Vitamin D in adolescents: a comprehensive review of guidelines and recommendations
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Introduction
- Vitamin D plays a key role in bone health of adolescents and has also potentially certain extra-skeletal health benefits.
- Hypovitaminosis D in adolescence is highlighted as a global public health concern.
- Practical guidelines help clinicians make their preventive and therapeutic choices and improve care management.

Objectives
To collect and synthesize available recommendations concerning vitamin D in adolescents, mainly vitamin D thresholds, dietary requirements, prophylactic supplementation and treatment of deficiency. To explore their level of consensus or the potential discrepancies.

Methods
- Systematic review and narrative synthesis of the literature
- Search design: clinical recommendations published by scientific societies and organizations as well as official reports published by the departments of health of different governments from different regions of the world
- Search terms: (vitamin D OR nutritional rickets) AND (guideline OR recommendation OR consensus OR statement)
- Selection criteria: Publications specifically targeting adolescents (defined as those from 10 to 19 years)
- Publications about general population with a reference for the adolescent subgroup
- Publications regarding full range of childhood (from birth to 18 years)
- Languages: English and French. Publication until December 31, 2017

Results
- 31 documents. Most of them targeted the general population, not specifically adolescents
- Almost one reference for each and every continent (Europe, America, Australia, Asia)
- 3 study groups issued guidelines applicable to patients with chronic diseases (rickets, chronic kidney disease, cystic fibrosis)
- Publications concerned either healthy populations or subgroups at risk for deficiency

Definition of vitamin D status
- Lack of consensus in defining 25(OH)D normal values
- Agreement on 25(OH)D > 25-30 nmol/L to avoid poor bone health
- Lack of consensus on the optimal 25(OH)D concentration values to aim for, levels varying between 25 nmol/L and 125 nmol/L
- Study groups who consider the higher levels for optimal vitamin D status are based also on its potential pleiotropic functions

Prophylactic vitamin D supplementation
- Agreement on the need for a preventive dose for adolescents at risk
- Doses are debated, ranging from doses equal to DRIs (400-1,000 IU/d) to doses at least 2 to 3 times higher (2,000 IU/d)
- Lack of consensus on the need to supplement healthy adolescents
- Recommended doses vary between 400 IU/d and 1,000 IU/d depending on sun exposure, consumption of vitamin D fortified foods, skin pigmentation and body weight

Dietary Reference Intakes (DRIs)
- No true consensus, values varying between 200 IU/d and 1,000 IU/d
- DRIs in accordance with the relevant 25(OH) sufficiency threshold:
  - 400 IU/d if sufficiency cut-off level is set to 25-30 nmol/L
  - 600 IU/d if sufficiency cut-off level is set to 50 nmol/L
  - 1,000 IU/d if sufficiency cut-off level is set to 75 nmol/L
- Agreement on Upper Intake Level (UL) estimated at 4,000 IU/d

Treatment of vitamin D deficiency
- Agreement on oral vitamin D (ergocalciferol/D2 or cholecalciferol/D3)
- Several daily therapeutic regimens proposed. Duration 1-3 months
  - 1,000-2,000 IU/d if 25(OH)D between 50 and 75 nmol/L
  - 3,000-10,000 IU/d if 25(OH)D < 50 nmol/L
- Alternatively: weekly doses: 50,000 IU per week for 6-8 weeks
  - Monthly doses: 1 single dose of 300,000 IU or 2 doses of 150,000 at a 6-week interval

Conclusions
- At present, there is no true consensus among different societies and different countries about vitamin D in adolescence.
- In clinical settings, this lack of consent makes decisions difficult or problematic, at least under certain clinical conditions.
- Strong guidance is needed to establish homogenous, evidence-based recommendations. Our findings could promote further research concerning the use of valid tools in order to evaluate the development process of the current guidelines.

Indicative Bibliography