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EDITORIAL

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Is a vitamin D fortification strategy needed?

Almost one in five adults aged 19–65 years in the UK has a low serum vitamin D concentration (below 25 nmol/l) according to the *National Diet and Nutrition Survey (NDNS)* (Roberts *et al*. 2018), which puts them at increased risk of the manifestations of vitamin D deficiency, described below. In some age groups, prevalence is even higher; for example, 39% among adolescent girls aged 11–18 years. Government recommendations in the UK emphasise the importance of ensuring adequate vitamin D for everyone to protect bone and muscle health. Public Health England (PHE) advises that adults and children over the age of 5 years require an average of 10 μg of vitamin D a day and should consider taking a daily supplement during autumn and winter (a combination of diet and sunshine exposure is sufficient for most people during the spring and summer provided they spend time outside). There is also specific advice for the under-fives (Table 1). People who have a higher risk of vitamin D deficiency are being advised to take a supplement all year round (Table 1).

In April 2020, PHE reissued its advice on vitamin D, recommending that whilst the stay at home coronavirus measures are in place, everyone (including children, pregnant and breastfeeding women and older people) should consider taking a daily supplement containing 10 μg of vitamin D, even during the summer months, if they are not going outdoors often (NHS 2020). But is the general advice on vitamin D supplement usage being adopted and, if this approach fails, what might plan B look like?

In September 2019, a Forum was convened, with funding from the Rank Prize Funds, to explore the current situation and options for implementation strategies for increasing vitamin D intake across the distribution of food consumption patterns in the UK. The Forum discussed the potential of food fortification as a strategy, using learnings from the pan-European *ODIN* study (Kiely & Cashman 2015; Kiely & Cashman 2018). Since the Forum took place, the coronavirus pandemic has placed a spotlight on the potential of good nutrition to promote immune function (www.nutrition.org.uk/healthyliving/helpingyoueatwell/covid19immunity.html) and, in this context, the association between low vitamin D status and reduced immune response has been flagged. Ill-informed advice about very high and potentially harmful vitamin D supplementation, which lacks an evidence base, has been circulating on social media (for a commentary see Lanham-New *et al*. 2020). Nevertheless, the fact remains that many people around the world are 'staying at home' and as a result may have less opportunity for sunlight exposure than usual during the spring and summer months, highlighting the importance of following government advice on vitamin D supplementation (10 μg/day is recommended in the UK, Table 1) and on consuming dietary sources as a means of achieving adequate vitamin D status. The government's reissued advice emphasises that even during the summertime, people who are not able to get outside much should consider taking a 10 μg daily supplement of vitamin D. The advice stresses that the recommendation is not about preventing coronavirus (COVID-19) or mitigating its effects; vitamin D is needed to keep bones and muscles healthy.

Vitamin D is a generic name for two different compounds, ergocalciferol (vitamin D_2) and cholecalciferol (vitamin D_3). Vitamin D_3 can be obtained from the diet and by endogenous synthesis in the skin via the action of UVB radiation (290–315 nm), which converts 7-dehydrocholesterol to vitamin D_3, whereas vitamin D_2 is obtained solely from the diet. Vitamin D_2 is naturally present only in fungi (*e.g.* wild mushrooms or UVB-treated cultivated mushrooms, and UVB-treated yeasts). There are relatively few dietary sources of vitamin D_3, the richest being oil-rich fish and egg yolks. Other sources include meat/meat products and fortified foods, such as some fat spreads, some breakfast cereals, some dairy products (especially yogurts) and vitamin D fortified dairy alternatives. In 1940, the vitamin D fortification of margarine became mandatory in the UK (see DH 1991) but this requirement ceased in 2013 (Defra 2014). In some countries (*e.g.* the US and Canada), liquid milk is fortified routinely but this is not the situation in the UK.

