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Commentary

Pale Europeans and Dark Africans share sun and common health problems:constancy in regional health differences and sunshine

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CHD mortality, regional risk, sunshine, inflammation, silicon

ABSTRACT
Regional risk of cardiovascular mortality has only recently been added to the group of major risk factors, but its effective sub-factors are not fully understood. The aim of this study was to assess the CHD mortality in Finland and other Europe, its stability and association with capability in vitamin D synthesis. In a worldwide assay several causes besides geographical and climatological factors restrict vitamin D synthesis in skin and several factors affect the activation as also the inactivation of vitamin D. Sunshine anyhow is the constant source of vitamin D, while dietary habits have changed. Effects of vitamin D could be based on mineral, anti-inflammatory and structural factors. Different availability of sunshine has thus associated with the constancy in proportional difference in CHD mortality in Finland as an example country. Conclusion: Sunshine is associated with lower CHD mortality in Europe. Other additive mechanisms are suggested.

INTRODUCTION

Usually, between 50% and 90% of vitamin D in the body is coming from the production in the skin and the remainder is from the diet (Lips 2010). Finland and South-Africa are at different ends of the same time zone. Both depend on sun radiation in their vitamin/hormone D synthesis. Miyauchi et al. (2013) reported that latitude is associated with lower vitamin D synthesis in skin. It is possible to suggest which diseases are caused by the low Vitamin D3 levels by looking at the geographical distribution and incidence of the diseases. Most of them are much reduced at the equator and much higher in the extreme latitudes (Plotnikoff and Quigley 2003). They can be Vitamin D3 related. Beneficial effect of moderate sunshine can be based on psychological well-being, too (Gannagé-Yared et al. 2001).

Previously people worked in rural occupations mainly outdoors and got more sun radiation. At present most people live in cities and are thus protected from sunshine by housing, vehicles used (also the dust generated) and clothing. During the past half century several studies have been performed and health behavior has changed in Finland, but still the difference in male coronary mortality is higher in Eastern than Western Finland. In South Africa significant numbers of people having dark skin have lower vitamin D levels that the light colored ones, while in whites no such difference exists Dark pigmentation hinders the satisfactory vitamin D synthesis although it protects against sun burns. Now many descendants of African Americans have lower D blood levels (Hall et al. 2010). Unfortunately these are also global health problems as many people get less sun radiation, are also less physical active outdoors but who also have excessive and improper food intake. Big cities have also serious air pollution that hinders the sun radiation to reach people at street level. Furthermore the television watching helps people to escape sunshine during their leisure time.

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Lips (2010) and Oren et al. (2010) have reported that Vitamin D deficiency was highly prevalent in India, China and Middle-East, less common in Japan, South-East Asia and North America and in Latin America, quite common in Africa, more common in Mediterranean area than in Nordic countries. Freisling et al. (2010) wrote that dietary intake of vitamin D was lower in Mediterranean area than in Norway, Sweden and Denmark.

North Europe

The people of Eastern Finland, living in Northern Europe and higher hills have suffered more from male coronary heart disease and other diseases than people in the lower of western parts of the country since the 19th century (Kannisto, 1947). Regional mortality risk has been affirmed by Jousilahti et al. (1998) who wrote that CHD risk was about 40% higher in the north-eastern than in south-western Finland. Differences in major and minor risk factor levels explained only about 40% of the excess CHD risk in eastern Finland. This higher CHD mortality in eastern Finland (see Fig1) was quite constant in 1973-2000 (Pajunen et al. 2004).

In Fig1 we see that ñwesternò Finland is located to the south from ñeasternò Finland. The eastern Finland is positively associated with the number of rainy days (Fig2), i.e. with lower capability for synthesis of vitamin D.

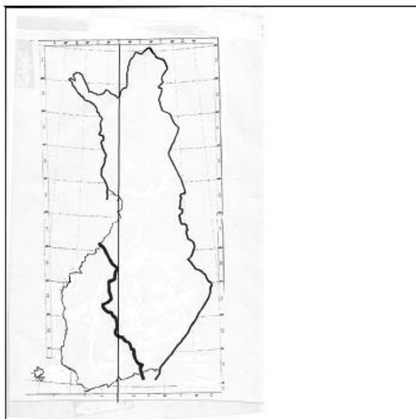

Fig1. The oblique thick line divides as Pajunen et al. (2004) the Eastern Finland (with high CHD and general mortality) from the west.

