment to health if the Prohibited Substance or Prohibited Method were to be withheld in the course of treating an acute or chronic medical condition″ (4.1.a); 2) ″There is no reasonable therapeutic alternative to the use of the otherwise Prohibited Substance or Prohibited Method″ (4.1.c)[10]. A further complicating factor in the medical treatment of the athlete is that specific substances may be prohibited at all times or in certain instances only when the athlete is in competition[11].

Treatment of attention-deficit/hyperactivity disorder (ADHD) within the athletic population is a unique challenge. The most recent practice parameter from the American Academy of Child and Adolescent Psychiatry for the treatment of ADHD summarized recommendations from the American Academy of Pediatrics, the Texas Children's Medication Algorithm Project, and an international consensus statement; all three listed stimulants as the first-line treatment for ADHD[12–15]. However, WADA bans stimulants in competition and it has been suggested that methylphenidate could be taken until twenty-four hours pre-competition in order to allow drug clearance[11,16]. Were the athlete and his physician to find stimulants necessary in competition to control ADHD, obtaining a TUE could pose difficulties. Specifically, based on the international standard, a TUE is not permitted unless alternative, non-prohibited medications have first been tried and found to be ineffective[10]. The only non-stimulant approved by the FDA for the treatment of ADHD is atomoxetine, a selective norepinephrine reuptake inhibitor (SNRI)[12]. While similar efficacy in the treatment of ADHD has been reported with the non-stimulant atomoxetine compared to the stimulant methylphenidate, a meta-analysis revealed a greater effect size for stimulants compared to atomoxetine[17,18]. Thus it is implied that the athlete must first have undergone a potentially unsuccessful therapeutic trial with atomoxetine, which may have arguably inferior results, prior to initiating stimulants[14].

ADHD is one of the most prevalent neuropsychiatric disorders of childhood and adolescence. Worldwide ADHD pooled prevalence has been reported to be 5.3%, ranging from Middle East's 2.4%, Europe's 4.6%, North America's 6.3%, to South America's 11.8%, with prevalence in boys 10.1%, girls 4.1%, children 6.5%, and adolescents 2.7%[19]. Nonetheless, there are no prevalence studies of ADHD in sports. It is difficult to address some of the controversial issues associated with stimulants in sports if the number of athletes who require such is not known.

The aims of this study are to address preliminary findings regarding ADHD in a boys' gymnastic team, implications for further studies with proposed research survey questionnaire to measure prevalence of ADHD with behavioral effects of gymnastics, and ethical considerations.

Method

Parents of a boys' gymnastic team were informally interviewed by the senior author during gymnastic practices, at gymnastic meets, and at social settings. Boys competing for that gymnastic team were similarly observed by the senior author. Further data was obtained from informal interviews of parents at local, regional, and invitational meets. Data accumulation occurred during a 30-month time period. These interviews and observations permitted determination of the primary outcome measure, prevalence of ADHD in a boys' gymnastic team. The secondary outcome measure, behavioral effects of gymnastics on ADHD, was suggested by these interviews. The third outcome measure was parents' knowledge of the WADC prohibition of in-competition stimulant use and the need for TUE.

To better address these preliminary findings, a brief survey was developed to estimate the actual prevalence of diagnosis and treatment of ADHD in the gymnastic population in future studies.

A review of the available literature concerning therapeutic stimulant use in sports and treatment effects was initiated to complement the preliminary findings from the parents' informal interviews and discussions with peers. PubMed, PsycINFO, Lexis-Nexis, and Google databases were utilized for the literature review. Search terms included but were not limited to: attention-deficit/hyperactivity disorder (ADHD), prevalence, treatment, stimulant, psychotropic medication, behavioral effects, gymnastics, boys, survey, World Anti-Doping Agency (WADA), World Anti-Doping Code (WADC), doping, therapeutic use exemption (TUE), ethics, sports, and Raducan.

Results

During a 30-month time period, the senior author informally interviewed all fourteen parents of a boys' gymnastic team as well as observed the boys competing for that gymnastic team in multiple settings. These informal interviews and observations permitted determination of the primary outcome measure, prevalence of ADHD in a boys' gymnastic team. Specifically, the parents reported that 5 of 7 (71.4%) boys in a gymnastic team were either diagnosed with ADHD in the past or had been treated with psychotropic medications, stimulant or non-stimulant, for inattentive/hyperactive/impulsive behaviors.