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Table 1 Public Health England advice on vitamin D for different population groups

	April to September	October to March
Birth to 1 year	8.5 to 10 micrograms of vitamin D a day, throughout the year. Babies consuming more than 500 ml infant formula per day do not need any additional vitamin D as formula is already fortified.	
1–4 years	10 micrograms of vitamin D a day, throughout the year	
5 years and above	Most people, other than those in at-risk groups, probably get enough vitamin D from being outdoors and consuming vitamin D-containing foods.	During the winter months, most people rely on dietary sources of vitamin D. Vitamin D is found naturally in a small number of foods, for example oil-rich fish, red meat, liver and egg yolks. It is also present in fortified foods, for example breakfast cereals, most fat spreads and in food supplements. Consider taking a daily supplement.
At-risk groups	At-risk groups include: • people who are not often outdoors (e.g. individuals who are frail or housebound); • people who reside in an institution such as a care home; • people who usually wear clothes that cover up most or all of their skin when outdoors. These individuals should take a daily supplement throughout the year, containing 10 micrograms of vitamin D.	
People with dark skin (e.g. individuals of African, African-Caribbean or South Asian background)	These individuals may not get enough vitamin D from sunlight and should consider taking a daily supplement containing 10 micrograms of vitamin D, throughout the year.	

Source: PHE (2016)

Consequences of inadequate vitamin D

In 2016, the UK's Scientific Advisory Committee on Nutrition (SACN) published a full risk assessment on vitamin D that involved a review of the evidence concerning vitamin D and a wide range of health outcomes (SACN 2016). The strongest evidence concerned the prevention of rickets, osteomalacia and falls, and benefits for muscle strength and muscle function in adults ≥50 years. This evidence was used by SACN to develop dietary reference values for the UK population. Insufficient evidence was found for vitamin D in relation to non-musculoskeletal outcomes such as cancer, cardiovascular disease, autoimmune diseases, infectious diseases and cognitive function.

Of relevance to the current coronavirus pandemic, a possible role of vitamin D in modulating the immune response to infectious diseases has been suggested by the presence of vitamin D receptors and an enzyme associated with vitamin D metabolism (1α-hydroxylase) in various cells of the immune system including B- and T-lymphocytes, macrophages and dendritic cells (SACN 2016). Support for an immunomodulatory role has also been suggested by ecological studies showing associations between seasonal variations in serum 25(OH)D concentration and incidence of various infectious diseases including respiratory infections. While findings from cohort studies are generally supportive of an inverse association between serum 25-hydroxyvitamin D [25(OH)D] concentration and respiratory tract infections, findings from randomised controlled trials (RCTs) have been inconsistent (SACN 2016) and further research is urgently required (Lanham-New *et al*. 2020).

Clinical musculoskeletal manifestations of poor vitamin D status are osteomalacia (adults) and nutritional rickets (children). Characterised by poor bone mineralisation, pain, deformities and fractures, these conditions are caused by low calcium intakes and/or vitamin D deficiency. It is of concern that the incidence of hospital admissions due to rickets in England increased between 2000 and 2011 (Goldacre *et al*. 2014), and a 2-year survey (2015–2017) suggested an annual incidence of nutritional rickets of 60 cases per year, with the greatest number in infants aged 12–23 months who were of Black or Asian ethnicity (Julies *et al*. 2020). Several of the infants sadly died as a result of dilated cardiomyopathy. The nature of the survey meant that it did not capture cases seen in primary care or those seen by general practitioners; Uday and colleagues suggest that these nutritional rickets cases presenting to secondary care are only the tip of the iceberg of hidden and widespread vitamin D deficiency (Uday & Hogler 2018). Nearly 80% of the cases were not taking the recommended vitamin D supplements.

Table 2 Percentage contribution of food groups to intakes of vitamin D (excluding supplements)

	4-10 year-olds, %	11-18 year-olds, %	19-64 years, %
Meat/meat products	21	31	30
Cereal products (mainly breakfast cereals)	30	28	15
Eggs/egg dishes	12	12	19
Fish/fish products (esp. oil-rich fish)	7	8	17
Fortified milk products	14	7	5
Fat spreads	14	11	11
TOTAL mean vitamin D intake from food (excluding supplements), μg/day	2.0	2.1	2.7
TOTAL mean vitamin D intake including supplements, μg/day	2.7	3.5	4.2

Source: Roberts *et al.* (2018)

Vitamin D intakes

The most recent data from the *NDNS* (Roberts *et al.* 2018), derived from measurements taken in 2014–2016 and, therefore, measured before PHE's advice on vitamin D supplementation, revealed that the main dietary contributors for adults and children over 1 year of age were cereals/cereal products (including fortified breakfast cereals), meat, fish, fortified milk/milk products, eggs and fat spreads, but their relative contributions varied with age (Table 2). Fortified milk/milk products were a major contributor for young children but this food group made a smaller contribution in older children and adults. Conversely, the contribution from meat and fish was higher in adults. The main dietary contributors for infants under 1 year of age were infant formula and commercial infant foods, meat, fish, eggs, fat spreads and cereals/cereal products.

