the need for particular additional health and social care services meant that inappropriate referrals were made and acted upon. Secondly, while appropriate referrals were identified and made, the additional services were either not delivered or were ineffective. Thirdly, even in the face of appropriate and effective new services being put in place with the aim of avoiding new problems and the consequent demand for emergency medical care, participation in the project actually increased the chances that such help would be sought. While we remain unable to solve this puzzle, the KWAH Project reveals that there can be a major gap between what seems to be a sensible national initiative and what actually occurs when attempts are made to apply the policy.

Acknowledgements

We are grateful to the Steering Group and staff of the KWAH Project for assistance in evaluating the programme, providing access to their data, and giving us permission to publish the findings. The Chelsea & Westminster Hospital and the Hammersmith Hospitals NHS Trusts kindly provided access to data from their A&E departments. The preparation of the present paper was supported by a grant from WeLReN, the West London Primary Care Research Network.

References


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Vitamin D concentrations among people aged 65 years and over living in private households and institutions in England: population survey

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Abstract

Background: vitamin D deficiency among older people results in poor bone and muscle health and an increased risk of fractures. In the UK, government initiatives and the launch of the Osteoporosis Strategy have been in place since 1998, highlighting
the importance of adequate levels of vitamin D for its prevention. The aim of this analysis is to assess vitamin D status and examine associations of deficiency with risk factors among older people in England.

**Methods**: a valid vitamin D sample was obtained from 1,766 informants as part of the Health Survey for England (HSE) 2000, a nationally representative survey of people aged 65 and over living in institutions and private households in England. **Results**: among both men and women in institutions, the prevalence of vitamin D deficiency was higher and mean serum vitamin D levels were significantly lower than among those in private households. Regression analyses showed that women were more likely to be vitamin D deficient than men (odds ratio (OR) 2.1) and deficiency was associated with limiting long-standing illness (OR 3.57), manual social classes (OR 2.4), poor general health (OR 1.92) and body mass index ≤25 kg/m² (OR 2.02), and was 67% more likely among informants in the winter/autumn. Overall, the results show no significant improvements in vitamin D status in comparison to earlier National Diet and Nutrition Survey (NDNS) results. **Conclusion**: vitamin D deficiency exists at worrying levels among those aged 65 years and over. Further action is needed to alert health professionals about the risks related to vitamin D deficiency and extend the provision of prevention and treatment programmes targeted to those in need.

**Keywords**: vitamin D deficiency, older people, England, population survey

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**Introduction**

It is well recognised that vitamin D deficiency in adults clinically manifests as osteomalacia and osteoporosis, characterised by muscle weakness, skeletal pain, deformed and brittle bones, and an increased risk of fractures. The risk of deficiency has important implications for general health. It increases as a result of an age-related reduction in bone mass (particularly after the menopause), with obesity [1], and among cigarette smokers, although it has been suggested that this could be due to the association with poor diets [2]. It also increases during the winter [3], and due to factors that effect adequate sun exposure and therefore formation of vitamin D by the skin [4].

In 1998, the UK government introduced new clinical guidelines on strategies for the management and treatment of osteoporosis [5]. The guidelines’ key messages were on prevention and treatment to help primary care teams develop consistent, evidence-based practice for diagnosing and managing osteoporosis. The COMA (Committee on the Medical Aspects of Food and Nutrition Policy) report on nutrition and bone health highlighted the importance of ensuring enough calcium and vitamin D in the prevention of osteoporosis [5, 6].

Although the efficacy of vitamin D supplementation as a health improvement strategy in the healthy community-dwelling elderly is not proven, it has been recommended that older people at high risk, i.e the frail, housebound or institutionalised and those with restricted mobility, should receive routine supplementation of vitamin D [6, 7] this can preserve muscle strength and functional ability [8–12]. In a recent meta-analysis [13], vitamin D supplementation between 700 and 800IU/d appears to reduce the risk of hip and any non-vertebral fractures in ambulatory or institutionalised elderly persons.

