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## OVERCOMING VITAMIN-D DEFICIENCY IN MALE GYMNASTS DURING PRETEEN YEARS

Prof. Dr. Syed Aif Kamal and Shahid Ali Khan

### ABSTRACT

*This paper addresses the issue of vitamin-D deficiency, which is approaching epidemic scale in the Asian countries. Lack of proper nutrition and awareness contributes to this problem. After an explanation of the mechanism of production of vitamin D, the authors list adverse effects of vitamin-D deficiency and propose mandatory testing of vitamin-D deficiency during physical examinations. The remedial measures to overcome this deficiency in the context of preteen male gymnasts include supplements, proper nutrition in the form of sun-ripe fruits and vegetables as well as guarded-graduated sun-exposure. The last two are preferred over supplements as the supplements may produce toxicity, if taken in higher doses.*

**Keywords:** diet-based intervention, supplements, sun-ripe fruits/vegetables, guarded-graduated sun-exposure, school-age child

### INTRODUCTION

Vitamin-D deficiency is becoming an epidemic in this part of the world. The problem is compounded by a lack of proper nutrition in preteen youngsters and awareness. Vitamin D is defined as a group of secosteroids, which are fat-soluble. This vitamin is responsible for increasing intestinal absorption micro-nutrients, which include calcium, magnesium and phosphate as well as a number of other biological effects. The paper explains the mechanism of production of vitamin D and lists adverse effects of vitamin-D deficiency. If a mandatory testing is introduced during pre-participation and end-of-the-term physical examinations of preteen male gymnasts, remedial measures could be taken

before serious harm is done to their bodies. The remedial measures, to overcome this deficiency, include vitamin-D supplements (oral and injectable), food items (sun-ripe fruits and vegetables) as well as sun-exposure (guarded and graduated). The last two are preferred over supplements as the supplements may produce toxicity if overprescribed.

### MECHANISM OF VITAMIN-D PRODUCTION

According to Laura Tripkovic (Surrey University) and Richard Cogdell (Glasgow University) vitamin D is needed to maintain our bones and to make sure we absorb enough calcium from our diet. Sun radiation penetrates

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Alzheimer's disease
Autoimmune diseases
Backache
Cancer
Chronic fatigue
Infectious diseases
Kidney stones
Muscular and joint pain
Nullification of calcium-rich diet-plans
Progressively weakening eyesight
<b>In very young children</b>
Chronic flu
Delayed teething
Skull-bone hardening
<b>During early childhood</b>
Rickets
Tuberculosis
<b>During later childhood and adolescence</b>
Kyphosis
Lordosis
Scoliosis
<b>During adulthood</b>
Osteomalacia
<b>During old age</b>
Osteoporosis

**Figure-1: Adverse effects of vitamin-D deficiency**

skin layers called the epidermis, while there's a chemical called 7-hydrocholesterol. This chemical is absorbed through ultraviolet light to produce the pre-vitamin-D molecule. Warm skin converts pre-vitamin D3 to vitamin D3, which moves from the skin, pushed out into the capillary system and, eventually, into the blood system, where it can then be activated and used.

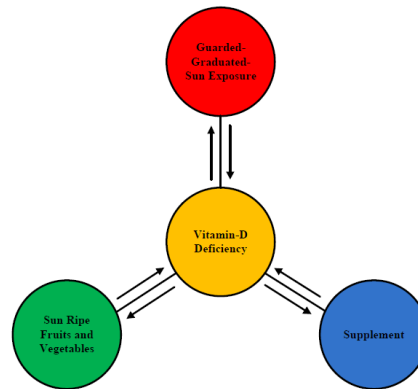
### **Adverse Effects of Vitamin-D Deficiency**

Zahoor (2012) mentioned a UK study, which isolated the problem in the population from Asia. 13 out of 14 found cases of vitamin-D deficiency were found in the Asian children. In fact, there are a lot of cases of vitamin-D deficiency in the East, in particular, Pakistan. According to the Consensus Report of the Institute of Medicine, a daily dose of 600 IU\* is recommended to maintain bones to prevent rickets and tuberculosis

(during early childhood), scoliosis, kyphosis and lordosis (during later childhood and adolescence) as well as osteomalacia (during adulthood) and osteoporosis (during old age). Untreated deficiency may be the cause of backache, chronic fatigue, muscular and joint pain as well as progressively weakening eyesight (Figure-1). In very young children, it may lead to chronic flu, delayed teething and hardening of the skull-bone. Further, deficiency of this vitamin may cause Alzheimer's disease, autoimmune diseases, cancer, infectious diseases and kidney stones (Kamal *et al.*, 2013c). Vitamin-D deficient athletes risk stress fractures, respiratory infections and muscle injuries (Angeline *et al.*, 2013; Koundourakis *et al.*, 2016).