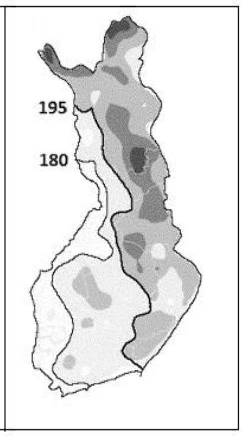

Fig 2. Mean annual rainy days (Ó 0.1 mm/d) in1981-2010, Finnish Meteorological institute (FMI). Added gross lines for 180 and 195 days.

In Finland 1951-72 the CHD mortality was lower in countryside than in urban areas (Fig3), which could be associated with the higher outdoor life especially in farming and forestry. Same time when number of people was 4ï 4.7 million (Statistics Finland 1978), the number of horses, used in farming and forestry, were reduced from 350,000 to 50,000 (Statistics Finland 1960 & 1978) and replaced to tractors, which got cabins, lumberjacks got helmets and outdoor work was in general reduced, all of these affecting vitamin D synthesis. Lamberg-Allardt et al. (1986) reported that vitamin D was trendlike higher in western than in eastern and northern Finland, trendlike higher in countryside than in urban areas

South Europe

Residence in a ñlow risk countryò (i.e. Mediterranean area, including Switzerland and Belgium) decreases the risk of cardiovascular mortality (including CHD) of smokers to the same level as by non-smokers in another country of Europe, if the other main risk factors are the same (Graham et al. 2007). In the southern Europe lower latitude is associated with lower number of annual number of rainy days than in other parts of Europe in general (van Engelen et al. 2014) increasing the capability for D-vitamin synthesis in the skin.

South Africa

Studies show that the vitamin D-level is low in those Africans who have a lot of dark pigment in their skin. Some of them thus suffer even vitamin D-deficiency (Poopedi et al. 2009, Martineau et al. 2011).

Urbanization is also going on in South Africa which happened earlier in Europe. Kruger et al. (2011) have reported that it may increase the health problems in South Africa. Black women may have low bone mass due to low vitamin D status, low calcium intake, and high bone turnover. Furthermore the indoor living and television watching inhibit of course the natural sun radiation exposure.

In Africa there are also other reasons which can affect the satisfactory vitamin D synthesis in skin. Mining is important and the underground work limits sun radiation. Also mining dust in air prevents the satisfactory sun radiation. Also traffic and heating mean also dust pollution.

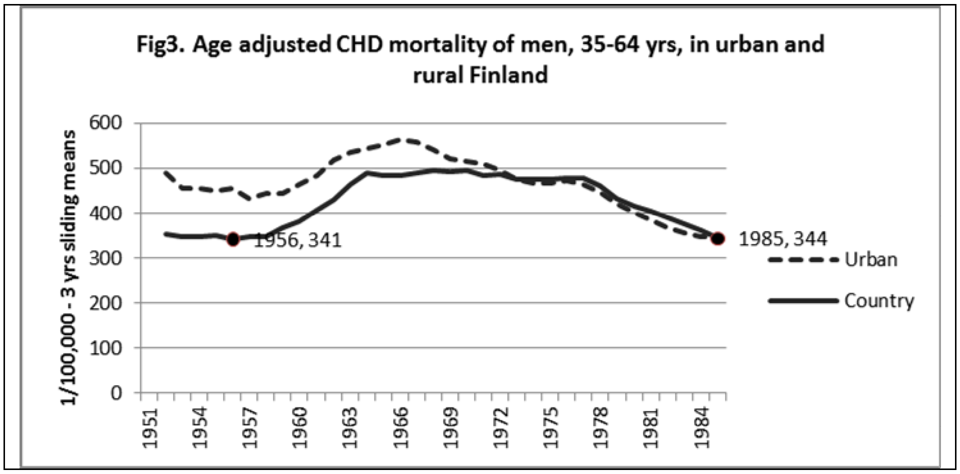

Fig3. Age adjusted CHD mortality of middle-aged men in rural and urban areas of Finland. (Valkonen and Martikainen 1990)

