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Vitamin D deficiency in Ireland – implications for COVID-19. Results from the Irish Longitudinal Study on Ageing (TILDA)

tilda

Staidéar Fadaimseartha na hÉireann um Dhul in Aois

The Irish Longitudinal Study on Ageing

An Roinn Sláinte
Department of Health

HRB Health Research Board

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The ATLANTIC Philanthropies

Irish Life

Vitamin D deficiency in Ireland – implications for COVID-19. Results from the Irish Longitudinal Study on Ageing (TILDA)

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The Irish Longitudinal Study on Ageing

On behalf of the TILDA team

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WHY IS VITAMIN D IMPORTANT?

ESSENTIAL FOR BONE AND MUSCLE HEALTH

MAY HELP TO PREVENT RESPIRATORY INFECTIONS

BENEFITS IMMUNE FUNCTION AND COUNTERS INFLAMMATION

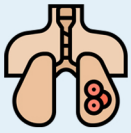
Anti-inflammatory — Pro - inflammatory

WHO IS AT RISK OF DEFICIENCY?

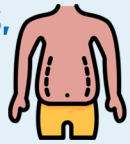
THOSE WHO DON'T GET ENOUGH...

HOUSEBOUND

PEOPLE WITH CHRONIC DISEASE AND LUNG CONDITIONS



SMOKERS, OBESE, INACTIVE PEOPLE



WHAT ARE THE RATES OF DEFICIENCY?

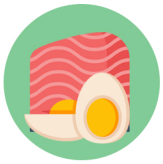
1 in 8 (13%) older adults in Ireland are deficient = 149,000 adults

1 in 5 (20%) older adults in Ireland are deficient in winter = 244,200 adults

Almost 1 in 2 (47%) of those over 85 are deficient in winter = 31,500 adults

1 in 4 (27%) of the over 70s 'cocooning' are likely to be deficient = 115,500 adults

WHERE IS IT FOUND?



IN RICH FOOD SOURCES LIKE OILY FISH, EGGS, LIVER, AND FORTIFIED FOODS

VITAMIN D CAN BE PRODUCED FROM 10-15 MINUTES OF SUN EXPOSURE FROM LATE MARCH TO LATE SEPTEMBER

HOW MUCH VITAMIN D SHOULD BE TAKEN TO PREVENT DEFICIENCY?

- 10 UG (400 IU) IS THE MINIMUM RECOMMENDED DAILY INTAKE DURING THE WINTER TIME

- BETWEEN 15 - 20UG (600-800 IU/DAY). IU/DAY) IS RECOMMENDED FOR MOST AT-RISK GROUPS

For more information please visit www.tilda.ie

Supported by

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Irish Life

Source: The Irish Longitudinal Study on Ageing 2020

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Key Messages

1. Why is Vitamin D important?

- Vitamin D is essential for bone and muscle health
- Vitamin D may help prevent respiratory infections in those who have low vitamin D levels
- Vitamin D is seasonal and cannot be made during the winter-time while the amount in summer time is subject to sunshine, weather and other factors

2. What are the rates of deficiency in older adults in Ireland*[1]?

- 47% of all adults aged >85 are deficient in winter (31,480)
- 27% of the over 70s who are 'cocooning' are likely to be deficient (115,536)
- 1 in 8 (13%) adults over 55 are deficient (149,049) all year

3. Who is at risk of Vitamin D deficiency in Ireland?

- People who are housebound/confined, little sun exposure and/or eat inadequate amounts of fortified foods
- People who don't take vitamin D supplements - currently over 91% of older adults 55+ do not take a supplement during the winter (1,038,752). Only 4% of men and 15% of women take a supplement
- People who are obese, physically inactive, have asthma or chronic lung disease

4. Where is vitamin D found

- Vitamin D is made in the skin from 10-15 minutes per day of sun exposure - in Ireland only made from late March to late September
- Vitamin D is available in oily fish (salmon, mackerel etc.), eggs, liver, fortified foods such as cereals and dairy products

5. How much vitamin D should be taken to prevent deficiency?

- 10 ug (400 IU) is the minimum recommended daily during the winter time
- Between 15 -20 ug (800-1,000 IU/day) recommended for most at risk groups

1 For further information see: Laird E, O'Halloran AM, Carey D, Healy M, O'Connor D, Moore P, Shannon T, Molloy AM, Kenny RA. The prevalence of vitamin D deficiency and the determinants of 25 (OH)D concentration in older Irish adults: Data from The Irish Longitudinal Study on Ageing (TILDA). The Journals of Gerontology: Series A. 2018 73(4):519-525. https://academic.oup.com/biomedgerontology/article/73/4/519/4103040

1. Introduction

In this report, we aim to describe the importance of vitamin D for immune function, the prevalence of vitamin D deficiency and vitamin D supplement use in Ireland by age group, gender, geographic location and by obesity and lung disease (particularly vulnerable to COVID-19), describe those most at risk of deficiency and the best sources of vitamin D and recommendations to improve status. By compiling this report, we hope the information given can help in the mitigation of the negative health consequences of COVID-19.

1.1 Vitamin D and immune function

Vitamin D is essential for older adults to help maintain bone and muscle health, plays a key role in the prevention and the treatment of falls and fractures and helps the absorption of calcium from the gut (2). Recent research has also highlighted that it may have an important function within the immune system (3). With increased age, there is a shift in the immune response to a more pro-inflammatory state which may lead to chronic low level inflammation and a slow accumulation of damage, with subsequent progression to chronic disease. This age related pro-inflammatory state is referred to as 'inflamm-aging' (4). This can be particularly important in periods of metabolic stress such as infection - the body is already pre-set to a higher level of inflammation and the necessary immune response to the infection may be impaired. Experiments and research has shown that vitamin D can alter the immune system response through its influence on the production and manufacturing of immune molecules known as cytokines (5). Vitamin D has been shown to help signal the increased production of ant-inflammatory molecules and decrease the production of pro-inflammatory molecules (6,7). This switch in immune response in theory may have some potential benefit in cases of 'cytokine storm' – a massive release of pro-inflammation (which has been observed in those infected with COVID (8)) which can cause acute respiratory distress syndrome (9). Importantly, in a large cross-sectional clinical trial (n=18,883) the risk of respiratory infection increased with lower blood vitamin D levels and the effect was even stronger in those with underlying lung conditions (10). Many case-control studies have also reported associations between low vitamin D and increased risk of infection (11) while in a trial supplementing patients at risk of respiratory infection with 1,000 International units (IU) of vitamin D a day for a year, supplement use reduced both symptoms and antibiotic use (12).

Recently, a large meta-analysis (data analysis of a large collection of previous studies) of 10,933 people from 25 trials conducted in 15 countries investigated whether taking a vitamin D supplement helped to prevent colds, flu and chest infections (acute respiratory infections - ARIs) (13). Vitamin D had a significant protective effect when it was given daily or weekly to people with lowest vitamin D levels: the risk of having at least one ARI was reduced from 60% to 32% in these people. Overall, vitamin D supplements reduced the risk of having at least one ARI. The study authors concluded that taking a vitamin D supplement was safe and can help protect against ARIs, particularly if baseline levels are low. In 2019, a newer analysis using 21,000 participants from across eight studies showed that those with a low blood vitamin D level had a 64% increased risk of community-acquired pneumonia (14).

Therefore, maintaining a sufficient vitamin D status in the adults is beneficial in prevention of ARI and may therefore be of benefit in the COVID-19 pandemic.