Vitamin-D deficiency prevents calcium to be, properly, absorbed from diet and contribute towards strengthening the bones and preventing scoliosis

\*IU stands for 'International Unit', established by WHO (World Health Organization) in 1931 — 1 IU of vitamin D is equivalent to 0.025 *micrograms* of cholecalciferol or ergocalciferol.



**Figure-2: Measures to overcome vitamin-D deficiency — first appeared in Kamal (2017b)**

(Kamal *et al.*, 2015; 2016d), gaining height through tissue synthesis (Kamal *et al.*, 2013d) and maintaining optimal weight (Kamal *et al.*, 2013a). According to Villacis *et al.* (2014), male athletes are more likely to be vitamin-D deficient as compared to their female counterparts.

### Some Remedial Measures

Figure-2 shows measures to overcome vitamin-D deficiency. They are described below:

#### *Supplements*

At times supplements are prescribed to overcome vitamin-D deficiency. The authors do not endorse supplementation via intramuscular injection, tablets or syrups, as these measures, sometimes, cause severe vitamin-D toxicity, since the vitamin may fail to absorb in the body. At times the supplements, given through injection cause swelling and other complications, if they are injected in the arm.

#### *Sun-Ripe Fruits and Vegetables*

Sun-ripe fruits and vegetables, also, provide vitamin D and are the natural way to overcome deficiency.

#### *Guarded-Graduated Sun-Exposure*

Air and sun exposure is needed by

the students to get adequate doses of vitamin D. A guarded-graduated approach should build up tolerance to sun-exposure, resistance to common colds as well as produce a melanin layer on skin, which protects the students from getting skin cancer, at the same time acclimatizing child to heat effects (American Academy of Pediatrics — Committee on Sports Medicine, 1982). *Guarded* means strict overexposure surveillance for possible harmful effects and *graduated* means systematic exposure increase in order to condition body to tolerate increased doses.

The authors, strongly, advocate that the most natural, the cheapest and the safest way is to expose skins of preteen male gymnasts to sunshine, at those times when sunrays are inclined and coming from a denser layer of atmosphere, so that intensity is reduced and harmful rays are cut down by absorption or removal from the main beam (Rybicki & Lightman, 1979). However, the sun should be treated with respect (Brady, 1958). Initially, start with a 10-minute exposure, gradually, increasing to 20 and, later, to 30 minutes, accompanied with 2-3-hour, fresh-air exposure in the shade. As there are no known risks associated

According to *Consensus Report of the Institute of Medicine* (November 30, 2010), recommended daily dose is 600 IU. 13 out of 14 cases were discovered in the Asian children — *UK Study*

Supplementation via intramuscular injection, tablets or syrups fails to absorb at times and may cause severe vitamin-D toxicity.

The safest, the most natural and the cheapest way is to expose boys' skins to sunshine, at times when sunrays are inclined and coming from denser atmosphere.

For guarded-graduated sun exposure, initiate with a 10-minute exposure to boys' bodies, gradually increasing to 20-30 minutes, combined with 2-3 hour (or even more during summer) fresh-air exposure.

During initial contact with rays of sun, apply appropriate SPF sunscreen to the uncovered body-parts of boys.

Boys should be dressed in briefs only, stripped-to-waist, barefoot and barehead, for sun treatment.

Boys should have their backs towards the sun to protect their eyes.

**Figure-3: Vitamin-D deficiency: Some facts and remedial measures — adapted from Box-2 of Kamal & Khan (2014)**

with the air-exposure practice, the duration of this activity may be increased. During the initial sun exposure, the authors recommend that gymnasts cover their exposed body-parts by an appropriate SPF (Sun-Protection Formula) sunscreen. The gymnasts should be minimally dressed, exposing hair, hands, arms, shoulders, backbone and back skin from external auditory meatus to waistline, legs from mid-thighs to feet. During this period, engage gymnasts in light floor activities, involving drawing, singing, scribbling, playing jigsaw puzzles or board games (*e. g.*, ludo), *etc.* Story reading/telling by teacher may form a structured activity. During an outdoor activity, the teacher should sit facing the sun and the students must have their backs towards the sun to protect their eyes (Kamal & Khan, 2014).

The importance of skin exposure of these gymnasts to the early morning (for the morning-shift schools) or the later-afternoon (for the afternoon-shift schools) sun cannot be overemphasised.

