biology and life sciences forum

MDPI

Proceeding Paper

Dietary Intake of Vitamin D in Young University Students from Leicester, England †

Antonio Peña-Fernández [1,2,*], Edna Segura [3], María de los Ángeles Peña [4] and Manuel Higueras [3]

[1] Department of Surgery, Medical and Social Sciences, Faculty of Medicine and Health Sciences, University of Alcalá, Ctra. Madrid-Barcelona, Km. 33.600, 28871 Alcalá de Henares, Madrid, Spain
[2] Leicester School of Allied Health Sciences, De Montfort University, Leicester LE1 9BH, UK
[3] Scientific Computation & Technological Innovation Center (SCoTIC), Universidad de La Rioja, Logroño, Spain; email1@email.com (E.S.); email2@email.com (M.H.)
[4] Departamento de Ciencias Biomédicas, Universidad de Alcalá, Crta. Madrid-Barcelona Km, 33.6, 28871 Alcalá de Henares, Madrid, Spain; email3@email.com
* Correspondence: antonio.penafer@uah.es
† Presented at the 3rd International Electronic Conference on Nutrients, 1–15 November 2023; Available online: https://iecn2023.sciforum.net/.

Abstract: About 30–40% of the general population in the United Kingdom (UK) has been reported to have vitamin D deficiency during winter months, representing a public health risk. The aim was to assess the dietary intake of vitamin D in university students at De Montfort University (DMU, UK). Nutrient intake was collected from 111 (20.45 yrs-old; 78 female) DMU students (41 Asia, 41 Africa, 27 Europe). The dietary intake of vitamin D was slightly higher in male participants (4.287 vs. 3.853 μg/day; p-value = 0.196), which could be attributed to the generally higher intake of food products rich in this vitamin, specifically cereals (436.165 vs. 308.750 g/day; p-value = 0.002), meat (271.553 vs. 193.063 g/day; p-value = 0.016) and bacon (4.911 vs. 1.551 g/day; p-value = 0.024), which were significantly higher in males. The dietary intakes of vitamin D recorded are lower than the recommended amount of 10 μg/day by the UK's National Health Service. The intakes did not show statistical differences according to ethnic background [Asian (3.708) < African (4.109) < European (4.199); all in μg/day], which might reflect poor and similar dietary habit/choices when they transition from home into university regardless of their ethnic background. Our results suggest some prevalence of hypovitaminosis D in DMU students, which should be tackled to prevent diseases related to vitamin D deficiency.

Keywords: vitamin D; dietary intake; vitamin D deficiency; university students; ethnic background; Leicester

Citation: Peña-Fernández, A.; Segura, E.; de los Ángeles Peña, M.; Higueras, M. Dietary Intake of Vitamin D in Young University Students from Leicester, England. *Biol. Life Sci. Forum* **2023**, *29*, x. https://doi.org/10.3390/xxxxx

Academic Editor(s): Name

Published: date

1. Introduction

Vitamin D is a group of fat-soluble secosteroid hormones responsible for increasing the intestinal absorption of important minerals including calcium (Ca), magnesium (Mg) and phosphate (PO_4^{2-}), and maintaining their homeostasis to support bone metabolism [1,2]. Vitamin D deficiency is becoming common worldwide, and has been defined as *globally endemic hypovitaminosis D* [2]. Thus, for example, Dunlop et al. [3] has detected that 32% of young Australian adults aged 18–24 years had serum 25-hydroxy-vitamin D [also known as calcidiol or calcifediol, 25(OH)D, which is used as biomarker of vitamin D status] concentrations below 50 nmol/L, the most widely accepted cut-off for vitamin D deficiency [4]. 32.6% out of 103 healthy university students (22.3 years old; 48.3% male, 26.1% female) living in the Canary Islands (Spain) had vitamin D deficiency (<50 nmol/L), indicating that even in countries close to the equator with high levels of sunshine suffer vitamin D deficiency, possibly because individuals living in these countries try to avoid skin exposure to sunlight [5]. In relation to the United Kingdom (UK), about 30–40% of the general population has been reported to have vitamin D deficiency (concentrations below 25 nmol/L) during winter months [1]. As such, monitoring vitamin D status is of the upmost importance to identify risks, especially in children and in young individuals. These risks would be even higher in European countries as only a few food items are fortified with vitamin D [4].