2. The TILDA Sample

This report uses data collected in Wave 1 of The Irish Longitudinal Study on Ageing (TILDA), a prospective study of 8,172 community-dwelling adults aged 50 years and older in Ireland. Since 2009, TILDA has collected information about the health and social circumstances of older adults using a comprehensive Computer Assisted Personal Interview (CAPI) conducted by interviewers who visited the participants in their own homes. This included detailed questions on socio-demographics, physical, mental and behavioural health. Information recorded included gender, age, habitation (living alone yes/no), currently smoking (yes/no), lung condition (yes/no), province of residence: (Leinster - East, Munster - South and the combined provinces of Ulster/Connacht - West/North) and household housing wealth (measure of economic resource “asset wealth” defined as above or below the average of 278,359 Euros). Medications taken on a daily basis including prescription, non-prescription and vitamin D supplements were also recorded. Self-reported physical activity levels were classified using the International Physical Activity Questionnaire (IPAQ) categories: physically active (minimally or health enhancing physically active) versus physically inactive (inactive or insufficiently active). Obesity was measured as a body mass index (BMI) > 30 kg/m2.

Approximately 72.1% (n = 5,895) of the study population consented to, and participated in, a health assessment. Of those, 91.3% (n = 5,382) provided a blood sample for vitamin D (25-hydroxyvitamin D (25(OH)D) measurement. In this report we use the internationally accepted definitions of vitamin D status: deficient (< 30 nmol/L); insufficient (30 -50 nmol/L) and sufficient (>50 nmol/L). Given that vitamin D is a seasonal vitamin, this had to be accounted for in any analysis of population prevalence. Thus, seasons were defined as winter (December-February), spring (March-May), summer (June-August), and autumn (September-November). Low and high vitamin D periods were defined as winter (with spring) and summer (with autumn), respectively.

2.1 Statistical Methods and Weighting

In this report, all TILDA prevalence estimates are weighted to account for age, sex, educational attainment and urban/rural residence in the 2011 Census (Wave 1 of TILDA collection). Prevalence estimates were also adjusted using modified base weights that accounted for survey non-response, non-attendance at the health assessment component of the study and whether or not respondents provided a blood sample. These weights

and adjustments ensure that these estimates are representative of the whole population aged 50 years and over in Ireland. All of the calculated population estimates are then based on figures collected from the most recent 2016 Census data (which reported a total of 1,446,460 people over 50 living in Ireland. It should be noted that the TILDA sampling frame does not include people with dementia at baseline or people living in nursing homes and as such this data may slightly underestimate prevalence for the total population in Ireland.

In light of the new HSE 'Guidance on cocooning to protect people over 70 years and those extremely medically vulnerable from COVID-19' (1) which came into effect from midnight on March 28th 2020, this report will also provide information in relation to vitamin D status in adults aged 70 years and over.

In light of the new HSE 'Guidance on coccooning to protect people over 70 years and those extremely medically vulnerable from COVID-19' which came into effect from midnight on March 28th 2020, this report will also provide information in relation to frailty on adults aged 70 and over.

3. Vitamin D Status of Older Adults in Ireland in Winter

During the winter period, 21.3% (244,209) of adults aged >55 years were vitamin D deficient (Figure 1; Table 2). The highest rates of deficiency were observed for those aged 80-84 years (29.6%; 23,987) and those aged >85 years (46.6%; 31,480). For those aged >70 years, the deficiency rates were 27.1% (115,536). Across all ages, deficiency rates were similar for both men and women though with men tending to have slightly higher deficiency rates overall.

Similar high rates of deficiency were observed when examined by province of residence (Figure 2; Table 3). Again, those aged >85 years had the highest rates of deficiency regardless of province. However, those aged 85+ in the Connacht & Ulster area had the highest deficiency rate (59.5%; 8,738). For those aged >70 years, the Munster region had the highest deficiency rate (31.8%; 39,410) vs the Leinster region (21.4%; 46,231). Overall, Leinster had the lowest rate of deficiency (17.6%; 103,615) compared to those residing in either Munster (25.3%; 83,615) or Connacht & Ulster (24.5%; 55,690).

In winter, only 9.4% (107,773) of those aged 55+ and 11.5% (49,028) of those aged 70+ reported taking a vitamin D supplement (Table 4). A much higher proportion of women (14.6%; 87,181) compared to men (3.8%; 20,877) took a supplement. This sex difference was consistent when examined by age as for instance, in those aged 85+ only 5.6% (1,291) of men vs 17.7% (7,875) of women reported taking a supplement..

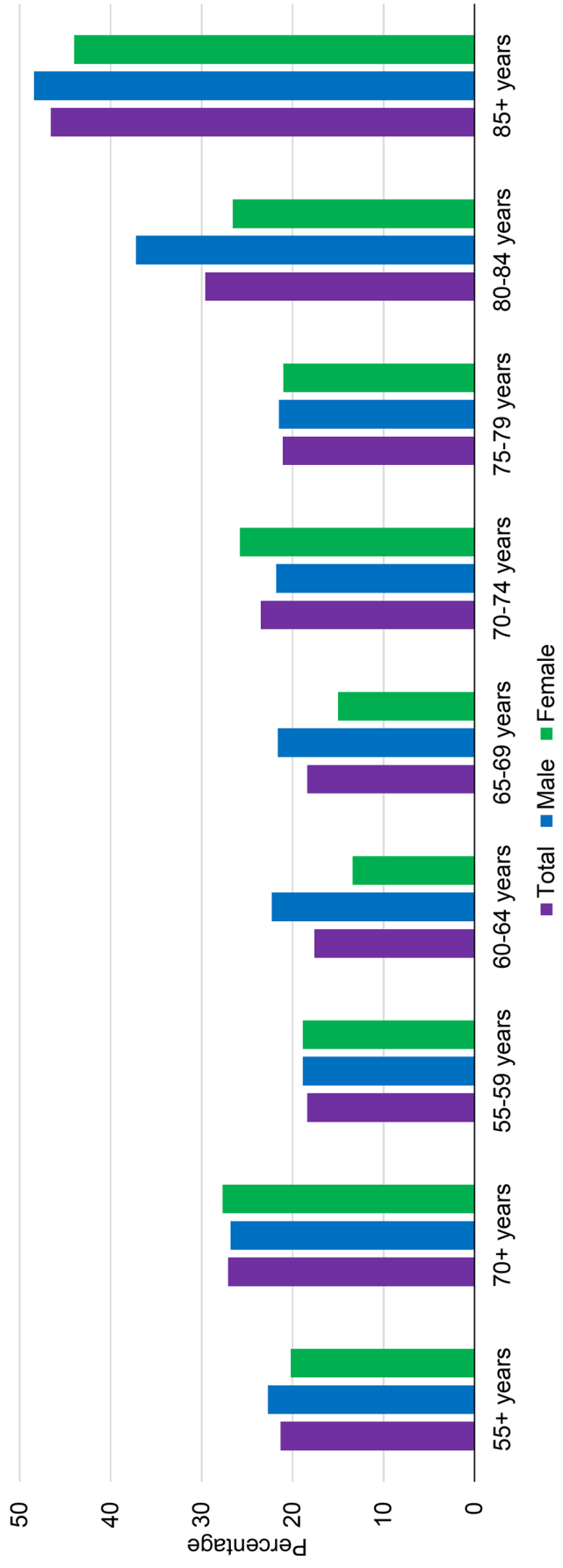


Figure 1. Winter vitamin D deficiency rates in older adults in Ireland by age and gender