A mirror exercise is needed by parents, whereby they should allow the boys to play in the sun stripped-to-waist, wearing only shorts/trousers in the later afternoon (for the morning-shift schools) or the morning (for the afternoon-shift schools). These dressing practices should, also, give the skin an opportunity to breathe. Figure-3 summarizes these ideas.

### **PRETEEN MALE GYMNASTS AND VITAMIN-D DEFICIENCY**

Primary-school instruction in gymnastics is based on aesthetic, cognitive, creative, physical, psychological and skill components, with or without use of apparatus (Carroll & Manners, 2003). Gymnastics is a sport, which relies on human-body-physiological functioning, so that there is an all-round harmonious development of human body (Joseph, 1949). This sport being a show of strength, speed, coördination, balance and agility, requires concentration, flexibility and devotion. Vitamin-D

No food or drink 1.5 *hour* before the start of a gymnastic session.

Upon arrival, boys are given morning inspection, stripped to short underpants, barefoot, all clothing above the waist removed — safety, hygiene and health (physical and mental) components; clothing worn from home stored in locker after security-check (hand-held detector).

Setting-up exercises, followed by light floor and structured activities, are performed in open air and sunshine so that the students get their required daily doses of vitamin D.

During the above activities, boys should have hair exposed, completely undressed except briefs, barefoot, having backs toward the sun to protect eyes.

Complete change of clothes for classroom lessons, gymnastic sessions and rest sessions.

End-of-class exercises performed for 5 *minutes*.

For gymnastic sessions, boys change into prescribed kit for their respective age groups.

Pre-departure inspection and handing over students to their parents.

**Figure-4: Typical routine of a day scholar at a gymnastic school — adapted from Figure-2a of Kamal & Khan (2015)**

deficiency in gymnasts should affect, severely, their performances on various apparatuses, as their bones would not be supporting their bodies for the optimal technique, variability and control required for this sport (Hiley & Yeadon, 2015).

### **Integration of Remedial Measures in Gymnastic-School Setup**

Figure-4 outlines the routine of a typical day of a gender-segregated-gymnastic school suggested by the authors.

#### *Morning Inspection*

There should be a morning inspection, covering safety and security, mental and physical health as well as cleanliness and hygiene. The first one should focus on absence of communicable diseases (for example, infections, skin problems), whereas the second one is conducted for the purpose of uncovering any form of abuse (verbal, physical, sexual), peer pressure/bullying (any unexplained bruises or cuts should be

be investigated), neglect and tendencies to destructive/suicidal behavior (Kamal & Khan, 2014) as well as spotting signs and symptoms of depression or schizophrenia (Kamal & Jamil, 2012) supplemented by remote video-monitoring of behavior by educational psychologists. The hygiene portion of inspection should be devoted to looking for cleanliness related to hair, mainly checking for lice, nails, uniform, shoes, vest, underwear and socks as well as a thorough inspection of feet (Kamal *et al.*, 2011*b*). Those presenting with the slightest deviations from normal health statuses (class teacher should compare current-day health-status with the last seven entries to spot unusual findings) should be sent to school doctor for a complete examination (with the student undressed), before allowed mixing with other students. Unclothed-morning-inspection practices are common in Russian crèches, which are headed by doctors.

**Table-1: Morning inspection to check for health statuses (mental and physical)<sup>Σ</sup>, hygiene, safety and security considerations — preteen male gymnasts stripped to short underpants for this inspection<sup>⊕</sup>**

<i>Inspection Component</i>	<i>Description</i>
<b>Safety<sup>⊕</sup> and Security<sup>⊕</sup></b>	Main purpose is to stop import of controlled substances: illegal drugs, pointed/sharp objects and all types of weapons (canine teams, observers, mandatory hand searching of school bags and clothing, sending carryon baggage through X-ray machine — shoes, clothes and other personal items carried close to body should not be X rayed)
<b>Mental Health</b>	Prime purpose is to spot depression, neglect, peer pressure, verbal abuse, schizophrenia, signs and symptoms of destructive behavior (video-monitoring from another room by educational psychologists)
<b>Physical Health</b>	General purpose is to pinpoint communicable diseases ( <i>e. g.</i> , infections, skin problems), signs of bullying/physical abuse (documentation as well as detailed questioning and investigation of unexplained bruises or cuts <sup>Ξ</sup> )
<b>Hygiene</b>	Inspection should include general appearance, very short hair (for presence of lice), nails (clean and trimmed), shoes (polished or not), socks (clean/ non-smelly), tidiness, uniform (clean and properly ironed), underwear, vest as well as thorough inspection of feet, in particular, between toes (for presence of fungus infection)

<sup>Σ</sup>The students, who show slightest deviation from normal health statuses (physical and mental), all new entrants to school and those reporting from sick leave should be examined completely by the school doctors as well as evaluated by the school psychologists before being allowed to mix with the other students (Kamal *et al.*, 2017b).