Synthesis of vitamin D following exposure of the skin to UVB radiation is the predominant source of the vitamin for most people in the UK during the summer months (April to September). This is likely to be May to September in the most northern parts of the UK. As already mentioned, foods that naturally provide vitamin D are few but it is added as a fortificant to some food categories such as breakfast cereals, spreads and milk products, and vitamin D supplements provide another option. Average daily intake of vitamin D, among adults, from foods and supplements combined is 4.5 and 3.9 μg, respectively, in men and women (aged 19–64 years) and 5.1 and 6.2 μg, respectively, in men and women aged 65 years and older (Roberts *et al.* 2018).

For many population groups and individuals in the UK, achieving an average of 10 μg/day will require supplementation yet the UK is not a nation of supplement users. For example, a minority (less than a third) of women of childbearing age adhere to the advice to take folic acid supplements despite the well-publicised benefits for prevention of neural tube defects in offspring (SACN 2017). Less than 20% use vitamin D supplements and, even in high-risk groups, usage is relatively low. Despite advice for at-risk groups to take a daily 10 μg supplement throughout the year, only 23% of men and 39% of women of South Asian ethnicity (aged 40–69 years) in the UK Biobank cohort took vitamin D supplements and the median intake from diet was low (between 1.0 and 3.0 μg) (Darling *et al.* 2018).

Vitamin D status

Vitamin D is converted in the liver to 25(OH)D, blood concentrations of which are used to assess vitamin D status. In the kidney, 25(OH)D is converted to the active form of the vitamin, 1,25-dihydroxyvitamin D, which acts in combination with parathyroid hormone and calcitonin to maintain calcium and phosphate homoeostasis. To maintain adequate serum or plasma levels of 25(OH)D and hence avoid vitamin D deficiency, SACN recommended a daily reference nutrient intake (RNI) of 10 μg/day. This was modelled on the basis of maintaining population protective 25(OH)D concentrations in serum or plasma of ≥25 nmol/l throughout the year; below this concentration, the risk of poor musculoskeletal health increases. The plasma concentration of 25(OH)D reflects the combination of dietary intake, UVB exposure and biological reserves of vitamin D.

The available data from UK dietary surveys show that, averaged across the seasons, mean serum or plasma concentrations of 25(OH)D were above the population protective level of 25 nmol/l in all age groups. The percentage of infants with a serum or plasma 25(OH)D concentration below 25 nmol/l was 6% (infants aged 5–11 months) and 2% (12–18 months of age). It is noteworthy that sampling among infants was weighted towards the summer months when 25(OH)D concentrations would be expected to be higher (Lennox *et al.* 2013). In comparison, a greater proportion of children (aged 4 years and over) and adults had plasma 25(OH)D concentrations below 25 nmol/l (Roberts *et al.* 2018). In particular, 39% of girls and 15% of boys aged 11–18 years were below the threshold, while 19% of men and

16% of women (aged 19–64 years) and 11% of men and 15% of women (aged 65+ years) also had a plasma 25(OH)D below 25 nmol/l (these results are averages of samples collected across all seasons of the year).

SACN reported that mean plasma 25(OH)D concentration was lowest in winter and highest in summer. On average, around 30–40% had concentrations below 25 nmol/l in winter compared to 2–13% in summer but a substantial percentage of some population groups did not achieve a plasma concentration ≥25 nmol/l even in summer (17% adults in Scotland, 16% adults in London, 53% of women of South Asian origin living in the south of England and 29% of pregnant women in a study in North West London) (SACN 2016).

Groups at risk of low vitamin D status

Endogenous synthesis is only possible during spring and summer at UK latitudes; during autumn and winter in the UK, vitamin D has to be obtained exclusively from the diet (including vitamin D supplements). Some at-risk groups with little or no skin exposure to sunlight during spring and summer, such as those who do not go outside often or who cover most or all of their skin, are reliant on dietary sources of vitamin D throughout the year. Furthermore, ethnic minority groups with dark skin may not get enough vitamin D from sunlight exposure during the summer months because melanin present in skin limits the rate of skin synthesis (Farrar *et al.* 2011).