Five additional parents of five gymnasts from other teams within the region made similar reports regarding their sons having ADHD or having used psychotropic medications to

treat core ADHD symptoms. The comments from the fifteen parents (ten from the team and these five additional parents) whose sons had been diagnosed with ADHD or had been treated with psychotropic medications for ADHD core symptoms were utilized to address the secondary outcome measure, behavioral effects of gymnastics on ADHD. Specifically, all fifteen parents described gymnastics as an effective form of "behavioral therapy" in controlling or improving ADHD symptoms and that this effect carried into other environments such as the home and classroom settings. Reported benefits included improvements in behavior as well as academic performance.

Responses from all nineteen parents were utilized for the third outcome measure, knowledge of the WADC. Only one parent of nineteen parents was cognizant of the WADC prohibition of in-competition stimulant use and the need for TUE.

Based on these preliminary outcome measure results, the authors developed and now present the new "Gymnastics and ADHD: Stimulant Medication, Therapy, and Behavior Survey" to estimate actual ADHD prevalence/treatment in the gymnastic population, potential behavioral effects of gymnastics on ADHD, and knowledge of the WADC in future studies.

Discussion

Through regular practice and competitions, gymnastic families readily become comrades over the course of one season and increasingly so throughout subsequent seasons. At the initial compulsory levels, competitions are within the state; but as the gymnast advances, competitions become regional, involving multiple states, and eventually national. While parents first interact with their child's own team's parents, with advancement of the gymnast, parents increasingly interact with other parents of gymnasts from other teams within the state, the region, and finally the nation. As a result of this camaraderie, it is not surprising that parents openly described in detail their child's behaviors in home and school settings and how gymnastics has played a role in the gymnast's behavioral and academic improvement. Further, in discussing these issues, parents also volunteered the existence of a prior diagnosis of ADHD and/or a history of medication treatment, stimulant or non-stimulant, for core symptoms of ADHD (inattention/hyperactivity/impulsivity).

At one Invitational, the senior author complimented a mother on her son's performance and sportsmanship. Her perception of the behavioral effects of gymnastics on ADHD is concisely summarized in her response: "You should have seen him one year ago; you cannot imagine how significant gymnastics has been for him. My son has ADHD and takes medication; but with gymnastics, his behavior is so much better at home and in the school, his grades are better and he needs less medication. I know it's the first time we talked, but I am so very happy that I could share." This interaction exemplifies the above-described relationship among parents of gymnasts.

The preliminary findings noted in this paper are quite unexpected. Were they to be generalized, these findings would suggest a greater than five-fold prevalence of ADHD in the boy gymnastic population compared to the national ADHD prevalence for boys[19]. That such a cluster was found is even more unusual considering the literature suggests a decreased interest in sports as well as athleticism in children and adolescents with ADHD[16,20]. In one study only 2/3 of ADHD children were motivated to participate in sports; other studies and reviews referred to children with ADHD having decreased coordination, impaired motor ability, clumsiness, and poor balance[16,20–23]. Further, >50% of children with ADHD have also been diagnosed with developmental coordination disorder (DCD)[24,25]. Finally, one survey suggested that gymnastics is one of the least suitable sports for untreated ADHD youth athletes[26]. It is important to determine whether these preliminary prevalence findings are secondary to small sample size only or are in fact accurate; in addition, it is important to address why ADHD boy gymnasts might gravitate toward gymnastics. Clearly the results presented point to the potential significance of a much larger study to better estimate the actual prevalence in gymnastics. The brief "Gymnastics and ADHD: Stimulant Medication, Therapy, and Behavior Survey" is included in this paper; it will be initially utilized regionally and if the results are positive will be expanded nationally. Also, in light of different prevalence of ADHD internationally, it might be beneficial to have this study done as a multi-national study under the auspices of the Fédération Internationale de Gymnastique (FIG).

Key to the success of an athlete is his ability to pay attention to coaching instruction and thereafter to incorporate what he has learned into his performance. Though limited studies have been done comparing athletes with ADHD with and without medication, it has been inferred that "With treatment they may be able to focus better on a specific task, and may be more aware of position and time[26]."

To better understand the attention required in gymnastics, it is important to appreciate the total time spent annually in gymnastic practice compared to the total time in actual competition. Optional (Levels 8, 9, 10) and elite gymnasts practice year round between 15-20 hours per week (47,250 minutes); yet these same gymnasts may only compete in 8 competitions in a given year (120 minutes). Thus only 0.25% of all time spent in gymnastic practice equates to the total time in competition.