<sup>⊕</sup>Adapted from Table-3 of Kamal & Khan (2014)

<sup>⊕</sup>Logbook should be maintained to enter students' arrival and departure as well as anything found in the morning inspection (to, legally, protect school authorities). Any unusual findings should be entered in student's diary and explanation sought from parents. Parents should be required to enter similar timings in the diary, so that any extra time spent by students during traveling is monitored. In case of an unauthorized absence, school authorities should call parents to rule out the possibility that a child left for school but did not reach there. Effective surveillance is the key to spotting internal injuries, possible abuse and may prevent student abductions en route to school or while going back home.

<sup>⊕</sup>Has taken center-stage in the wake of shooting spree by gun-holding individuals in the Marjory Stoneman Douglas High School, Parkland, Florida, United States (2018) and the Sandy Hook Elementary School, Newton, Connecticut, United States (2012); terrorist attack in the Army Public School and College, Peshawar, Khyber Pakhtunkhwa, Pakistan (2014) as well as terrorist take over in School Number One, Baslan, North Ossetia-Alania, Russia (2004) — the authors recommend that the person and the belongings of all newcomers (prospective parents, prospective students, persons bringing in deliveries/providing services or doing repairs, individuals/groups from any institution/agency) should be checked before they are allowed to enter the school premises.

<sup>Ξ</sup>School physician must conduct a complete, unclothed examination of any student reporting for even a minor cut or bruise to rule out damages and abrasions to other parts of body as well as internal injuries — mandatory for safety of students and legal protection of school/club.

There are, also, indications that selected schools in Asia, Europe and North America have adopted these practices. Visits to doctor shall be reduced if drills are arranged to reinforce practice of hand washing after activity programs,

before and after eating as well as after responding to call of nature. Summary of morning inspections is available in Table-1 and details may be found in Kamal & Khan (2014). It would be best if the initial activity of



**Table-2: Exercise plans for preteen male gymnasts<sup>Ω</sup>**

<i>Exercise Name</i>	<i>Description</i>
<b>For the following, all boys strip to waist</b>	
<b>Setting-up exercises</b> (at the start of school day)	Stretching hands (palms together) to front and top of head (stretching body by standing on toes), reaching to toes such that knees are not flexed, exercising to relax neck muscles (chin up, chin down, neck turned to left and right at an angle of 90 degrees)
<b>End-of-class exercises</b> (for 5-minute duration)	Stretching, bending sideways, bending to touch toes with knees extended, moving head up and down, rotating neck on both sides so that the respective chin is aligned with shoulder
<b>For the following, younger boys strip to briefs; older to figure-hugging half pants<sup>†</sup></b>	
<b>Exercises to increase height</b> (for stunted <sup>‡</sup> students)	Light-stretching exercises (bar hanging, mild stretching, summer-sault, cartwheel) — diet plan <sup>©</sup> should include calcium-, protein- and fiber-rich diet
<b>Exercises to gain weight</b> (for wasted <sup>∇</sup> students)	Heavy exercises performed for shorter duration, consistently — diet plan <sup>©</sup> should include milk, potato items and protein-rich diet (meat, fish)
<b>Exercises to lose weight</b> (for obese <sup>‡</sup> students)	Light exercises performed for longer duration, consistently — diet plan <sup>©</sup> should include salad and yogurt

<sup>Ω</sup>Adapted from Table-2 of Kamal & Khan (2014). All these exercises should be performed outdoors, weather permitting — setting-up exercises with the students' backs towards the sun, all of the other set of exercises in the shade of trees

<sup>†</sup>All clothing above the waist removed, barefoot indoors, sneakers (plimsolls) outdoors

<sup>‡</sup>Lesser height-for-age (below 50<sup>th</sup> percentile of height; our group defines stunting as height lesser than current-age-mid-parental height)

<sup>∇</sup>Lesser weight-for-height<sup>£</sup> (percentile of mass lesser than percentile of height)

<sup>‡</sup>Excess weight-for-height (percentile of mass greater than percentile of height)

<sup>©</sup>All diet-based interventions would be ineffective if the student is suffering from vitamin-D deficiency

school day were based on light gymnastic-exercises outdoors. As the students would be undressed for these activities, the morning inspection could be carried out smoothly.