Consequently, it is not surprising that low vitamin D status is more prevalent among some ethnic minority groups living in the UK than in the white-skinned population. The 2010 *Health Survey for England* reported that Asian participants (over 16 years) had a lower mean 25(OH)D status (20.5 nmol/l) than White participants (45.8 nmol/l) (NatCen Social Research 2015). In a study of South Asian women living in the south of England, mean 25(OH)D concentrations were relatively low and remained at around the 25 nmol/l threshold throughout all seasons of the year, with 53% of women not achieving a concentration >25 nmol/l during the summer months (Darling *et al.* 2013). Data from the UK Biobank cohort show a similar situation in participants of South Asian ethnicity (Darling *et al.* 2018).

The potentially devastating consequences of nutritional rickets in infancy are preventable, yet it is evident that UK government advice on vitamin D supplementation is not reaching all families. This emphasises the importance of healthcare professionals routinely alerting parents and carers to the need for supplementation, with this advice being reinforced through local parenting and community groups and via faith groups. The latter strategies may prove to be particularly important ways of reaching the most vulnerable at-risk groups. During the Forum, it was suggested that the need for somewhat complex and nuanced advice (shown in Table 1) appears to have led to an oversimplified interpretation by some healthcare professionals, which may be leading to confusion about the detail of the government's recommendations.

Public Health England's advice does not include specific recommendations for vegans (general population advice about UVB exposure and fortified foods applies). It is important to note that most foods that naturally contain vitamin D are of animal origin and there are limited food sources of vitamin D_2. It is acknowledged in SACN's vitamin D report that concern about the vitamin D status in this group may increase, particularly in light of the recent trend among adolescents and younger adults to adopt a vegan style of eating, combined with current statistics for vitamin D inadequacy in this age group (*i.e.* low vitamin D status is already evident in 39% of adolescent girls). Using *NDNS* data to monitor intakes among vegetarians and vegans is unlikely to be effective owing to the relatively small percentage of these groups within the population as a whole [estimated to be around 3% and 1%, respectively, currently (FSA 2019)] and therefore present in the nationally representative *NDNS* sample.

Options for increasing vitamin D intake

Several themes emerged during discussions at the Forum, in particular 'if, over time, it transpires that there has been insufficient improvement in the nation's vitamin D status, what might plan B look like?' Full proceedings of the Forum will be published separately (Buttriss *et al.* 2020), but a brief summary of some of the considerations is provided here.

Three potential strategies for addressing poor micronutrient intakes have been identified by the World Health Organization (WHO) and the Food and Agricultural Organization of the United Nations (FAO): (1) increasing the diversity of foods consumed, (2) food fortification and (3) supplementation (WHO/FAO 2006). Each of these, alongside sensible sunlight exposure during the summer months, potentially has a part to play in addressing the widespread prevalence of inadequate vitamin D intake. As mentioned elsewhere, in the context of the current coronavirus pandemic, dietary supply (including supplementation) is particularly important for those for whom sunlight exposure is limited.

Considerations for implementing successful strategies include: whether there is (or needs to be established) supportive food legislation; improved public and health professional understanding of the importance of vitamin D (including awareness of the clinical consequences of inadequate vitamin D status); and consistent, unambiguous communication of government advice on vitamin D across the health and social care professions, with amplification via the food industry within the context of food labelling and claims legislation, in schools and in healthcare professional training.

What evidence exists to support a fortification strategy?

Low vitamin D status is not a problem peculiar to the UK, concentrations of 25(OH)D below 30 nmol/l are relatively common in Europe and there is a several-fold higher risk of low vitamin D status among some ethnic minority groups. The first option on the WHO/FAO list is increasing the diversity of foods consumed but this has its challenges because there are very few food sources naturally rich in vitamin D. These are mainly of animal origin, which is highly relevant in the context of the recent calls for a radical transformation of the global food system, with emphasis on increased consumption of plant-based foods and reductions in animal-derived foods for many, as part of a more sustainable flexitarian-type diet (see Buttriss 2020; Steenson & Buttriss 2020).

The WHO/FAO have indicated that food fortification has potentially the widest and most sustainable impact and is generally considered to be more cost-effective than other intervention approaches (WHO/FAO 2006). Animal-feeding trials with added vitamin D in the animals' diets (*e.g.* to biofortify meat or eggs), food production studies and data from dose–response and dietary modelling studies indicate that dairy products, bread, meats and hens' eggs could be viable fortification vehicles and that diverse fortification strategies could increase vitamin D intake across the distribution of population intakes and hence reduce the risk of deficiency (Kiely & Cashman 2018). Vitamin D_3 is considered more effective than vitamin D_2 for raising plasma 25(OH)D concentrations, which has implications for choice of fortificant (Tripkovic *et al.* 2012; Tripkovic *et al.* 2017).