It is critical to pay attention to everything that is happening in practice sessions as well as during the competitions themselves. It is more than simply listening to the coach and remembering the routine for a specific apparatus. To be an excellent gymnast requires the individual to pay attention to his body, to have body awareness —be it a question of position or balance (static and dynamic) or strength or pain with creation of an inner awareness[27–31]. Although the gymnast is invested in the outcome of his own routine, he can learn from watching the routines of other gymnasts regarding both techniques and even pitfalls for a given competition —for example, to obtain a stick bonus on a landing having an uneven mat, the gymnast learns not only from his warm-ups but also from observing the landings of his fellow gymnasts. In essence the elite gymnast must have excellent skills of observation (self and others), imagery, and self-talk while being able to listen to coach's feedback to maximize self-assessment, improve technical execution, and improve visual perceptions[32]. Also, it is important to

pay attention to the judges —their signals and facial expressions can yield valuable information in competition. Further, it is very important that the gymnast not be impulsive in his behaviors or in his routines —once his arm is raised to salute the judges his scoring begins and every move he makes counts until he ends his routine by saluting the judges again. Even if a gymnast were to accidentally break his routine and need to rapidly complete a different set of skills to finish his apparatus, what might seem impulsive, is in reality a gymnast's complicated correction performed with great attention to detail. One gymnast was asked to describe how he would correct his position mid-routine were he to find himself after a drop cast too close to the end of the parallel bars; he instantly responded by describing a complex series of consecutive skills that would bring him back to the middle of the bars: ″«back up-rise; L; press handstand; pirouette; shoulder stand; and, finally, roll back up-rise straddle cut to an L.″ Clearly being a gymnast is more than physical, there is a strong cognitive component focused on attention and impulse control. Since a boy gymnast with ADHD can win state and regional championships, perhaps it is time for future studies to consider whether successful performance can be because of, rather than in spite of, ADHD.

Several key questions must now be considered. 1) Is gymnastics a behavior treatment for ADHD wherein there is the development of greater attention and decreased impulsivity with carryover into other environments? 2) Can sport itself have a positive effect independent of the associated physical exercise? 3) Do stimulants improve performance in athletes with ADHD?

First, several reports suggest that exercise can increase calmness, decrease motor impersistence, improve behavior, and function as a dopaminergic adjuvant[33–36].

Second, competitive gymnastics functions as a token economy consisting of frequent praise with competition ribbons for all participants at the lower levels and half of the gymnasts in optional levels at invitational meets. Improved sportsmanlike behaviors have been reported with tokens and praise in ADHD children[37].

Third, the performance-enhancing effects of stimulants in athlete with ADHDhave been debated as there are conflicting findings, some suggesting that performance is actually impaired[16,22,26,38]. In addition to potentially significant individual variability, the response to stimulants in an athlete with ADHD may be dependent on gender, age, and specific sport. There is insufficient research to clearly answer these three questions which supports the need for further investigations focused specifically on the athlete with ADHD.

To handicap an athlete with ADHD by preventing the requisite medication to maximize attention and diminish impulsivity should be construed as unethical; however, WADA/WADC prohibits stimulants[11,26,39]. Should every newly diagnosed athlete with ADHD initially be treated with a non-stimulant medication? Presently only ∼50% of all children with ADHD are receiving treatment consistent with the guidelines from the American Academy of Child and Adolescent Psychiatry[40]. What if the child were diagnosed with ADHD and initiated on successful stimulant treatment prior to initiating athletics, should the now athlete with ADHD be forced to change to a potentially less effective non-stimulant treatment with reportedly increased adverse effects[17,18]? In essence, is it appropriate that relevant national or international Therapeutic Use Exemption Committees (TUECs) function as medical arbiters instead of the treating physician?

Limitations to this paper include the small sample size, observational evidence, only parent reports, and no standardized instrument to verify ADHD diagnosis. Further there are limitations to the proposed survey, which though having face validity has not been validated. Specifically, a survey can be all inclusive with resultant limited responses due to the burden of the survey itself, or the survey can have fewer but directed questions to maximize responses. In this study, the authors chose to pursue a more focused survey. This clearly leads to specific limitations:

- No data is obtained concerning the number of gymnasts not formally diagnosed with ADHD but nonetheless being treated with non-stimulant medications effective for this diagnosis.
- No data is obtained regarding siblings without formal diagnosis of ADHD but with symptoms of hyperactivity/inattention/impulsivity.
- No data is obtained as to whether gymnastics was selected as a treatment for ADHD by the gymnast's parents.
- Though the survey does inquire as to other psychiatric diagnoses, the survey does not target common co-morbidities.