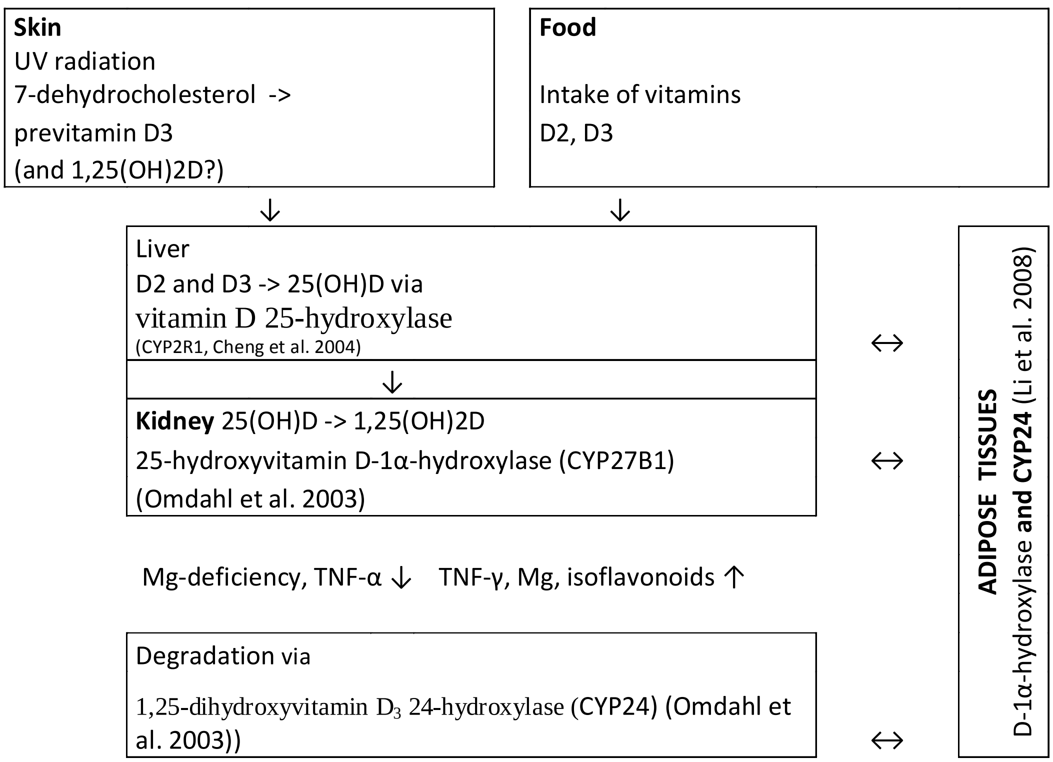

Fig. 4.
The balance of vitamin/hormone D between the intakes in foods, supplements and the syntheses in skin, liver and kidneys and the storage and dilution in body lipids, adipose tissue especially (vitamin D is fat-soluble vitamin) and catabolism and final disposure by the liver into bile.

Deficiency of vitamin D means increases the risks of HIV and Tuberculosis (Martineau et al. 2011). The vitamin-D supplementation is motivated to prevent the problems of deficient vitamin levels in those whose dark skin may prevent the satisfactory endogenous D3 production.

Discussion

It is generally known that Vitamin D works against rachitis by acting on mineral uptake. It has been suggested that vitamin D protects against several other chronic conditions like diabetes, and some cancers, all of which are prevalent or more prevalent among blacks than whites (Harris 2006). Vitamin D is needed for insulin secretion (Borisova et al. 2003), glucose tolerance and lipid metabolism. Insulin receptor gene promoter is sensitive to vitamin D (Maestro et al. 2003). Kositsawat et al. reported inverse correlation between serum 25(OH)D3 and plasma HbA1C. Resently in a prospective study vitamin D supplementation has decreased HbA1 level in African Americans (Green et al. 2014).

Experimentally vitamin D3 has shown anti-inflammatory action on the decrease of MDA and hs-CRP (Sharifi et al.2014) and anti-infectious action (Li et al. 2014). Garcia et al. (2003) have reported that elevated PTH can increase LVH, hypertension and CVD death. Martins et al. (2014) wrote that experimentally vitamin D has decreased arterial stiffness and PTH level. Anyhow effects on CHD need further studies (Schnatz and Manson, 2014).

Vitamin D is lipophilic and is therefore distributed in adipose tissues (Fig4). Its turnover is slow (half-life approximately 2 mo). Its main transported metabolite, 25(OH)D3, shows a half-life of approximately 15 h while hormone 1,25(OH)2D has a half-life of approximately 15 h (Jones 2008).

The negative effect of human activity on air quality has been evident ever since the beginning of the industrialization in big cities. The traffic, heating and industries themselves release dust particles as also various chemicals released interact in air. Over 90% of European Union population lives in area where the recommendations of WHO air quality are exceeded, especially due to particles PM2.5 and 10 and ozon (O3) (EEA 2013). In Chinese megacities one can see sun shining from the cloudless sky above but one cannot properly see horizontally more than some 300 meters in the streets and you sense it your lungs (OH in Beijing personal experience).

In cities open swimming pools and beaches are rare and distant as also the parks of any significant size. Thus the possibilities to get sun radiation in any larger skin area are limited. People having dark skin in cities get less sun radiation than other Americans.