The *ODIN* project included a series of RCTs that improved understanding of the potential of fortification strategies (in research settings) to improve 25(OH)D status. *ODIN* also modelled whether consumption of fortified foods might contribute to a risk of exceeding the tolerable upper intake level (UL) for vitamin D of 100 μg/day (adults). The modelling showed that consumption of a combination of fortified and biofortified foods did not pose a risk at the 99^{th} percentile of the distribution. Even those taking high-dose vitamin D supplements (*e.g.* 50 μg/day) in addition to fortified foods would be unlikely to reach the UL. Furthermore, in summertime, endogenous vitamin D synthesis in individuals with plentiful sun exposure is self-regulating, thus when combined with fortified foods this would not be expected to lead to excessive exposure to vitamin D although this assumption needs to be tested.

While the RCT evidence suggests a benefit from fortification, one of the greatest challenges is how to take interventions shown to work in a research setting and implement them in a real-world setting; a key issue highlighted by WHO (Peters *et al.* 2013). There is a need for follow-up implementation research and implementation *per se,* involving a variety of stakeholders, to scale up interventions into real-world settings, with the aim of preventing vitamin D deficiency. A voluntary, government-driven vitamin D fortification policy in Finland provides a useful example. Following introduction in 2003, the percentage of the population with a 25(OH)D concentration 30 nmol/l decreased from 12% in 2000 to <1% in 2011 (Jaaskelainen *et al.* 2017).

Is there a role for an industry-wide fortification policy?

Although the theoretical modelling of increased fortification of foods with vitamin D described above suggested that it would not pose a risk of excessive consumption, a particular purpose of any industry-wide fortification policy would be to ensure that addition of the nutrient is controlled, either by a code of practice or something more formal. This would help to ensure that excessive amounts are not added to individual foods or to the wider food supply, perhaps by restricting the amount that can be added to individual foods and/or the range of foods that can be fortified.

Choice of food vehicle (and form of the vitamin, *i.e.* D_3 vs. D_2) may allow targeting to particular consumer groups, according to age, dietary preferences, region or other characteristics. Factors to be considered include: consumer acceptability and preference; shelf-life of the fortified products and stability of the fortificant over time; and the relative healthiness of the food vehicle (to avoid a fortificant being added to a food not considered healthy). To ensure consumer acceptability, changes to the sensory characteristics (*e.g.* taste, texture and smell) need to be minimised. Processing using heat may affect stability, and different ways of cooking foods (*e.g.* boiling, frying or baking) may also impact on the final vitamin D content and bioavailability in the prepared food. For example, as vitamin D is heat sensitive it is added at the end of manufacturing of breakfast cereals using a spray method to provide a coating, thus limiting exposure to light and temperature. The ability of a particular approach to raise vitamin D status will be dependent on the amount of the food consumed and on any food matrix components, such as fibre or lipids, which affect absorption. Another consideration is the cost to manufacturers of fortification of products.

For manufacturers, the regulatory landscape in Europe is complex, with fortification of foods permitted in some countries (*e.g.* the UK, Austria, Finland, Sweden) and prohibited in others (Norway and Denmark). In yet others, such as Germany, fortification of food categories (*e.g.* breakfast cereals) is tightly restricted and dependent on the fortificant used and product type (*e.g.* muesli vs. whole wheat cereals).

'Fortified with vitamin D' is considered to be a valued health claim in the UK, with industry evidence (personal communication) that it is a driver of purchasing. Vitamin D_3 is most commonly sourced from lanolin extracted from sheep's wool, which is not acceptable to those following a strict vegan diet, for whom fungus-derived vitamin D_2 is the form of choice. However, vitamin D_3 appears to be more bioavailable and have better shelf stability and reliability of supply. The Forum participants heard that, with the growing interest in plant-based eating and flexitarian diets, and the increased availability of vegan-style foods, there is increasing pressure on manufacturers from a section of the public to fortify foods with vitamin D_2 (rather than D_3). There is also a tension between desire for fortification and a growing consumer interest in minimally processed 'natural' products, with short ingredient lists comprising recognisable kitchen ingredients, which might predicate against fortification in some food formats.