The aim of this paper is to assess vitamin D status among older people in England by means of the Health Survey for England (HSE) 2000, a continuous survey carried out on behalf of the Department of Health to look at the health of people living in England. In 2000 it included a nationally representative sample of people aged 65 and over living in institutions and in private households in England [14].

**Methods**

The HSE 2000 was designed to provide data at both national and regional level from a sample of older people (aged 65 and over) resident in private households and care homes.

For the institution sample, 677 care homes were selected. Up to six residents at each care home were selected for interview, and interviews were achieved with 1,217 residents. Residents who were capable of completing a full interview were interviewed in person; other residents were interviewed by proxy. The private household sample included 1,677 residents, aged 65 and over, who were interviewed. As in previous years, the general population sample for the 2000 survey included a cross-section of the population living in private households for which over 6,800 addresses were drawn from the Postcode Address File (PAF). The private household sample was set at about half the size of those in most previous years of the Health Survey, so that resources could be devoted to the sample of older people resident in care homes.

A blood sample was obtained from 61% of the total institution sample (1,217) and 64% of the private household sample (1,677) aged 65 and over who gave written consent. A valid 25-hydroxycholecalciferol (vitamin D) sample was obtained from 1,766 informants (708 men and 1058 women). Those who gave a blood sample were representative of those interviewed both in institutions and private households (the mean age of those interviewed in institutions was 85.0 in comparison to 84.6 for those who gave a blood sample). For those in private households, the mean age among those interviewed was 74.3 in comparison to 74.1 for those who provided a blood sample. Of those with a valid vitamin D sample, 1,297 informants were included in the analysis; 466 informants taking medications that would affect their vitamin D status and/or taking vitamin supplements were excluded. Vitamin D analyses were carried out at the Royal Victoria Infirmary (RVI) in Newcastle upon Tyne using the Diasorin Kit. Comparisons of the vitamin D results were made with the National Diet and Nutrition Survey (NDNS) [15], a survey nationally representative of older people aged 65 and over living in institutions and in private households in Great Britain. It included plasma vitamin D
analyses for 1,185 people (927 free-living, 258 in institutions). The survey was carried out from October 1994 to September 1995; the methods by which vitamin D was analysed in both surveys were comparable. Vitamin D deficiency was defined as serum concentrations of 25-hydroxycholecalciferol <25 nmol/l [16, 17].

**Results**

Table 1 shows mean, lower and upper percentiles of vitamin D concentrations by sex and age group. Mean vitamin D levels declined with age and were higher among men than women, although the sex differences were only significant for those living in private households.

The mean serum vitamin D levels were significantly lower for both men (38.1 nmol/l) and women (36.7 nmol/l) in institutions than among men (56.2 nmol/l) and women (48.4 nmol/l) in private households (P<0.05). This was comparable with the NDNS results for both sexes. Both surveys also showed a decline in vitamin D levels with age, but not among those in institutions (NDNS data not shown).

![Figure 1](image.png)

Figure 1 shows the differences in prevalence of vitamin D deficiency by sex and age group between those in institutions and private households. In institutions there was little difference overall in the prevalence of vitamin D deficiency between men (30.2%) and women (32.5%), while in private households women (15.0%) were significantly (P<0.001) more deficient than men (9.6%). In the NDNS, no sex differences were observed.

Seasonal differences were observed among men in institutions only: 37% of men whose blood sample was collected in winter and autumn were vitamin D deficient in comparison to 22% of those whose sample was collected in the spring and summer.

Social class differences were observed for men living in private households and women living in institutions. Among men in private households, those from manual social classes (13%) were more likely to be vitamin D deficient than those from non-manual social classes (5%, P<0.05). Women living in institutions, from manual social classes, were more likely to be vitamin D deficient (40%) in comparison to those from non-manual social classes (23%).