Thus, the aim of our study was two-fold: (a) to assess the dietary intake of vitamin D in a young population of university students at De Montfort University (DMU, UK), to identify potential deficiencies in this relevant group of the population, who have been little studied in epidemiological studies; (b) to investigate the effectiveness of a previously validated food frequency questionnaire (specifically the European Prospective Investigation into Cancer and Nutrition Norfolk Food Frequency Questionnaire, EPIC-Norfolk FFQ), which was specifically tailored to include individuals from different ethnic backgrounds, as DMU has a diverse student population mainly comprised of Black, Asian and Minority Ethnic groups.

2. Material and Methods

A total of 111 (20.45 ± 1.16 yrs-old; 78 female) DMU students voluntarily participated in this nutritional and biomonitoring study between 2015–2016, specifically from three major ethnic backgrounds (selected as the continent in which they born: 41 Asia, 41 Africa, 27 Europe), following previous methods described by our team in Peña-Fernández et al. [6,7].

Participants completed a validated variant of the Nutrition Norfolk Food Frequency Questionnaire (FFQ; version 6, CAMB/PQ/6/1205) [8] with more than 130 food items, which also records the portion. The used FFQ was appropriately adapted to include different food items popular from the different ethnic backgrounds studied following previous experiences of developing FFQs [9] and guidance on popular foods in the UK [10]. Collected FFQs were processed with Nutritics® software (v.5.7 Research Edition, Nutritics Ltd., Dublin, Ireland) as briefly described in Peña-Fernández et al. [6,7].

Body weight and height were measured using a digital scale (Tanita SC 330-S, London, UK). Body mass index (BMI) was calculated as weight in kilograms divided by squared height in meters, to identify individuals as underweight or obese, depending on their ethnic background [11].

Statistical analyses were performed using the free software R-project, version 4.1.0 [12]. Significance scores were based on Kruskal-Wallis for nonparametric multiple comparisons; one-way analysis of variance with for normal multiple comparisons. For normality, Shapiro-Wilk test was used. Differences were considered statistically significant at *p*-values lower than 0.05.

3. Results and Discussion

The dietary intake of vitamin D was slightly higher in male participants (4.287 vs. 3.853 μg/day; *p*-value = 0.196), which could be attributed to the generally higher intake of food products known to contribute to dietary vitamin D intake (which include: milk and dairy; cereals; meat; fish; eggs; cakes; fortified foods, drinks and dietary supplements [13]. Thus, the intake of cereals (436.165 vs. 308.750 g/day; *p*-value = 0.002) and meat (271.553 vs. 193.063 g/day; *p*-value = 0.016) were significantly higher in male counterparts. The intake of bacon (4.911 vs. 1.551 g/day; *p*-value = 0.024) was the only red meat product that showed significantly higher intakes in male, meanwhile the intakes of beef (53.513 vs. 38.935 g/day; *p*-value = 0.136), pork (11.348 vs. 10.174 g/day; *p*-value = 0.996) and lamb (16.75 vs. 11.197 g/day; *p*-value = 0.358) were also higher in male participants but non-significant. Similarly, the intake of eggs (17.625 vs. 16.998 g/day; *p*-value = 0.860), dairy products (319.78 vs. 274.95 g/day; *p*-value = 0.119) and fish (72.656 vs. 53.907 g/day; *p*-value = 0.826) were higher in male participants. However, the consumption of oily fish (13.406 vs. 10.056 g/day; *p*-value = 0.857), the fish food products with the highest content of vitamin D, were higher in female participants, although without showing statistical differences.

The dietary intake sof vitamin D recorded were similar/within the same order of magnitude to those described in adults (19–62 years-old) mostly recruited at the university of Chester, Northern England (average = 9.7 µg/day; range = 0.5–129.5) [1]. However, and despite a comprehensive analysis of the diet in DMU students, our results should be considered as preliminary, as further analysis will be needed to explore differences and amounts of consumption of vitamins and supplements, as they can affect the dietary intakes of micronutrients.

The intakes of calcidiol [25(OH)D3; 0.0321 vs. 0.0333 mg/day; *p*-value = 0.690] and cholecalciferol (also known as vitamin D3; 0.8677 vs. 0.7698 mg/day; *p*-value = 0.684) were very similar and higher in male counterparts, respectively, although without statistical differences, which could be explained by the differences in the intake of eggs and meat explained previously [2,14] although further analysis would be needed.