Obese people are overwhelmingly more deficient in lipid soluble Vitamin D (Botella-Carretero et al. 2007). Low levels of 25(OH)D are seen in fatty liver diseases independent on obesity (Hao et al., 2014, Nobili et al. 2014). Good part of Vitamin D stores of different components are located in adipose tissue and thus diluted by other lipids of the body. The mass of adipose tissues competes easily with the forms obtained in foods and produced in the skin, liver and kidneys. Obesity is also associated with low physical inactivity. Further possibility is too much tasty energy rich foods available, even selenium deficiency, too (Kim et al. 2012). These is discrepancy concerning vitamin D causality in obesitas: Although 1,25(OH)2D inhibits adipogenesis in some mouse experiments, it can increase lipid accumulation in human subcutaneous preadipocytes (Nimitphong et al. 2012).

Active Vitamin D is metabolized by enzymes of the cytochrome P-450 family whose activity is modifiable. In general the first step, 25-hydroxylation to 25(OH)D, occurs in liver via CYP2R1 (Cheng et al. 2004) and then 1Ŭ-hydroxylation in kidney via CYP27B1 (Omdahl et al. 2003). Degradation of 1,25(OH)2D and (and obviously of 25(OH)D occurs via cytochrome P450C24 (CYP24) (Wietrzyk 2007).

Alpha-tocopherol has been reported to regulate vitamin D3 25-hydroxylation (Velykyǯ2010). Mg-deficiency can potentiate peroxide stress by increasing lipid peroxidation and ATP-decrease (Manju and Nair 2006). Decreased ATP availability could decrease liver function and 25-hydroxylation.

Rude et al. (2006) wrote that reduction of Mg intake of 50% from nutrient requirement reduced 1,25(OH)2D formation, as well as increased release of the inflammatory cytokines TNF-alpha and IL-1beta. Matsuzaket al. (2013) reported that Mg deficiency induced downregulation of 1Ŭ(OH)ase and upregulation of 24(OH)ase in the kidney, i.e. reduced 1,25(OH)2D synthesis and increased degradation (of 1,25(OH)2D and 25(OH)D). Wietrzyk (2007) wrote that isoflavonoids inhibit activity of CYP24, so inhibiting reduction of 25(OH)D and 1,25(OH)2D.

Noyola-Martínez et al. (2014) reported that INF-ɔ may contribute to calcitriol production while TNF-Ŭ favors its catabolism in human trophoplasts. Lehmann and Maurer (2010) have reported that irradiated skin is able to produce calcitriol ñin substantial amountsò, too. Li et al. (2008) observed 1,25(OH)2D synthesis and degrdation in adipose tissue.

Availability of Vitamin D is globally not enough (Lips 2010). Serum levels of 25(OH)D reflect not only its availability, but effects of proactive and counteractive factors (Fig4.): Low levels of 25(OH)D in fatty liver diseases (Hao et al., 2014, Nobili et al. 2014) could reflect the activity of vitamin D3 25-hydroxylase (Velkyȝ et al. 2010). Relatively elevated CYP24 activity has reported to explain low vitamin D deficiency in gestational DM (Gho et al. 2013). On the other hand cytokines can control vitamin D status: INF-ɔ may contribute to 1,25(OH)2D production (via CYP27B1) while and TNF-Ŭ favors its catabolism (via CYP24A1gene expression) (Noyola-Martínez et al. 2014). Cf. Memon et al. (1993) reported that TNF-alpha and IL-6 can increase cholesterol synthesis more than 2-fold.

25(OH)D does not fully reflect the amount of 1,25(OH)2D because of the above mechanisms. The number of large scale vitamin D analyses are scanty. Dietary assessments forget sometimes the sunshine, which has been suggested to be the main route of vitamin D production (Lips 2010). Earlier the East-West difference in CHD mortality has been explained by significantly higher drinking-water silicon content and is structural characteristics in West Finland (Schwarz et al. 1977). Vitamin D can also increase collagen stability (Nagaoka et al. 2008), like silicon. Rabon et al. (1995) reported that vitamin D can increase more silicon absorption.

Conclusions

It seems that the availability of Vitamin/hormone D3 in humans is not necessarily optimal in South Africa, Europe and Finland as a special example. There are increasing data supporting that the Vitamin D is not only associated with mineral uptake, but in immunological defense, diabetes and cardiovascular diseases and the same time one indicator of inflammation as cholesterol. Recently milk products have been supplemented with Vitamin D, why not the same in selected cases with food oils? Because the amount of active Vitamin D [1,25(OH)2D] is dependent on pro- and counteracting mechanisms, they should be monitored in epidemiological studies, too. Epidemiological studies are important not only for avoiding vitamin D deficiency, but toxicity, too. Because of deficiency of hard data concerning vitamin D effects on regional differences in CHD mortality in Europe, studies on silicon is suggested.

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