Table 2. Percent prevalence of vitamin D status (winter) in TILDA (Wave 1) extrapolated to CSO population estimate data from 2016

Winter time	TILDA (%, Wave 1)			CSO (n, 2016)			
Age group	**Deficient**	**Insufficient**	**Sufficient**	**Deficient**	**Insufficient**	**Sufficient**	**Total**
Total							
55+ years	**21.3**	**33.2**	**45.5**	**244,209**	**380,647**	**521,669**	**1,146,525**
70+ years	**27.1**	**29.7**	**43.2**	**115,536**	**126,620**	**184,175**	**426,331**
55-59 years	18.4	38.3	43.3	49,698	103,449	116,955	270,102
60-64 years	17.6	33	49.4	42,039	78,823	117,994	238,856
65-69 years	18.4	34.2	47.4	38,867	72,243	100,126	211,236
70-74 years	23.5	32.1	44.4	38,134	52,089	72,049	162,272
75-79 years	21.1	30.7	48.2	24,363	35,449	55,655	115,467
80-84 years	29.6	34.5	35.9	23,987	27,958	29,092	81,037
85+ years	46.6	14.4	39	31,480	9,728	26,347	67,555
Male							
55+ years	**22.7**	**36.9**	**40.4**	**124,712**	**202,726**	**221,955**	**549,393**
70+ years	**26.8**	**35.0**	**38.2**	**51,302**	**66,999**	**73,125**	**191,426**
55-59 years	18.9	41	40.1	25,299	54,882	53,677	133,858
60-64 years	22.3	37.3	40.4	26,470	44,274	47,954	118,698
65-69 years	21.6	34.1	44.3	22,672	35,792	46,498	104,961
70-74 years	21.8	38.2	40	17,233	30,197	31,620	79,051
75-79 years	21.5	31.4	47.1	11,635	16,993	25,489	54,117
80-84 years	37.2	34.8	28	13,093	12,248	9,855	35,196
85+ years	48.4	40.9	10.7	11,162	9,432	2,468	23,062
Female							
55+ years	**20.2**	**29.8**	**50**	**120,621**	**177,945**	**298,566**	**597,132**
70+ years	**27.7**	**25.3**	**47.0**	**64,944**	**59,327**	**110,194**	**234,455**
55-59 years	18.9	41	40.1	25,750	55,860	54,634	136,244
60-64 years	13.4	28.7	57.9	16,101	34,485	69,571	120,158
65-69 years	15	34.2	50.8	15,941	36,346	53,988	106,275
70-74 years	25.8	25.3	48.9	21,355	20,941	40,475	82,771
75-79 years	21	29.8	49.2	12,884	18,282	30,184	61,350
80-84 years	26.6	33.7	39.7	12,194	15,448	18,199	45,841
85+ years	44	5.2	50.8	19,577	2,314	22,602	44,493

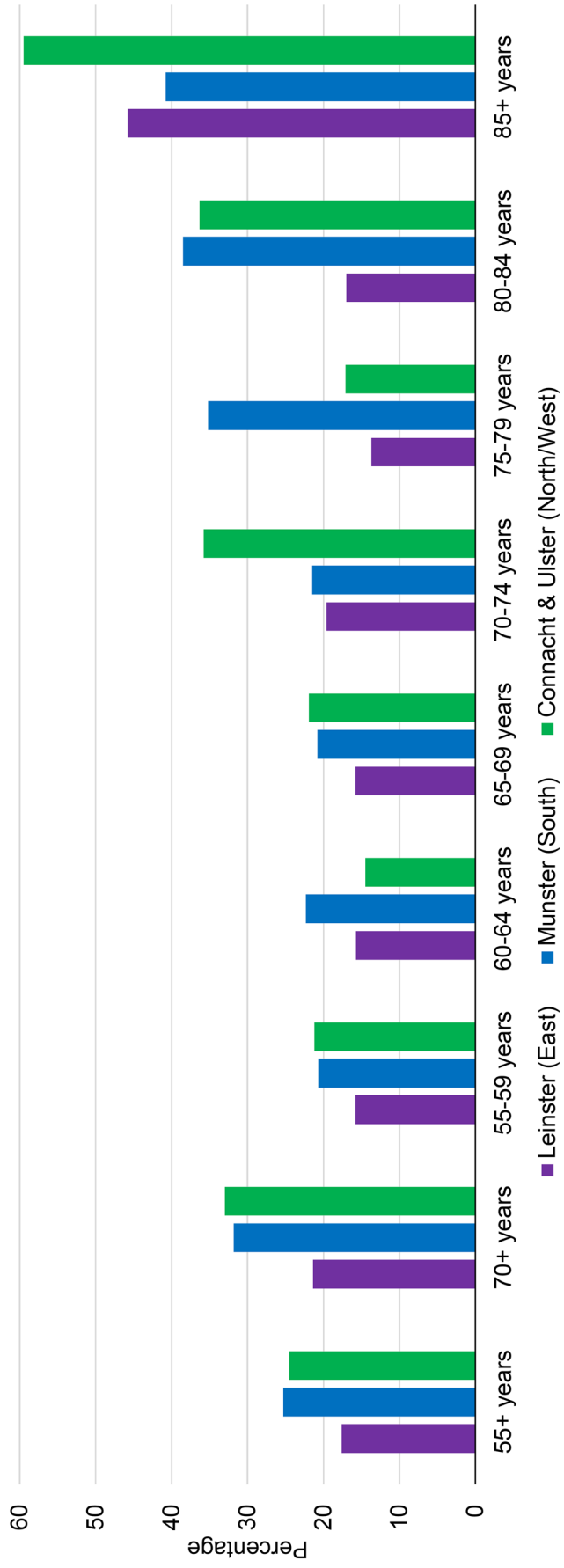


Figure 2. Winter vitamin D deficiency rates by age and province in older adults in Ireland

Table 3. Percent prevalence of vitamin D status (winter) in TILDA (Wave 1) extrapolated to CSO population estimate data from 2016

Winter time	TILDA (%, Wave 1)			CSO (n, 2016)			
Age group	Deficient	Insufficient	Sufficient	Deficient	Insufficient	Sufficient	Total
Leinster							
55+ years	**17.6**	**33.7**	**48.7**	**103,615**	**198,400**	**286,709**	**588,724**
70+ years	**21.4**	**27**	**51.6**	**46,231**	**58,329**	**111,474**	**216,035**
55-59 years	15.8	40.8	43.4	22,500	58,102	61,805	142,408
60-64 years	15.7	33.9	50.4	19,325	41,727	62,037	123,089
65-69 years	15.8	37	47.2	16,936	39,661	50,595	107,192
70-74 years	19.6	27.7	52.7	16,155	22,831	43,437	82,424
75-79 years	13.7	31.2	55.1	8,082	18,405	32,503	58,990
80-84 years	17	32.2	50.8	6,935	13,135	20,723	40,793
85+ years	45.8	12.2	42	15,493	4,127	14,208	33,828
Munster							
55+ years	**25.3**	**33.2**	**41.5**	**83,615**	**109,724**	**137,155**	**330,493**
70+ years	**31.8**	**33.5**	**34.7**	**39,410**	**41,517**	**43,004**	**123,930**
55-59 years	20.7	34.1	45.2	15,774	25,986	34,445	76,205
60-64 years	22.3	31.1	46.6	15,291	22,696	31,953	68,569
65-69 years	20.8	34.9	44.3	12,852	21,564	27,373	61,789
70-74 years	21.5	40.7	37.8	10,229	19,363	17,983	47,575
75-79 years	35.2	25.4	39.4	11,826	8,534	13,238	33,598
80-84 years	38.5	40.1	21.4	9,131	9,510	5,075	23,716
85+ years	40.8	28.5	30.7	7,769	5,427	5,846	19,041
Connacht & Ulster							
55+ years	**24.5**	**32.6**	**42.9**	**55,690**	**74,102**	**97,515**	**227,308**
70+ years	**33**	**30.7**	**36.3**	**28,501**	**26,514**	**31,351**	**86,366**
55-59 years	21.2	37.9	40.9	10,916	19,514	21,059	51,489
60-64 years	14.5	34.7	50.8	6,844	16,378	23,977	47,198
65-69 years	21.9	25.4	52.7	9,254	10,733	22,268	42,255
70-74 years	35.8	29.3	34.9	11,554	9,456	11,263	32,273
75-79 years	17.1	38.2	44.7	3,912	8,740	10,227	22,879
80-84 years	36.3	36.7	27	6,000	6,066	4,463	16,528
85+ years	59.5	0	40.5	8,738	0	5,948	14,686