**Table 1.** Distribution of vitamin D concentrations among older people aged 65 years and over living in private households and institutions by sex and age group (HSE 2000)

<table>
<thead>
<tr>
<th>Private households</th>
<th>Age</th>
<th>Vitamin D (nmol/l)</th>
<th>Mean (SE)</th>
<th>Median</th>
<th>Upper 2.5th percentile</th>
<th>Lower 2.5th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men 65–79 (n = 260)</td>
<td>80+ (n = 62)</td>
<td>All (n = 322)</td>
<td>58.3(1.7)</td>
<td>53.5</td>
<td>132.0</td>
<td>19.0</td>
</tr>
<tr>
<td></td>
<td>80+ (n = 71)</td>
<td>All (n = 320)</td>
<td>47.5(3.0)</td>
<td>44.5</td>
<td>120.9</td>
<td>15.2</td>
</tr>
<tr>
<td>Women 65–79 (n = 249)</td>
<td>80+ (n = 71)</td>
<td>All (n = 320)</td>
<td>56.2(1.5)</td>
<td>50.5</td>
<td>131.5</td>
<td>18.1</td>
</tr>
<tr>
<td></td>
<td>80+ (n = 71)</td>
<td>All (n = 320)</td>
<td>47.5(3.0)</td>
<td>44.5</td>
<td>120.9</td>
<td>15.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institutions</th>
<th>Age</th>
<th>Vitamin D (nmol/l)</th>
<th>Mean (SE)</th>
<th>Median</th>
<th>Upper 2.5th percentile</th>
<th>Lower 2.5th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men 65–79 (n = 73)</td>
<td>80+ (n = 128)</td>
<td>All (n = 201)</td>
<td>40.0(2.8)</td>
<td>32.0</td>
<td>108.1</td>
<td>11.6</td>
</tr>
<tr>
<td></td>
<td>80+ (n = 369)</td>
<td>All (n = 454)</td>
<td>37.1(1.8)</td>
<td>32.0</td>
<td>85.9</td>
<td>11.0</td>
</tr>
<tr>
<td>Women 65–79 (n = 85)</td>
<td>80+ (n = 369)</td>
<td>All (n = 454)</td>
<td>38.1(1.5)</td>
<td>32.0</td>
<td>85.9</td>
<td>11.0</td>
</tr>
<tr>
<td></td>
<td>80+ (n = 369)</td>
<td>All (n = 454)</td>
<td>37.4(2.0)</td>
<td>32.0</td>
<td>86.3</td>
<td>11.0</td>
</tr>
</tbody>
</table>

**Figure 1.** Percentage of older people aged 65 years, living in institutions and private homes, with vitamin D deficiency by sex and age group.
Among both men and women living in private households an association between vitamin D deficiency and poorer self-reported general health was observed. Women with vitamin D deficiency were twice as likely (66.7%) to have moderate or severe disability in comparison to those with no disability (33.3%).

To examine further the link between vitamin D deficiency and possible risk factors, a logistic regression model was developed (Table 2). The dependent variable was vitamin D deficiency (serum concentrations of 25-hydroxycholecalciferol <25 nmol/l). The independent variables included were household type (i.e. institution or private household), sex, general health, season, cigarette smoking status, social class, body mass index (BMI), longstanding illness, musculoskeletal condition and disability.

Household type, disability and cigarette smoking did not show an association with vitamin D deficiency, once the other independent variables were included in the model. Sex was associated with vitamin D deficiency: women had double the odds in comparison to men (odds ratio (OR) 2.1). Vitamin D deficiency was 67% more likely among informants whose samples were collected in winter/autumn in comparison to those collected in the spring/summer. There was an association between those suffering from a limiting longstanding illness and vitamin D deficiency (OR 3.57). Being from manual social classes and having poor general health more than doubled the odds of deficiency. BMI of <25 kg/m² (underweight or normal weight) was significantly associated with vitamin D deficiency. Those who were underweight or normal weight were twice as likely to be vitamin D deficient in comparison to those who were classified as overweight and obese (OR 2.02).