Adequacy of Vitamin D Intake According to Sex and Ethnic Background

The dietary intakes of vitamin D recorded are lower than the recommended amount of 10 µg/day by the UK's National Health Service (PHE) [15] and much lower than the 15 µg/day recommended dietary allowance described by the United States's National Institutes of Health (IOM, 2011). Although our results cannot be extended to the general young adult population, our findings would be logical as the mean UK dietary vitamin D intake for adults aged 19–64 recorded by the National Diet and Nutrition Survey in 2020 is below to 3 µg/day (PHE) [16].

The ranges recorded for males (0.252–10.719 µg/day) and females (0.338–18.151 µg/day) highlight that some DMU individuals would be at risk of vitamin D deficiency, which should be further explored by measuring levels of serum 25-hydroxyvitamin D to identify individuals at risk, especially male participants. Our results are in agreement with similar reports described in the literature. Thus, 99% of 198 university male students 18–23 years old from Murcia (southern Spain) were shown to have a dietary vitamin D intake below the recommended 600 IU/day [17]. However, only three (1.5%) of these male students had deficient levels of serum vitamin D (below 30 nmol/L), which authors explain in function of sufficient sun exposure. Thus, monitoring the levels of 25(OH)D in the serum of these participants would be needed to identify individuals at risk.

Moreover, the intakes did not show statistical differences according to ethnic background [Asian (3.708) < African (4.109) < European (4.199); all in µg/day], which might reflect poor and similar dietary habit/choices when they transition from home to university regardless of their ethnic background. Differences in vitamin D status by ethnicity have been previously described in Europe, including in the UK, and in other developed countries such as the US [19]. Although controversial, increased prevalence of at risk of deficiency has been associated with increasing skin pigmentation. However, we have seen similar intakes of vitamin D between students from African origin to European. Future studies should consider non-modifiable lifestyle factors, such as latitude and cultural clothing practices, which can affect the dietary intake of this vitamin and other micronutrients [20].

4. Conclusions

Although our results should be considered as preliminary until assessing the levels of serum 25-hydroxy-vitamin D, our results suggest some prevalence of hypovitaminosis D in DMU individuals. A higher intake of foods naturally rich and fortified in vitamin D may be recommended in this young adult population to prevent future risks and diseases related to the vitamin D deficiency.

Author Contributions: Conceptualization, A.P.-F.; methodology, A.P.-F., E.S., M.D.L.Á.P. and M.H.; validation, A.P.-F.; formal analysis, A.P.-F., E.S. and M.H.; investigation, A.P.-F., E.S.,

M.D.L.Á.P. and M.H.; resources, A.P.-F., E.S., M.D.L.Á.P. and M.H.; data curation, A.P.-F., E.S. and M.H.; writing—original draft preparation, A.P.-F.; writing—review and editing, A.P.-F., E.S., M.D.L.Á.P. and M.H.; visualization, A.P.-F., E.S., M.D.L.Á.P. and M.H.; supervision, A.P.-F. and M.H.; project administration, A.P.-F. and M.D.L.Á.P.; internal funding acquisition, A.P.-F. and M.D.L.Á.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by DMU Research Ethics Committee (Ref. 1674; 11 January 2016), subsequently amended and approved in 2017.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to further processing for a future submission as a manuscript.