Table 4. Prevalence of vitamin D supplement use (winter) in TILDA (Wave 1) by province extrapolated to CSO population estimate data from 2016

Winter time	TILDA (%, Wave 1)		CSO (n, 2016)		
Age group	**Yes**	**No**	**Yes**	**No**	**Total**
Total					
55+ years	**9.4**	**90.6**	**107,773**	**1,038,752**	**1,146,525**
70+ years	**11.5**	**88.5**	**49,028**	**377,303**	**426,331**
55-59 years	5.6	94.4	15,126	254,976	270,102
60-64 years	9.6	90.4	22,930	215,926	238,856
65-69 years	9.6	90.4	20,279	190,957	211,236
70-74 years	11.5	88.5	18,661	143,611	162,272
75-79 years	13.9	86.1	16,050	99,417	115,467
80-84 years	7.6	92.4	6,159	74,878	81,037
85+ years	13.5	86.5	9,120	58,435	67,555
Male					
55+ years	**3.8**	**96.2**	**20,877**	**528,516**	**549,393**
70+ years	**4.8**	**95.2**	**9,188**	**182,238**	**191,426**
55-59 years	2.2	97.8	2,945	130,913	133,858
60-64 years	4.1	95.9	4,867	113,831	118,698
65-69 years	3.6	96.4	3,779	101,182	104,961
70-74 years	5.4	94.6	4,269	74,782	79,051
75-79 years	5	95	2,706	51,411	54,117
80-84 years	4.6	95.4	1,619	33,577	35,196
85+ years	5.6	94.4	1,291	21,771	23,062
Female					
55+ years	**14.6**	**85.4**	**87,181**	**509,951**	**597,132**
70+ years	**16.7**	**83.3**	**39,151**	**195,284**	**234,435**
55-59 years	9.3	90.7	12,671	123,573	136,244
60-64 years	15.1	84.9	18,144	102,014	120,158
65-69 years	15.3	84.7	16,260	90,015	106,275
70-74 years	17.8	82.2	14,733	68,038	82,771
75-79 years	21.8	78.2	13,374	47,976	61,350
80-84 years	9.2	90.8	4,217	41,624	45,841
85+ years	17.7	82.3	7,875	36,618	44,493

4. Vitamin D Status of Older Adults in Ireland in Summer

During the summer period (optimum period for making vitamin D from sunlight), 8.4% (96,308) of adults aged >55 years were vitamin D deficient (Figure 3; Table 5) while for those aged 70+, the rate of deficiency was 12.1% (51,586). The highest rates of deficiency were observed for those aged 85+ years (30.7%; 20,739). Similar age defined rates were observed for both men and women though with women having slightly higher deficiency rates overall.

Similar rates of deficiency were observed when examined by province of residence (Figure 4; Table 6). Again, those aged >85 years had the highest rates of deficiency regardless of province. However, those aged 85+ in the Connacht & Ulster area had the highest deficiency rate (48.3%; 7,093) followed by Munster area (41.1%; 7,826) and then Leinster (20.7%; 7,002). Overall, Leinster again had the lowest rate of deficiency (6.8%; 40,033) compared to those residing in either Munster (9.5%; 31,397) or Connacht & Ulster (10.0%; 22,731). For those aged 70+, those residing in Munster had a deficiency rate of 15.9% (19,705) vs 10.3% (22,252) in Leinster.

In summer, 10.3% (118,092) of those aged 55+ reported taking a vitamin D supplement (Table 7). Again, a much higher proportion of women (14.6%; 87,181) compared to men (5.5%; 30,217) took a supplement. For those aged 70+, only 14.2% (60,539) took a vitamin D supplement.

4.1 Risk factors for deficiency

The risk factors for vitamin D deficiency are displayed in Figure 5. The largest negative predictors included smoking, geographic location (living in the North and West compared to the East of the country), winter season, physically inactivity, and older age. The largest positive predictor of vitamin D was vitamin D supplement use followed by being female.

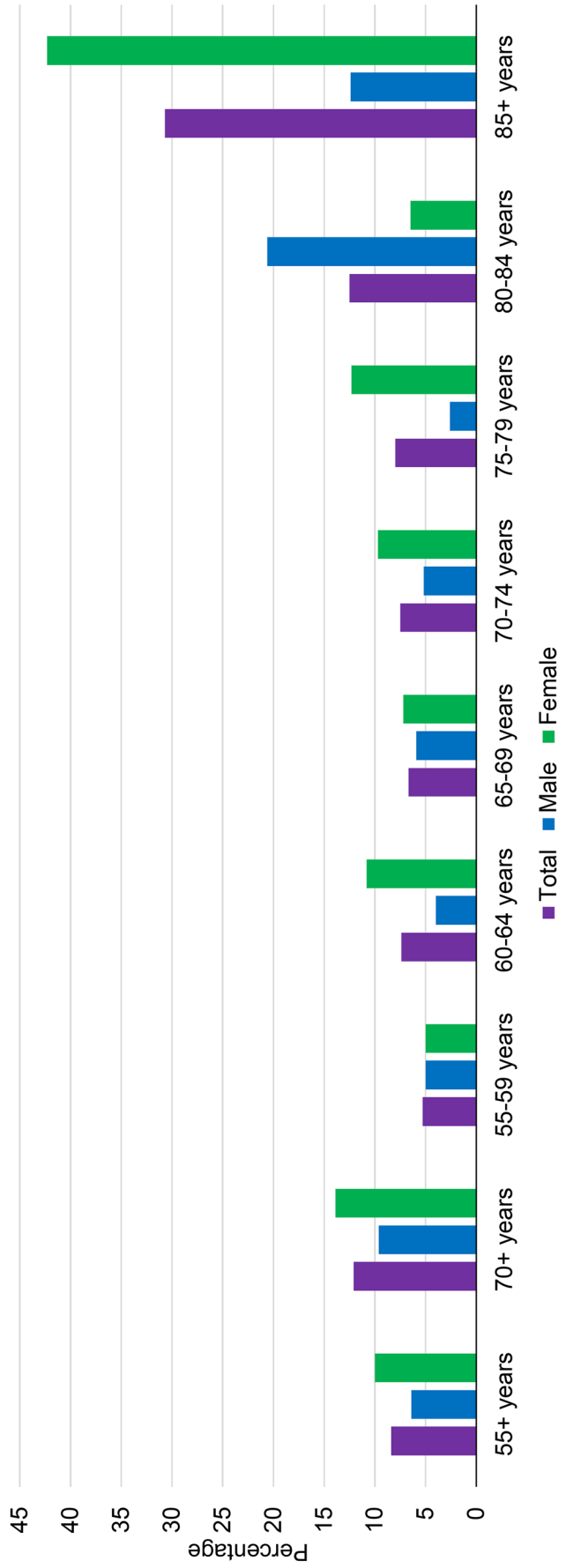


Figure 3. Summer vitamin D deficiency rates in older adults in Ireland by age and gender