Exercise routine for students in the gymnastic school, which include setting-up exercises, end-of-class exercises as well as exercises to pick-up height and put-on/shed-off weight, preferably, conducted outside in fresh air and, possibly, under the sun during moderate weather, is listed in Table-2.

#### *Attire for Gymnastic Activities*

Age-appropriate hairstyle, footwear and clothing for preteen male gymnasts for instruction program of gymnastics, which is *efficient*, requiring

the least amount of time spent in changing, as well as *effective*, rendering quality instruction. Such a kit choice should allow the coach to view a gymnast's neck, shoulders, scapulae, body triangles, spinal dimples as well as spinal outline from external auditory meatus to hip joint without obstruction (Kamal & Khan, 2015). Gymnasts are given numbered boxes, in which they store their accessories for safekeeping.

Boys should have very short hair. They should do gymnastics barefoot, indoors as well as outdoors. Where barefoot is not possible during outdoor gymnastic activities, the students should wear white sneakers with white cotton socks. Disinfectant powder needs

<sup>£</sup>Equivalent to mass-for-height; weight being proportional to mass in uniform, homogeneous gravitational field

In Gymnastic Clothing
Colored Gym Clothing/Underwear (for training sessions)
Fancy Strings
Loose Strings
Silky Gym Clothing/Underwear
Straps
Zippers
Other Accessories
Belt
Bow
Cap
Dress Shoes
Jewelry (chain, finger ring, locket)
Shirt
Shorts
Socks (made of synthetic material)
Street Shoes
Tie
Trousers
T-shirt
Vest
Watch

**Figure-5: Prohibited items during gymnastic activities of preteen male gymnasts — adapted from Figure-1 of Kamal & Khan (2015)**

to be applied before putting on socks.

Children’s attire during physical activity is being discussed for a long time (Curtis, 1922). Gym kit should not be loose enough to prevent the garment from getting caught into equipment, furnishings or fixtures. During head-stand and summersault, baggy attire and loose garments (*e. g.*, T-shirt) may come over faces of gymnasts, obstructing vision and causing accidents. Further, gym clothing should not have loose strings or straps. Loose garments, strings or straps may get tangled into asymmetric bars or vault. Zippers are, also, not allowed, as these items damage apparatus. On the other hand, gym outfit should, also, not be too tight (at the waist and around thighs), prohibiting free movement as well as heating/irritation of genital areas. Gym apparel should be form fitting, white/light-colored having elastic bands at waistline/around thighs, good enough to hold the garment in place

and prevent private-part exposure.

The items, which are prohibited during gymnastic lessons include belt, bow, cap, chain, dress shoes, (silky) gym clothing, locket, rings, shirt, shorts, socks (made of synthetic material), street shoes, T-shirt, tie, trousers, vest and watch (Figure-5). Preteen gymnasts get heated, quickly. Committee on Sports Medicine of the American Academy of Pediatrics (1982) proposed, “Clothing of exercising child should be light-weight, limited to one layer of absorbent material in order to facilitate evaporation of sweat and *expose as much skin as possible.*” Hence, the authors suggest that younger students exercise in minimal clothing. The benefits include:

- a) During the outdoor exercises, performed in secluded grassy patches, gymnasts get their vitamin-D doses from air and sun exposure.
- b) Minimal attire makes the coach

- aware of obese/wasted gymnasts.
- c) The gymnasts would be compelled to maintain balanced gait and improved body image.
  - d) It gives the coach a chance to observe unconscious posture/free movement.
  - e) Gymnasts in this age group grow rapidly; fitting clothing, purchased at the beginning of school year, becomes tight quickly. Loose clothing looks shabby, besides being unsafe for apparatus activities.
  - f) Gym kit kept on during the entire activity does not allow body to breathe, becomes sweat-soaked, causing skin infections, irritations and tan lines on shoulders/arms.
  - g) During free play, mud/water/sand activities, upper portion of kit gets damp and dirty, causing students to get cold or chest infections.
  - h) Undressing to underclothes for training sessions saves time and money as well as increases tactile stimulation.

Other arguments may be seen in Kamal & Khan (2015). Table-3 lists recommended kit for training and public-performance sessions of preteen male gymnasts.

Boys should have very short hair. They should do gymnastics barefoot, indoors as well as outdoors. Where barefoot is not possible during outdoor gymnastic activities, the students should wear white sneakers with white cotton socks. Disinfectant powder needs to be applied before putting on socks.