### Table 2. Estimated odds ratio for vitamin D deficiency (serum vitamin D concentrations <25 nmol/l) by associated risk factors and sex among older people aged 65 years and over living in private households

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Base (weighted) 714</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex (&lt;0.001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>353</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>361</td>
<td>2.1</td>
<td>1.40, 3.0</td>
</tr>
<tr>
<td>Season (&lt;0.007)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring and summer</td>
<td>345</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Winter and autumn</td>
<td>369</td>
<td>1.67</td>
<td>1.15, 2.42</td>
</tr>
<tr>
<td>Social class (&lt;0.001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-manual</td>
<td>332</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Manual</td>
<td>382</td>
<td>2.4</td>
<td>1.61, 3.57</td>
</tr>
<tr>
<td>BMI status (&lt;0.001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over 25 kg/m²</td>
<td>471</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Below 25 kg/m²</td>
<td>243</td>
<td>2.02</td>
<td>1.39, 2.93</td>
</tr>
<tr>
<td>General health (&lt;0.04)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very good/good</td>
<td>432</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Bad/very bad</td>
<td>58</td>
<td>1.92</td>
<td>1.04, 3.57</td>
</tr>
<tr>
<td>Longstanding illness (&lt;0.001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No longstanding illness</td>
<td>254</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Limiting longstanding illness</td>
<td>291</td>
<td>3.57</td>
<td>2.06, 6.20</td>
</tr>
<tr>
<td>Condition of musculoskeletal system (&lt;0.03)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No condition present</td>
<td>517</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Has condition</td>
<td>197</td>
<td>0.62</td>
<td>0.40, 0.96</td>
</tr>
</tbody>
</table>

*Confidence interval.

### Discussion

The results from the HSE 2000 confirm the high prevalence of low vitamin D concentrations in the older general population in England and an even higher prevalence among those in institutions, where about one in three men and women were vitamin D deficient, using the cut-off level of <25 nmol/l. Vitamin D deficiency also exists at high levels among older populations in other European countries and the USA [18–21]. There is no generally accepted criterion for vitamin D deficiency. This, together with differences in serum vitamin D measurement, can make comparisons between studies and the interpretation of results problematic. Studies have previously measured serum vitamin D in ‘healthy’ human subjects to define the normal range for vitamin D, without taking into account underlying factors that affect vitamin D status such as lifestyle, sunscreen use, age and latitude [4], hence the controversy on which cut-off to use to define deficiency. In general, serum vitamin D concentrations <20 nmol/l have been regarded as indicating severe vitamin D deficiency, clinically associated with rickets and osteomalacia [22, 23].

McKenna and Freaney [16] suggested that hypovitaminosis should be defined as <100 nmol/l, vitamin insufficiency as levels <50 nmol/l and vitamin deficiency as serum vitamin D concentrations <25 nmol/l. It has recently been proposed that parathyroid hormone (PTH) levels and calcium absorption are not optimised until serum vitamin D levels reach approximately 80 nmol/l and therefore levels <80 nmol/l should be considered as insufficient [24]. Holick [25] suggested that normal values of serum vitamin D should be between 75 and 125 nmol/l.

In our study the proposed threshold of <25 nmol/l to indicate vitamin D deficiency was used, in accordance with the Department of Health recommendations [6], and to enable comparisons with the NDNS. Further analysis of the HSE 2000 data showed that when a higher threshold of <50 nmol/l is used, around 80% (80.7% for men and 81.5% for women) of those in institutions are vitamin D deficient; the figures for those in private households are 50 and 62.2%, respectively. At a threshold of <75 nmol/l, 97.9% of men and 93.9% of women in institutions are vitamin D insufficient, whereas the figures for those in private households are 79.5 and 86.6%, respectively. These results suggest that such groups of individuals require careful surveillance in order to prevent their vitamin D levels declining even further and increasing their risk of poor bone health.