Table 5. Percent prevalence of vitamin D status (summer) in TILDA (Wave 1) extrapolated to CSO population estimate data from 2016

Summer time	TILDA (%, Wave 1)			CSO (n, 2016)			
Age group	**Deficient**	**Insufficient**	**Sufficient**	**Deficient**	**Insufficient**	**Sufficient**	**Total**
Total							
55+ years	**8.4**	**27**	**64.6**	**96,308**	**309,562**	**740,655**	**1,146,525**
70+ years	**12.1**	**31.9**	**56**	**51,586**	**136,000**	**238,745**	**426,331**
55-59 years	5.3	24	70.7	14,315	64,824	190,962	270,102
60-64 years	7.4	23.8	68.8	17,675	56,848	164,333	238,856
65-69 years	6.7	26.9	66.4	14,153	56,822	140,261	211,236
70-74 years	7.5	28.3	64.2	12,170	45,923	104,179	162,272
75-79 years	8	29.7	62.3	9,237	34,294	71,936	115,467
80-84 years	12.5	36.4	51.1	10,130	29,497	41,410	81,037
85+ years	30.7	41.8	27.5	20,739	28,238	18,578	67,555
Male							
55+ years	**6.4**	**26.4**	**67.2**	**35,161**	**145,040**	**369,192**	**549,393**
70+ years	**9.6**	**33.6**	**56.8**	**18,377**	**64,319**	**108,730**	**191,426**
55-59 years	5	19.7	75.3	6,693	26,370	100,795	133,858
60-64 years	4	25.7	70.3	4,748	30,505	83,445	118,698
65-69 years	5.9	24.2	69.9	6,193	25,401	73,368	104,961
70-74 years	5.2	38.2	56.6	4,111	30,197	44,743	79,051
75-79 years	2.6	34.8	62.6	1,407	18,833	33,877	54,117
80-84 years	20.6	35.6	43.8	7,250	12,530	15,416	35,196
85+ years	12.4	56.6	31	2,860	13,053	7,149	23,062
Female							
55+ years	**10**	**27.4**	**62.6**	**59,713**	**163,614**	**373,805**	**597,132**
70+ years	**13.9**	**30.6**	**55.5**	**32,589**	**71,743**	**130,123**	**234,455**
55-59 years	5	19.7	75.3	6,812	26,840	102,592	136,244
60-64 years	10.8	21.6	67.6	12,977	25,954	81,227	120,158
65-69 years	7.2	29.1	63.7	7,652	30,926	67,697	106,275
70-74 years	9.7	29.8	60.5	8,029	24,666	50,076	82,771
75-79 years	12.3	25.3	62.4	7,546	15,522	38,282	61,350
80-84 years	6.5	37.5	56	2,980	17,190	25,671	45,841
85+ years	42.3	33.1	24.6	18,821	14,727	10,945	44,493

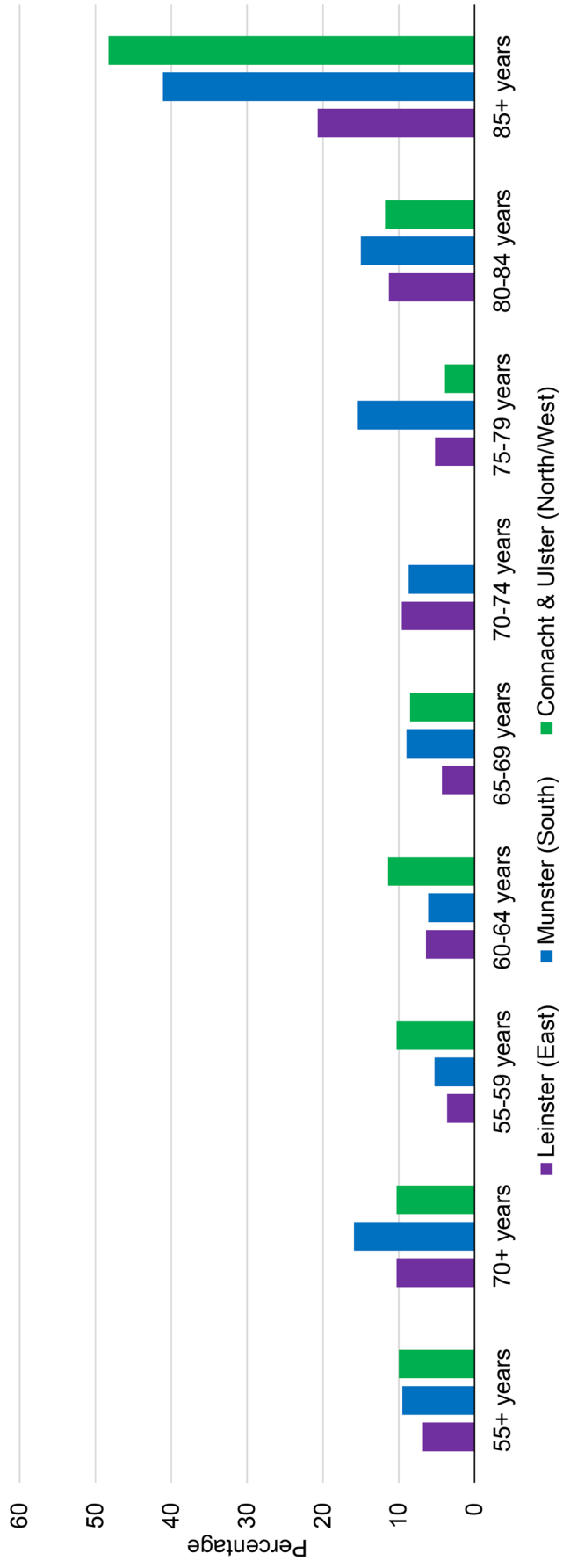


Figure 4. Summer vitamin D deficiency rates by age and province in older adults in Ireland