#### *Attire in Classrooms*

The first author proposed earlier that classroom sections should, also, be

formed according to build to allow students to switch seating during middle of class — front-of-classroom students sent to back and vice versa. This would serve the purpose of breaking mischief groups and allowing the students opportunity to make new friends. Further, students having *big build* (body dominating brain) would not be forced to sit on the backbenches all the time, every time compared, for classroom performance, with students having *small build* (brain dominating body) — the later, already, smart due to their anatomical and physiological structures, at the same time receiving maximum attention from teachers, who teach, generally, from the front of classroom<sup>‡</sup>, provide passive motivation to big-build students, in this setup, to (physically) bully small-build students (Kamal, 2015d). In the professional training programs for mature audiences, switching of seats during the middle of a session is standard practice.

Keeping students attired in long-sleeved shirts and neckties all week long does not increase productivity, in particular, during, hot, humid season, with occasional absence of light in this country. The authors suggest that in a 5-day week, preteen male gymnasts dress in T-shirts, no undershirt/vest, for 3 days, formal dress, long-sleeved shirt, tie and jacket, for 1 day (used for formal presentations by students) and remain stripped-to-waist for 1 day (allowing their skins to breathe). It would be interesting to document their creativity, productivity and adherence to school discipline during these three dressing periods. If the educational philosophy of the Nikitin family in the suburb of Moscow, Russia and the authorities of the Hikari Kindergarten

<sup>‡</sup>In the interactive classrooms of third millennium, the instructor (facilitator) does not teach from the front of classroom, but mixes with students sitting in any row, using modern teaching aids, e. g., iPad.

**Table-3: Recommended hairstyle, footwear and clothing for training and public-performance sessions of preteen male gymnasts<sup>⊗</sup>**

<i>Setting</i>	<i>Training Session</i>	<i>Public-Performance Session</i>
<b>Hairstyle<sup>⊕</sup></b>		
<b>Indoors</b>	Very short hair	Very short hair
<b>Outdoors</b>	Very short hair	Very short hair
<b>Footwear<sup>⊕</sup></b>		
<b>Indoors</b>	Barefoot	Barefoot
<b>Outdoors</b>	Pure-cotton socks + sneakers (plimsolls)	Pure-cotton socks + sneakers (plimsolls)
<b>Clothing<sup>⊖</sup></b>		
<b>Under 7</b>		
<b>Indoors</b>	A <sup>⊘</sup> : Briefs	A: Briefs
	B <sup>Ⓜ</sup> : Briefs	B: Briefs
	C <sup>⊙</sup> : Briefs	C: Briefs
<b>Outdoors</b>	During colder weather, coats/sweater to be worn for warn-up and cool-down activities	
<b>Under 9</b>		
<b>Indoors</b>	A: Briefs	A: Briefs
	B: Briefs	B: Briefs
	C: Briefs	C: Briefs
<b>Outdoors</b>	During colder weather, coats/sweater to be worn for warn-up and cool-down activities	
<b>Under 11</b>		
<b>Indoors</b>	A: Briefs	A: Figure-hugging half-pants
	B: Briefs	B: Figure-hugging half-pants
	C: Figure-hugging half-pants	C: Figure-hugging half-pants
<b>Outdoors</b>	During colder weather, coats/sweater to be worn for warn-up and cool-down activities	
<b>11+</b>		
<b>Indoors</b>	A: Figure-hugging half-pants	A: Figure-hugging half-pants
	B: Figure-hugging half-pants	B: Figure-hugging half-pants
	C: Figure-hugging half-pants	C: Figure-hugging half-pants
<b>Outdoors</b>	During colder weather, coats/sweater to be worn for warn-up and cool-down activities	

<sup>⊗</sup> Adapted from Tables-1 & -2 of Kamal & Khan (2015) — training sessions are gender segregated

<sup>⊕</sup> For all ages

<sup>⊖</sup> Gymnastic teams and classroom sections should be formed according to build (Kamal, 2015*d*), recommended to allow students to switch seating during middle of class; gym clothing should be form-fitting, made of absorbent material; training-session clothing should be white to allow posture and motion studies using moiré fringe topography and dotted rasterstereography; public-performance-session clothing should be light-colored representative of different teams

<sup>⊘</sup> Team A/(Classroom) Section A should comprise of ‘small build’ (brain dominating body: analytical/mental tasks) gymnasts— sum of scaled percentiles of height and mass less than 50; scaled percentiles are obtained by mapping 40<sup>th</sup> CDC percentile to 50<sup>th</sup> scaled percentile; 0 is mapped to 0 and 100 to 100 (Kamal & Khan, 2015; Kamal *et al.*, 2017*b*)