The key strengths in the survey thus become its brevity and focus on prevalence.

When one considers the future for athletes with ADHD and the potential use of stimulants in-competition, it is important to better appreciate the prevalence of ADHD in specific athletic populations and whether stimulants have performance enhancing effects for the athlete with ADHD in specific sports. The authors personally expect that the planned study will reveal an increased prevalence of ADHD in the gymnastic population compared to the national prevalence leading to increased studies and whether stimulants have performance-enhancing effects for the athlete with ADHD in specific sports. The authors believe that only then will the issue of in-competition stimulant use by the athlete with ADHDbe appropriately solved. Both the athlete with ADHDand the professionals involved in his care (medical clinicians, trainers and coaches) have responsibilities to ensure that substances on the WADC Prohibited List are not utilized and that, as necessary, the appropriate TUE is obtained. Further research and education are required in this complex field of anti-doping in sports medicine.

Conclusion

In the context of a small sample population (N = 7), ADHD prevalence is reported in a surprisingly large proportion (71.4%) of gymnasts in a boys' gymnastic team. Detailed survey of a larger number of gymnasts of both genders is required to verify the high prevalence of ADHD in this population and behavioral effects of gymnastics reported by parents in this one team. A proposed research survey questionnaire to measure both prevalence

of ADHD and behavioral effects of gymnastics is presented (table 1 table 1).

Table 1 Gymnastics and ADHD: Stimulant Medication, Therapy, and Behavior Survey.

Section I — Demographics
Gymnast's age: _____
Gymnast's gender: _____
Gymnast's level: _____
Years participated in gymnastics: _____
Survey completed by: _____
Relationship to athlete: _____
Section II — Survey

1. Has the gymnast ever been diagnosed as having ADHD or ADD?
   a. Yes.
   b. No.
2. Who diagnosed the gymnast?
   a. Pediatrician.
   b. Psychiatrist.
   c. Child Psychiatrist.
   d. Therapist.
   e. Other, please specify. _____
3. Is the gymnast CURRENTLY being treated with stimulant medication for either ADHD/ADD or symptoms of hyperactivity/inattention/impulsivity?
   a. Yes, please specify medication. _____
   b. No.
4. Is the gymnast CURRENTLY being treated with therapy for either ADHD/ADD or symptoms of hyperactivity/inattention/impulsivity?
   a. Yes, please specify therapy type if known. _____
   b. No.
5. Was the gymnast EVER treated with stimulant medication for ADHD/ADD or symptoms of hyperactivity/inattention/impulsivity in the PAST?
   a. Yes, please specify medication. _____
   b. No.
6. Was the gymnast EVER treated with therapy for ADHD/ADD or symptoms of hyperactivity/inattention/impulsivity in the PAST?
   a. Yes, please specify type. _____
   b. No.
7. Do you feel the gymnast's ADHD/ADD symptoms or symptoms of hyperactivity/inattention/impulsivity have improved or worsened after starting gymnastics?
   a. Improved, please specify. _____
   b. Worsened, please specify. _____
   c. No change observed.
   d. Not applicable.
8. Has the change in symptoms of ADHD/ADD or hyperactivity/inattention/impulsivity carried over into other environments such as home or school?
   a. Yes, please specify. _____
   b. No, please specify. _____
   c. Unsure.
   d. Not applicable.
9. Do you feel the gymnast's performance during competitions is affected by medication treatment?
   a. Yes, performance is IMPROVED with medication.
   b. Yes, performance is WORSENED with medication.
   c. No, no obvious difference in performance with or without medication
10. Does the gymnast have any current/prior psychiatric diagnoses aside from ADHD or ADD?
    a. Yes, please specify. _____
    b. No.
11. Have any members of the gymnast's biological family been diagnosed with ADHD or ADD?
    a. Yes, please specify who. _____
    Are they also involved in gymnastics? _____
    b. No
12. Has the gymnast ever been identified as misusing alcohol, over-the-counter or illicit drugs?
    a. Yes, please specify what substances. _____
    b. No
13. Are you currently aware of the World Anti-Doping Code and/or USA Anti-Doping Code policies regarding stimulant medications often used to treat ADHD/ADD?
    a. Yes.
    b. No.

Thank you for your time.

Conflict of interests

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. There are no conflicts of interest to declare.

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