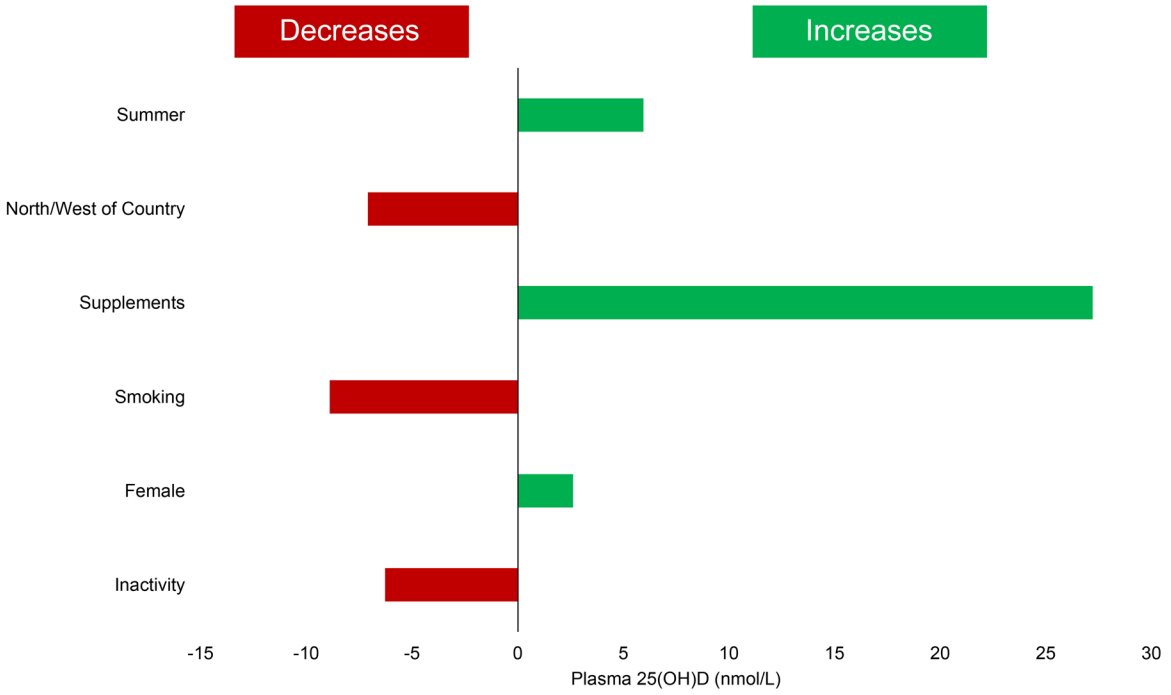
Table 6. Percent prevalence of vitamin D status (summer) in TILDA (Wave 1) by province extrapolated to CSO population estimate data from 2016

Summer time	TILDA (%, Wave 1)			CSO (n, 2016)			
Age group	**Deficient**	**Insufficient**	**Sufficient**	**Deficient**	**Insufficient**	**Sufficient**	**Total**
Leinster							
55+ years	**6.8**	**22.4**	**70.8**	**40,033**	**131,874**	**416,817**	**588,724**
70+ years	**10.3**	**27.1**	**62.6**	**22,252**	**58,545**	**135,238**	**216,035**
55-59 years	3.6	19.2	77.2	5,127	27,342	109,939	142,408
60-64 years	6.4	17.5	76.1	7,878	21,541	93,671	123,089
65-69 years	4.3	25.6	70.1	4,609	27,441	75,142	107,192
70-74 years	9.6	26.1	64.3	7,913	21,513	52,999	82,424
75-79 years	5.2	20	74.8	3,067	11,798	44,125	58,990
80-84 years	11.3	28	60.7	4,610	11,422	24,761	40,793
85+ years	20.7	46.4	32.9	7,002	15,696	11,129	33,828
Munster							
55+ years	**9.5**	**30.5**	**60**	**31,397**	**100,800**	**198,296**	**330,493**
70+ years	**15.9**	**35.6**	**48.5**	**19,705**	**44,119**	**60,106**	**123,930**
55-59 years	5.3	25.8	68.9	4,039	19,661	52,505	76,205
60-64 years	6.1	32.1	61.8	4,183	22,011	42,376	68,569
65-69 years	9	26.7	64.3	5,561	16,498	39,730	61,789
70-74 years	8.7	28	63.3	4,139	13,321	30,115	47,575
75-79 years	15.4	36.4	48.2	5,174	12,230	16,194	33,598
80-84 years	15	44.4	40.6	3,557	10,530	9,629	23,716
85+ years	41.1	34.9	24	7,826	6,645	4,570	19,041
Connacht & Ulster							
55+ years	**10**	**34.3**	**55.7**	**22,731**	**77,967**	**126,611**	**227,308**
70+ years	**10.3**	**39.1**	**50.6**	**8,896**	**33,769**	**43,701**	**86,366**
55-59 years	10.3	30.3	59.4	5,303	15,601	30,584	51,489
60-64 years	11.4	32.7	55.9	5,381	15,434	26,384	47,198
65-69 years	8.5	31.7	59.8	3,592	13,395	25,268	42,255
70-74 years	0	34.2	65.8	0	11,037	21,236	32,273
75-79 years	3.9	40.7	55.4	892	9,312	12,675	22,879
80-84 years	11.8	42.1	46.1	1,950	6,958	7,619	16,528
85+ years	48.3	34.4	17.3	7,093	5,052	2,541	14,686

Table 7. Prevalence of vitamin D supplement use (summer) in TILDA (Wave 1) by province extrapolated to CSO population estimate data from 2016

Summer time	TILDA (%, Wave 1)		CSO (n, 2016)		
Age group	**Yes**	**No**	**Yes**	**No**	**Total**
Total					
55+ years	**10.3**	**89.7**	**118,092**	**1,028,433**	**1,146,525**
70+ years	**14.2**	**85.8**	**60,539**	**365,792**	**426,331**
55-59 years	7.3	92.7	19,717	250,385	270,102
60-64 years	8.6	91.4	20,542	218,314	238,856
65-69 years	9	91	19,011	192,225	211,236
70-74 years	14	86	2,272	139,554	162,272
75-79 years	10.2	89.8	11,778	103,689	115,467
80-84 years	21.2	78.8	17,180	63,857	81,037
85+ years	10.1	89.9	6,823	60,732	67,555
Male					
55+ years	**5.5**	**5.5**	**30,217**	**519,176**	**549,393**
70+ years	**9.1**	**90.9**	**17,420**	**174,006**	**191,426**
55-59 years	3.9	3.9	5,220	128,638	133,858
60-64 years	3.7	3.7	4,392	114,306	118,698
65-69 years	3.7	3.7	3,884	101,077	104,961
70-74 years	8.9	8.9	7,036	72,015	79,051
75-79 years	4.8	4.8	25,976	51,519	54,117
80-84 years	11.5	11.5	4,048	31,148	35,196
85+ years	16.7	16.7	3,851	19,211	23,062
Female					
55+ years	**14.6**	**85.4**	**87,181**	**509,951**	**597,132**
70+ years	**18.1**	**81.9**	**42,436**	**192,019**	**234,455**
55-59 years	10	90	13,624	122,620	136,244
60-64 years	13.4	86.6	16,101	104,057	120,158
65-69 years	14.2	85.8	15,091	91,184	106,275
70-74 years	18.2	81.8	15,064	67,707	82,771
75-79 years	14.7	85.3	9,018	52,332	61,350
80-84 years	28.2	71.8	12,927	32,914	45,841
85+ years	6.4	93.6	2,848	41,645	44,493

Figure 5. Factors which can influence blood vitamin D levels in older Irish adults



5.Vitamin D status by obesity and respiratory lung conditions

Overall, obese older adults had much higher rates of vitamin D deficiency both in winter and summer (Figures 6-7). During winter, rates of vitamin D deficiency in the obese were 27.3% for those aged 55+ and 35.3% for those aged 70+ compared to 20.8% and 27.0% respectively for those not obese. Similar trends were also observed during summer.