<sup>Ⓜ</sup> Team B/Section B should comprise of ‘medium build’ (equal contribution of brain and body) gymnasts — sum of scaled percentiles of height and mass equal to or more than 50, but less than 150

<sup>⊙</sup> Team C/Section C should comprise of ‘big build’ (body dominating brain: tasks involving strength and power) gymnasts — sum of scaled percentiles of height and mass equal to or more than 150, but less than 200

in Tokyo, Japan is valid (children in both these setups remain uncovered from the waist up, all year long, even going outside to play in snow), the above-mentioned indicators should be

maximum on that 1 *day*, the gymnasts remain stripped-to-waist, followed by those 3 *days*, when the gymnasts wear light T-shirts.

## **Mandatory Vitamin-D Deficiency Testing during Physical Exams**

The authors recommend testing of vitamin-D deficiency during pre-participation and end-of-the-term physical examinations, which are described below:

### *Pre-Participation Physical Examination*

This comprehensive psychological, physical and motor examination combined with fitness testing (Kamal & Khan, 2013) should concentrate on safety considerations of the potential gymnasts, their teammates, their coaches and the gymnastic school/club staff (Kamal *et al.*, 2017b). Its purpose is set to bring into light conditions, which may cause serious injury and harm during gymnastic routines, *e. g.*, cardiac problems, epilepsy, hernia or hydro seal, acute malnutrition (Kamal, 2015a) as well as conditions, which may be corrected, *e. g.*, knees joining/knees knocking and excessive obesity (Kamal, 2015b; 2017b). Main emphasis should be on detection of communicable diseases, in particular, skin problems, evaluation of sight and hearing (severe impairment may render the gymnast vulnerable to accidents) as well as presence of acute malnutrition, fatigue and psychological disorders. Gymnasts must be barefoot, undressed to briefs, all clothing above the waist removed, in the beginning. Underwear must be removed for genital (puberty rating, signs of sexual abuse, venereal diseases), orthopedic (posture, gait, presence of trunk deformities, cerebral palsy and rickets), nutritional-status (vitamin-D deficiency, signs of neglect, classification as under nutrition, over-nutrition, energy channelization I-III — Kamal, 2015a) and skin (signs of

physical abuse, presence of skin cancers) examinations. Net mass (mass with no clothing worn) could, also, be taken during this segment. These segments should be grouped together to reduce time for the gymnast to remain totally disrobed. Information on abnormalities detected should be provided to gymnastic coaches, class teachers and parents. Table-4 lists appropriate hairstyle, footwear and clothing for free play and observation, psychological testing, physical examination and fitness testing of gymnasts.

### *End-of-the-Term Physical Examination*

This should integrate psychological testing with physical examination combined with fitness testing, with gymnasts completely stripped except underwear, of course with nothing on above the waist. It should be, mainly, based on performance considerations and improvements achieved compared to previous term as well as psychological disorders, *e. g.*, trends of anorexia and bulimia (Alexescu *et al.*, 2014).

In both of the above health appraisals, heights, masses (weights) and mid-upper-arm circumferences of gymnasts should be recorded using enhanced anthropometric instruments, capable to record heights and masses to least counts of 0.005 *cm* and 0.005 *kg*, respectively (Kamal *et al.*, 2016b), according to laid-down protocols (Kamal, 2006; 2017a; c — Additional File 2; Kamal *et al.*, 2013e) by reproducible measurers (Kamal and Razzaq, 2014). Recorded heights and masses should be used to assign build of gymnasts (Kamal & Khan, 2015) using scaled percentiles suitable for the Pakistani population (Kamal *et al.*, 2017b), compute estimated adult-

**Table-4: Hairstyle, footwear and clothing for free play and observation, psychological testing, physical examination<sup>‡</sup> and fitness testing of preteen male gymnasts**