The lack of consistency between the reference intake (RI) for vitamin D that must currently be used for labelling purposes in Europe (5 μg/day) and the UK government's RNI (10 μg/day) has been highlighted as a potential barrier to voluntary fortification by food manufacturers, and risks compromising clear communication.

On-pack claims are currently obliged to follow labelling regulations and, therefore, refer to 5 μg/day rather than the UK government's RNI of 10 μg/day. This inconsistency makes it difficult for manufacturers to communicate clearly to consumers and increases the potential for consumers to feel confused or misled. For example, a claim that a product provides 50% of the RI (as required by labelling regulations) might be interpreted to mean a content of 5 μg (half of the amount advocated per day by the UK government) rather than 2.5 μg. Furthermore, the wording used is restricted, and so labelling has to refer to the RI rather to more user friendly words such as 'daily needs'. Nevertheless, it has been estimated that if everyone consumed even 5 μg/day then it would reduce the population prevalence of a 25(OH)D concentration <25 nmol/l to less than 10% (Cashman *et al.* 2017). So, to aim for consolidating current intakes to this level could, at the very least, be a starting point.

How can public understanding about vitamin D be improved?

The next set of data from the rolling *NDNS* programme will be critical in clarifying whether or not vitamin D intakes, through a combination of diet and supplementation, and concomitant nutritional status of the vitamin are improving. In the meantime, it is evident that there is a public health problem concerning vitamin D, manifested in the reemergence of nutritional rickets in young children in some groups of the population, but also an issue widespread in the population as a whole, as evident from the growing percentage of people with low vitamin D status. It can be surmised that people are insufficiently familiar with government advice on vitamin D and/or how to implement it.

Greater understanding about where members of the public (and also healthcare professionals) obtain scientific information might help inform which communication channels may be best utilised. In principle, multiple media avenues should be considered, including for example having a well-known person with a track record of science advocacy to champion and communicate the message.

As discussed earlier, crucial advice to parents on the importance of vitamin D does not appear to be reaching all families in at-risk groups. In the absence of a high-profile government-backed campaign, it's important that healthcare professionals use their interactions with parents and parents-to-be to remind them of the advice and the health implications of ignoring the guidance, in a consistent manner. The message can usefully be amplified by community groups, including faith groups, and schools are another route to ensure young people understand the importance to their health of vitamin D and how to implement the advice.

As already mentioned, food packaging and associated communications is another route to consider but currently the legislative framework risks introducing ambiguity.

The coronavirus pandemic has served as a reminder that evidence-based research findings have to compete with far less robust information circulating on the Internet and social media, such as the influx of immunity-boosting claims seen over recent weeks, many of which have no scientific foundation and some might even be dangerous. When people are bombarded with information, communication becomes a competitive space – only so much information can be absorbed and so how we engage with people to ensure that reliable and safe information is prioritised is extremely important.

It was agreed at the Forum that a multi-pronged approach may be needed to ensure that the government's vitamin D recommendations are actioned, involving the food and health sectors, government and other stakeholders, and that there is not necessarily a universal solution. In particular, the potential of some form of code of practice developed by food manufacturers, ingredients suppliers and retailers in association with other stakeholders was discussed. The code of practice might provide guidance on the most appropriate foods, vitamin D sources and fortification levels, and suggest strategies for specified food categories.

Conclusions

In 2016, updated UK government advice on vitamin D was published and this was reissued in 2020 in the context of the coronavirus 'stay at home' measures. In the coming months, it is expected that *NDNS* data will indicate whether or not this advice is being adopted, and whether modification to current policy approaches is warranted. Meanwhile, many in the UK, across all age groups, have a low vitamin D status and there is the potential that the current need for populations (in the UK and across the globe) to 'stay at home,' in response to the coronavirus pandemic, may exacerbate this unless PHE's advice on vitamin D supplement use for those who are 'not often outdoors' (Table 1) is followed.

Several speakers at the Forum referred to the potential merits of a code of practice for industry, or more coordinated action involving government, industry and other stakeholders. Given the limited impact of advice on use of folic acid supplements in the UK and concerns about excessive sun exposure in terms of skin cancer risk, improved understanding of dietary sources of vitamin D and also, potentially, a fortification strategy to improve dietary intakes are the obvious options going forward.

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