In those reporting chronic lung disease (such as chronic bronchitis or emphysema), the prevalence of vitamin D deficiency was significantly higher than those not reporting disease across the age groups both in winter and summer (Figures 8-9). For instance in those aged >55 years, the prevalence in winter of deficiency was 33.8% in those with lung conditions vs 22.7% with no conditions. Similar trends were observed in 70+ age group where rates were 32 vs 29.9% in winter and 16.9 vs 12.3% in summer

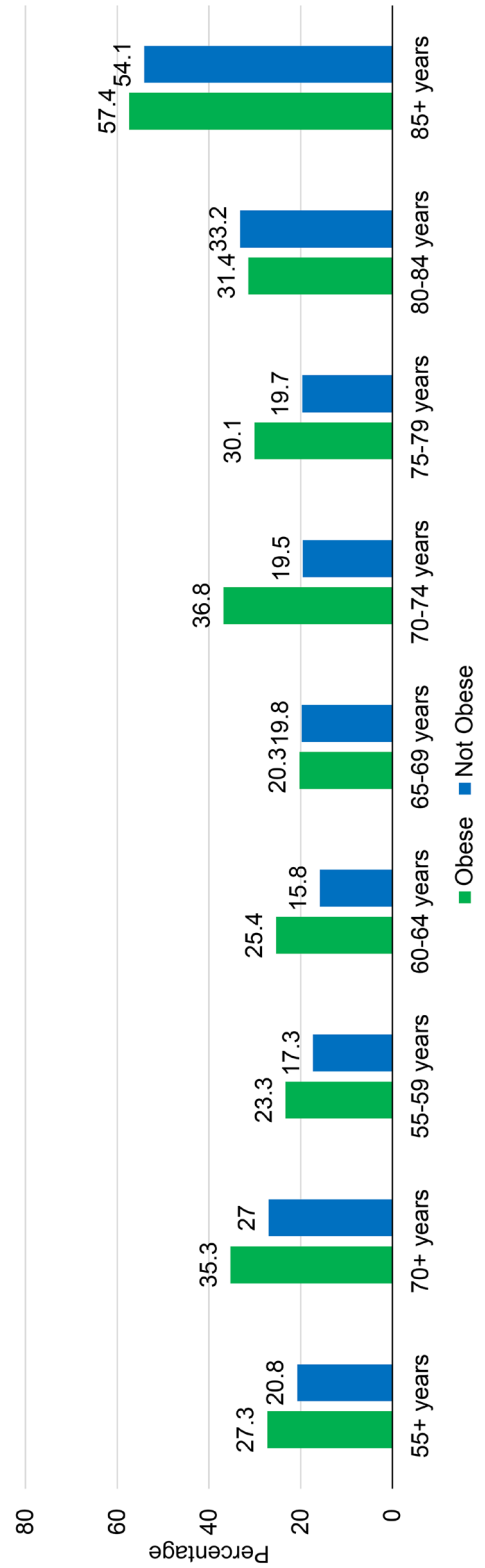


Figure 6. Vitamin D deficiency in older adults in Ireland with obesity by age (winter)

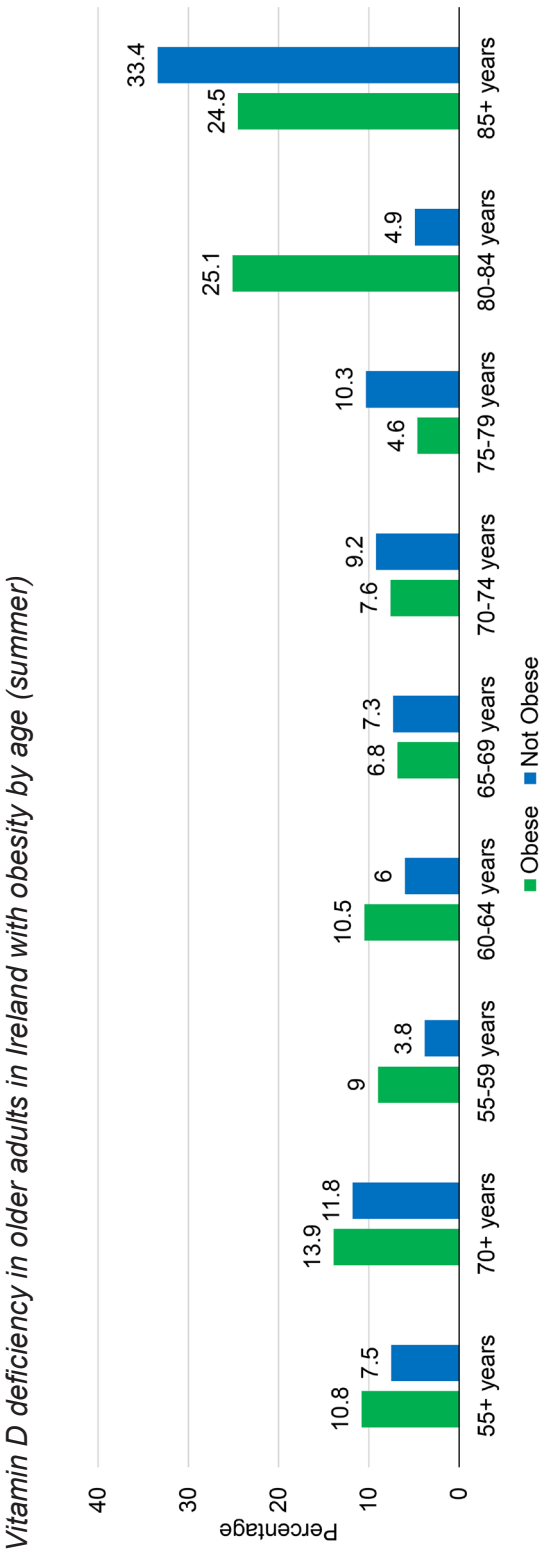


Figure 7. Vitamin D deficiency in older adults in Ireland with obesity by age (summer)

Figure 7. Vitamin D deficiency in older adults in Ireland with lung conditions (winter) by age