Our findings show that women were more likely to be vitamin D deficient than men. Vitamin D deficiency is often seen in post-menopausal women and has been associated with a greater incidence of hip fractures [26]. The Decalysos II study examined the effect of combined calcium and vitamin D supplementation in a group of older women studied for 2 years, and results suggested that such supplementation could reduce the risk of hip fractures in this population [27].
However, these results were contradicted by two studies that showed no evidence that calcium and vitamin D supplementation reduces the incidence of fractures in patients with a history of previous low-trauma fracture [28] and among women at high risk of fracture [29]. It could be argued that both these studies had quite a few limitations though, such as poor compliance, and that serum vitamin D levels were not measured in the study population at baseline.

In our study, for both sexes, those with vitamin D deficiency were twice as likely to be in manual as in non-manual social classes. Poor socioeconomic status among older people has been shown in other studies as a risk factor for vitamin D deficiency [30]. In addition to this, those living in deprived areas often have little access to a wide variety of good quality foods [31]. This suggests that government initiatives to tackle social inequalities could also potentially influence vitamin D status among older people.

Our findings also show that poor general health and having a limiting longstanding illness were associated with vitamin D deficiency. This may be due to many factors; for example, those with poor health may have limited mobility, being unable to go outdoors and therefore lacking exposure to sunlight. They may also experience difficulties in shopping and cooking, and therefore be unable to consume an adequate diet to meet their calcium and vitamin D requirements. Lack of physical activity, especially weight-bearing exercise, is known to exacerbate poor bone health [32]. A recent Cochrane review of falls in older people [33] shows that muscle strengthening and balance training are likely to be beneficial.

Our analysis shows seasonal differences in vitamin D deficiency. Blood samples that were collected in the winter/autumn had lower serum vitamin D concentrations than those collected in the spring/summer. The evidence states this as one of the risk factors for poor bone health [34]. It is suggested that housebound older people and those in institutions should be encouraged to spend more time outdoors, but the precise dose and duration of exposure are not yet clearly established. Recommended levels are about 5–10 min of sun exposure on bare skin, two or three times per week [4]; however, this is not always possible especially in the UK. In addition older people have an age-related lowered capacity to synthesise vitamin D when exposed to sunlight.

In our analysis, those with a BMI <25 kg/m² (underweight/normal weight) had double the odds to be at risk of vitamin D deficiency in comparison to those with a BMI >25 kg/m² (overweight and obese), suggesting that nutritional status and dietary vitamin D levels among those who are underweight/normal weight are inadequate, possibly due to lack of overall food consumption and low bone density. A BMI <18.5 kg/m² has been shown to be one of the strongest risk factors for poor bone health [35]. Due to small numbers of individuals with a BMI <18.5 kg/m², the analysis could not be carried out separately in this subgroup.

The analysis fails to show any significant improvement in vitamin D status in England with comparison to earlier NDNS [15] results. Even with the government initiatives in place [36] and the launch of the Osteoporosis Strategy, vitamin D deficiency, a preventable public health problem, still exists at worrying levels.

As the number of older people in the population continues to rise, the future impact is likely to be phenomenal, resulting in a poor quality of life and major cost implications to the National Health Service. The question to ask then is whether enough is being done in primary care to prevent vitamin D deficiency. There are very few published evaluations of interventions carried out at the primary care level. Improving the diet to ensure that adequate vitamin D-containing foods are consumed and promoting more exposure to sunlight seems like a natural beneficial intervention, but may be less effective since absorption of vitamin D has been shown to decrease with age. Therefore, early detection and treatment for those with sub-optimal levels of vitamin D may be necessary.

Our data suggest that people aged 65 living in institutions are at a higher risk of vitamin D deficiency and insufficiency than other groups in the population. Therefore, supplementation with 800 IU of vitamin D per day may be the best cost-effective option, shown to be effective in reducing falls and fractures among high-risk groups [12]. However, there may be disadvantages associated with this such as poor compliance and problems in distribution. It has been suggested that a better option could be supplementation once a month; however, the effectiveness of this intervention is not proven.