<i>Session</i>	<i>Preteen Male Gymnasts</i>
<b>Hairstyle</b>	
<b>Free Play and Observation<sup>†</sup></b>	Very short hair
<b>Psychological Testing</b>	Very short hair
<b>Physical Examination</b>	Very short hair
<b>Fitness Testing</b>	Very short hair
<b>Footwear</b>	
<b>Free Play and Observation</b>	White pure-cotton socks + black pure-leather (mocasion) shoes with foot support <sup>‡</sup>
<b>Psychological Testing</b>	White pure-cotton socks + black pure-leather (mocasion) shoes with foot support
<b>Physical Examination</b>	Barefoot
<b>Fitness Testing</b>	Barefoot
<b>Clothing</b>	
<b>Free Play and Observation</b>	<i>Younger:</i> Vest <sup>‡</sup> and shorts with briefs <i>Older:</i> T-shirt <sup>‡</sup> and trousers with briefs
<b>Psychological Testing</b>	<i>Younger:</i> Shorts with briefs, stripped-to-waist <sup>λ</sup> <i>Older:</i> Trousers with briefs, stripped-to-waist
<b>Physical Examination</b>	White <sup>⊃</sup> briefs only, legs exposed from upper thighs to feet, stripped-to-waist
<b>Fitness Testing</b>	White <sup>⊃</sup> briefs only, legs exposed from upper thighs to feet, stripped-to-waist

<sup>†</sup>Should include testing for vitamin-D deficiency.

<sup>†</sup>Gymnast is observed unaware for 10 *minutes* for social interaction with parent(s) and other children.

<sup>‡</sup>Disinfectant powder is to be applied between toe and thumb as well as between toes before wearing clean socks on dry feet.

<sup>‡</sup>Absolutely nothing is to be worn under vest or T-shirt, which must be put on only dry skin. Disinfectant powder is to be .applied on dry skin before wearing underpants.

<sup>λ</sup>Passive observation of posture and gait (with shoes on), concentrating on upper torso, is conducted .during walking, standing (free speech), sitting (on chair/free writing), sitting (on floor/working on .jigsaw puzzle) and drawing various figures (self, family) on whiteboard in this segment of .examination.

<sup>⊃</sup> White color is needed to conduct moiré and raster examinations (Kamal & Khan, 2015).

height (Kamal *et al.*, 2017a; Malina & Bielicki, 1996), so that those planning to serve in the Armed Forces of Pakistan, may plan their exercise routines, accordingly, and generate Growth-and-Growth-and-Obesity Profiles (Kamal *et al.*, 2011) as well as Growth-and-Obesity Vector-Roadmaps (Kamal, 2017c; Kamal *et al.*, 2016a) of gymnasts using mathematical tools (Kamal, 2008; 2014) and employing enhanced growth charts, with height and mass

values in the range — 0.01<sup>th</sup> percentile to 99.99<sup>th</sup> percentile (Kamal & Jamil, 2014). End-of-the-Term evaluation should, also, include a detailed examination of posture (Kamal, 1996) and gait: walking (normal — mainly, looking for arm-swing asymmetry, limp and spastic gait; on heels; on toes; heel-to-toe; with book on head) and running (Kamal *et al.*, 1996; 2016c), including meticulous examination of feet (Kamal *et al.*, 2011a). There should

be emphasis on screening for skeletal deformities, in particular, scoliosis, preferably using moiré fringe topography (Akram and Kamal, 1991; Kamal *et al.*, 2015*b*) and rasterstereography (Kamal *et al.*, 2016*d*) during the preteen years (later-childhood years). The examinations, which require removal of underwear, should not be conducted in the presence of other gymnasts.

## CONCLUSION AND RECOMMENDATIONS

Vitamin-D deficiency combined with inability of bones to absorb iron and calcium is approaching an epidemic among younger population. Lack of out-door physical activities; excessive screen time (TV, computer, cell phone, *etc.*) and use of carbonated drinks are some of the factors contributing to this state of affairs. The nation must rise up to this challenge by mandating soft-drink producers to print detailed warning on their bottles/cans of the adverse effects of their products, as is the practice for all cigarette brands. In addition, students should be

asked to go outdoors more often, for 10 *minutes* after every 2 sessions of 45-*minute* each and perform light exercises in the sun, eyes should be protected by sun glasses. They should be encouraged to consume sun ripe fruits and vegetables as snacks instead of bakery items. Screen time should be limited to 1 *hour* during the entire day (half-an-*hour* for TV, half-an-*hour* for computer/tablet). Teachers should be trained to spot vitamin-D deficiency in their morning inspections. Those showing vitamin-D deficiency after laboratory tests should be put in specialized programs to overcome the problem. As all diet-based interventions to increase height and maintain weight are ineffective in the presence of vitamin-D deficiency, gymnasts would not be able to attain their full growth potential if they are suffering from this disorder. A robust and a progressive gymnastic program to produce Olympic-level gymnasts in our country could not be materialized if such drastic measures to overcome vitamin-D deficiency in male gymnasts are not taken.

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