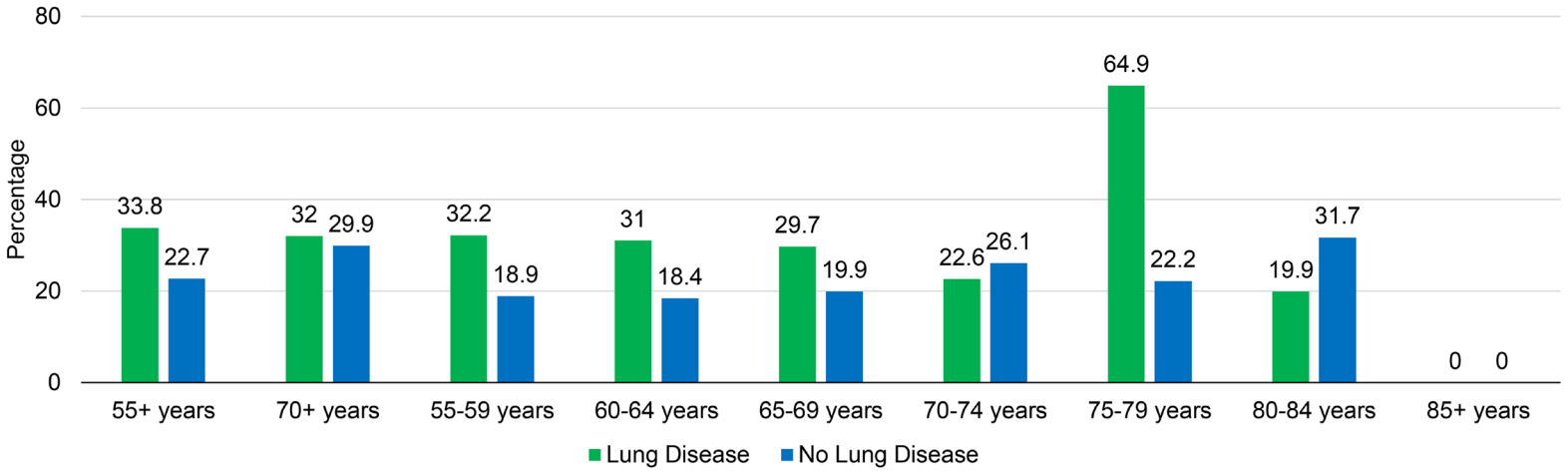
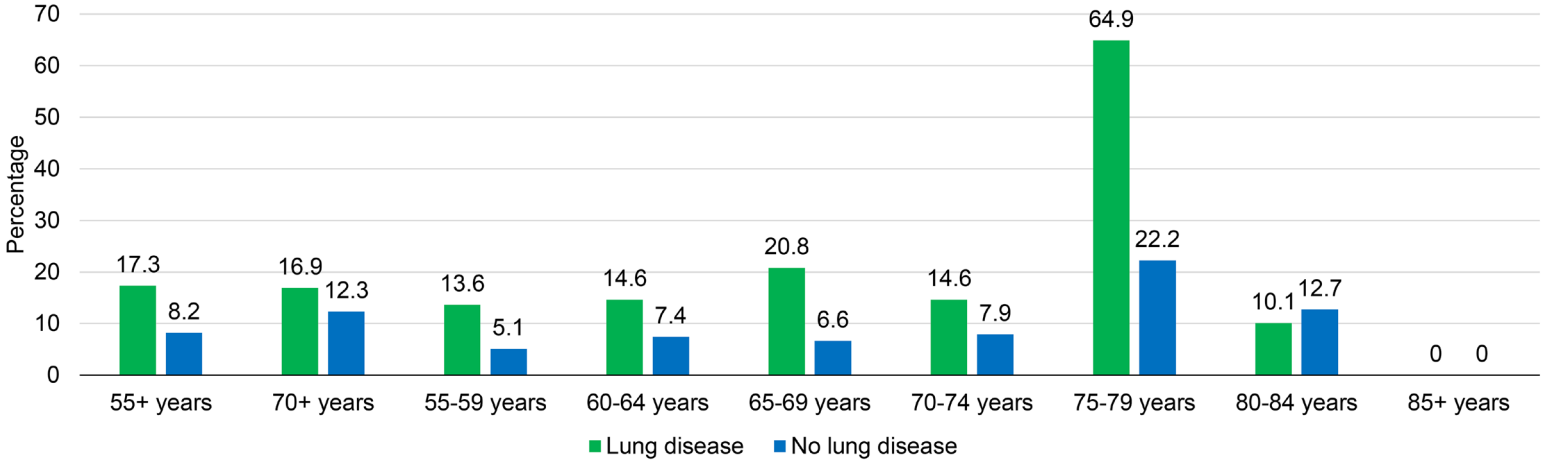


Figure 7. Vitamin D deficiency in older adults in Ireland with lung conditions (summer) by age



6. Discussion

This report demonstrates that of those aged 55+ years in Rep. of Ireland, 1 in 5 are vitamin D deficient during the winter and 1 in 12 during the summer. Of particular concern is that nearly 30% of those aged 70+ and 47% of those aged 85+ are deficient in vitamin D. These are the age groups who are considered to be 'extremely medically vulnerable' to the adverse health outcomes of COVID-19 and have been advised to participate in 'cocooning' during the COVID-19 public health emergency. Of extra concern is the fact that only 10.5% of those aged 70+ actually report taking a vitamin D supplement – because of 'cocooning' many may now lack the opportunity for sun exposure and given the low use of supplements, many of this vulnerable group could be at very high risk of deficiency. This of key importance given the usefulness of vitamin D for immune function particularly at this time.

Of particular concern we have observed very high levels of vitamin D deficiency in those who are obese and those with pre-existing lung conditions both of which have been observed to make individuals particularly vulnerable to COVID-19 and complications from the virus (15,16).

Ireland does not have any formal vitamin D food policy – we practice a voluntary but not mandatory food fortification policy where food manufacturers can decide to fortify (or not) their food products with vitamin D. The vitamin D status of those in Ireland is lower than either the United States or Canada who have systematic (mass) vitamin D food fortification. However, vitamin D deficiency is not inevitable in older adults in Ireland and the ability to have sufficient vitamin D status year round is an achievable goal that many countries meet. For example, another European country - Finland (which is at a much higher latitude and therefore receives less sunshine than Ireland) has virtually eliminated vitamin D deficiency in its population with rates <1% (17). This is due in part to a successful food fortification and vitamin D supplement policy and educating the public and medical practitioners on the importance of vitamin D. This vitamin D success story demonstrates what could be achieved in Ireland.

Here we outline the main sources of vitamin D and what are the intake recommendations

Vitamin D sources

There are three main sources of vitamin D – sunlight, food and supplements. Due to Ireland's far latitude geographic location, vitamin D synthesis by sunlight is only during the months of late March to late September. This is 10-15 minutes exposure to sunlight (before application with sun-protection at a time period between 12-4 pm). However, even during the summer, the amount of vitamin D that can be made is affected by cloud cover, use of skin creams, clothing, obesity and age (18). Foods rich in this micronutrient include oily fish (tinned or fresh salmon, mackerel etc.), egg yolks, liver and vitamin D fortified foods such as cereals and dairy products (Appendix 1). Regular consumption of vitamin D rich foods is recommended to help prevent deficiency, particularly in the winter months and those not exposed to sunshine in the summer time.

Vitamin D Intake recommendations

During the winter-period at least 10 ug/day (400 IU) from the diet is required (due to the lack of sunlight for vitamin D synthesis). Recent data has shown that the average intakes from diet are significantly below this level and therefore a 10 ug (400 IU) vitamin D supplement maybe be required during the winter. For those who are housebound (due to illness or quarantine for an extended period) an upper supplement of 15-20 ug/day (600-800 IU) maybe required due to the lack of sunshine exposure. In persons over 70 years, 20-25 ug/day (800-100IU) is recommended.

6.1 Conclusion

Our people aged 70 and over are the fabric of our society (19) and we must use all available tools to facilitate the reduction and transmission of COVD-19. Vitamin D is a potent immune modifying micronutrient and if vitamin D status is sufficient, it could benefit vulnerable adults in particular those 70+ years and older who are 'cocooning' during the COVID-19 outbreak.

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7. Appendix

Appendix Table 1. Common dietary sources of vitamin D

Dietary source	Quantity	Vitamin D (µg)*	Vitamin D (IU)
Egg	1 egg	1.6	64
Liver (lamb)	100g	0.9	36
Kidney (Lamb)	100g	0.6	24
Salmon	140g	10.2	408
Mackerel	140g	11.9	476
Sardines (canned in oil)	100g	5	200
Fortified milks	200ml (glass)	4	160
Fortified cereals	35g	2.94	117.6

***10ug or 400 IU per day suggested requirements**

Appendix Table 2. Factors that can influence vitamin D status

	Reason	Notes
1	Geographic location	Far latitude countries most at risk
2	Season (Winter vs Summer)	Majority of vitamin D is made in Summer
3	Low sun exposure	Due to sun-cream, clothing or skin pigmentation
4	Age	Older age, infants and pregnant women at risk
5	Obesity	BMI >25 kg/m2 at risk
6	Smoking	Sustainably increased risk of deficiency
7	Poverty	Can result in low sun exposure (holidays) or poor diet
8	Poor diet	Low intakes of oily fish, eggs, fortified foods
9	Malabsorption syndromes	This can include Coeliac, Crohn's etc.
10	Genetic conditions	Can result in lower blood vitamin D