Within the community, a cost-effective approach would be to target those at high risk and treat them appropriately. The elderly are more susceptible to poor nutritional status and low BMI, which are indicators of vitamin D deficiency. Individuals at risk could be identified initially by assessment of their nutritional status using a sensitive screening tool. There are many tools available, but some are less sensitive than others. The Mini Nutritional Assessment (MNA) tool [37] is validated and has been shown to correlate very well with nutritional intake of vitamin D and with biological parameters such as serum vitamin D levels. Even though the tool only provides an indication of dietary vitamin D intake without taking exposure to sunlight into account, it may be useful to identify individuals who may benefit from further assessments. Among individuals who are only 'marginally' deficient, vitamin D supplementation may not be necessary. Interventions that include education and advice about consuming vitamin D-fortified foods, and increased exposure to sunlight may be sufficient to prevent vitamin D levels from declining any further.

In addition, in order to target appropriate interventions, health professionals should be alerted to complaints presented to them by older people, such as muscle weakness, muscle and bone pain, and a history of falls and fractures, which are indicators of vitamin D deficiency.

In conclusion, vitamin D deficiency exists at worrying levels among those aged 65 years and over, especially in institutions. Further research is required to monitor the provision of interventions over time, with clear guidelines that include awareness, evidence-based advice and education in the primary care setting.
V. Hirani and P. Primatesa

Key points

- Vitamin D deficiency in England is higher among those living in institutions than in private households.
- Increased odds of vitamin D deficiency are seen among women and in the winter/autumn. It is associated with manual social classes, low/normal BMI, poor general health and existing longstanding limiting illness.
- No significant improvements in vitamin D status were seen in comparison with earlier NDNS results.
- Further action is needed to alert health professionals of the risks related to vitamin D deficiency and extend the provision of interventions to those in need.

Funding

The survey (HSE 2000) on which this paper is based was funded by the Department of Health.

Competing interests

None declared.

Informed consent

Those who provided a blood sample gave written consent. Ethical approval for the survey was obtained from the North Thames Multi-centre Research Ethics Committee (MREC) and from all Local Research Ethics Committees (LRECs) in England.

References

Mortality predictors following acute exacerbation of COPD


Predictors of 1-year mortality in patients discharged from hospital following acute exacerbation of chronic obstructive pulmonary disease

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Abstract

Introduction: acute exacerbation of COPD (AECOPD) is a major cause of hospital admission, and predicts subsequent medium-term mortality. We aimed to examine mortality predictors in patients discharged from hospital after AECOPD.

Methods: we obtained baseline demographic and clinical data from 100 patients (mean age (range) = 73 (60–98) years; 48 males) admitted with AECOPD. All completed the following validated questionnaires: a quality of life questionnaire (Breathing Problems Questionnaire; BPQ); a screening questionnaire for depression (Brief Assessment Schedule Depression Cards; BASDEC); a disability questionnaire (Manchester Respiratory Activities of Daily Living questionnaire; MRADL). Following discharge all were prospectively followed and survival/mortality at 12 months confirmed from hospital notes and by contacting general practitioners.

Results: the prevalence of depression at recruitment was 56%. One-year mortality in the whole group was 36%. Odds ratios (95% confidence intervals) for mortality predictors (univariate logistic regression analysis) were: use of long-term oxygen therapy = 2.72 (1.06–6.97); subsequent readmission = 2.57 (1.08–6.12); MRADL score = 0.87 (0.80–0.94) (disability predicting death); BASDEC score = 1.13 (1.02–1.26) (depression predicting death); BPQ score = 1.08 (1.04–1.12) (low quality of life predicting death); length of original hospital stay = 1.03 (1.00–1.07). On multivariate logistic regression analysis the only mortality predictor was BPQ with an odds ratio (95% confidence limits) of 1.13 (1.04–1.22). In terms of mortality prediction for