Acknowledgments: This project was funded by Leicester School of Allied Health Sciences, De Montfort University.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Watkins, S.; Freeborn, E.; Mushtaq, S. A validated FFQ to determine dietary intake of vitamin D. *Public Health Nutr.* **2021**, *24*, 4001–4006.
2. Sosa, M.; Gómez de Tejada, M.J. Cholecalciferol or calcifediol in the management of vitamin D deficiency. *Nutrients* **2020**, *12*, 1617. https://doi.org/10.3390/nu12061617.
3. Dunlop, E.; Boorman, J.L.; Hambridge, T.L.; McNeill, J.; James, A.P.; Kiely, M.; Black, L.J. Evidence of low vitamin D intakes in the Australian population points to a need for data-driven nutrition policy for improving population vitamin D status. *J. Hum. Nutr. Diet.* **2023**, *36*, 203–215. https://doi.org/10.1111/jhn.13002.
4. Holick, M.F. Vitamin D deficiency. *N. Engl. J. Med.* **2007**, *357*, 266–281.
5. González-Padilla, E.; López, A.S.; González-Rodríguez, E.; García-Santana, S.; Mirallave-Pescador, A.; Marco, M.; Henríquez, M.S. High prevalence of hypovitaminosis D in medical students in Gran Canaria. Canary Islands (Spain). *Endocrinol. Nutr. (Engl. Ed.)* **2011**, *58*, 267–273.
6. Peña-Fernández, A.; Ali, N.; Millington, D.; Lobo-Bedmar, M.C.; Haris, P. Human biomonitoring research at De Montfort University: School and university participants' recruitment experience. In Proceedings of the 12th International Technology, Education and Development Conference, Valencia, Spain, 5–7 March 2018; INTED2018 Proceedings, pp. 6258–6262.
7. Peña-Fernández, A.; Higueras, M.; Segura, E.; Evans, M.D.; Peña, M.A. Inadequacies of iron dietary intake of in normal- and over-weight young university students from Leicester, England. *Biol. Life Sci. Forum* **2023**, *submitted for publication*.
8. Bingham, S.; Welch, A.; McTaggart, A.; Mulligan, A.; Runswick, S.; Luben, R.; Day, N. Nutritional methods in the European Prospective Investigation of Cancer in Norfolk. *Public Health Nutr*. **2001**, *4*, 847–858. https://doi.org/10.1079/PHN2000102.
9. González-Muñoz, M.J.; Peña, A.; Meseguer, I. Monitoring heavy metal contents in food and hair in a sample of young Spanish subjects. *Food Chem. Toxicol.* **2008**, *46*, 3048–3052.
10. McCance, R.A.; Widdowson, E.M. *McCance and Widdowson's the Composition of Foods*; Royal Society of Chemistry: London, UK, 2014.
11. Centre for Public Health Excellence at NICE (UK) & National Collaborating Centre for Primary Care (UK). *Obesity: The Prevention, Identification, Assessment and Management of Overweight and Obesity in Adults and Children*; National Institute for Health and Clinical Excellence (UK): UK, 2006.
12. Core Team. R*: A Language and Environment for Statistical Computing*; R Foundation for Statistical Computing, Vienna, Austria, 2021. Available online: https://www.R-project.org/ (accessed on).
13. Weir, R.R.; Carson, E.L.; Mulhern, M.S.; Laird, E.; Healy, M.; Pourshahidi, L.K. Validation of a food frequency questionnaire to determine vitamin D intakes using the method of triads. *J. Hum. Nutr. Diet.* **2016**, *29*, 255–261.
14. Nuti, R.; Gennari, L.; Cavati, G.; Pirrotta, F.; Gonnelli, S.; Caffarelli, C.; Tei, L.; Merlotti, D. Dietary Vitamin D Intake in Italian Subjects: Validation of a Frequency Food Questionnaire (FFQ). *Nutrients* **2023**, *15*, 2969. https://doi.org/10.3390/nu15132969.
15. Scientific Advisory Committee on Nutrition. Vitamin D and Health Report. 2016. Available online: https://www.gov.uk/government/publications/sacn-vitamin-d-and-health-report (accessed on 10 September 2023).
16. Public Health England. National Diet and Nutrition Survey. 2021. Available online: https://www.gov.uk/government/collections/national-diet-and-nutrition-survey (accessed on 10 September 2023).
17. Herrick, K.A.; Storandt, R.J.; Afful, J.; Pfeiffer, C.M.; Schleicher, R.L.; Gahche, J.J.; Potischman, N. Vitamin D status in the United States, 2011–2014. *Am. J. Clin. Nutr.* **2019**, *110*, 150–157.

18. Rudnicka, A.; Adoamnei, E., Noguera-Velasco, J.A.; Vioque, J.; Cañizares-Hernández, F.; Mendiola, J.; Torres-Cantero, A.M. Vitamin D status is not associated with reproductive parameters in young Spanish men. *Andrology* **2020**, *8*, 323–331. https://doi.org/10.1111/andr.12690.
19. IOM (Institute of Medicine). *Dietary Reference Intakes for Calcium and Vitamin D*; The National Academies Press: Washington, DC, USA, 2011.
20. O'Neill, C.M.; Kazantzidis, A.; Kiely, M.; Cox, L.; Meadows, S.; Goldberg, G.; Cashman, K.D. A predictive model of serum 25-hydroxyvitamin D in UK white as well as black and Asian minority ethnic population groups for application in food fortification strategy development towards vitamin D deficiency prevention. *J. Steroid Biochem. Mol. Biol.* **2017**, *173*, 245–252.