Background to the project (200 words Max):
Vitamin D deficiency is prevalent in older adults residing in Northern Europe (McCarroll et al, 2015) including Northern Ireland (Forsythe et al, 2012; Laird et al, 2014). A number of factors negatively impact vitamin D status in the elderly including impaired mobility, reduced sun exposure, medication use, reduced intrinsic skin synthesis and inadequate dietary vitamin D intake. In residential homes, almost everyone is vitamin D insufficient if vitamin D is not supplemented (Chel et al, 2008). Furthermore, a large number of residents have undetected vitamin D deficiency and osteoporosis may be underdiagnosed and undertreated in long-term care settings (Aguilar et al, 2015). The incidence of vitamin D deficiency in residential homes in Northern Ireland is not known.

The importance of vitamin D among the elderly is growing with evidence supporting a role for vitamin D as a promoter of bone health, physical performance and as a possible disease modulator (Veleva et al, 2014). Fractures are very common in the elderly due to age-related weakening of their bones (osteoporosis) and can lead to considerable disability or even death. Improving vitamin D status may help to reduce the risk of fractures in the elderly. Two recent meta-analysis support the use of vitamin D plus calcium supplements as an intervention for fracture risk reduction in institutionalized older adults (Weaver et al, 2015; Avenell et al, 2014). Furthermore, vitamin D supplementation in older adults has been found to be a cost-effective strategy for fall prevention in the USA and in the UK it has been suggested that treatment of the elderly with colecalciferol 800 IU daily would be associated with reductions in mortality and substantial cost-savings through fall prevention (Bistra, 2014; Poole et al, 2015).

Gastrointestinal dysfunctions are common among the elderly and may result in malabsorption of vitamin D. Oral spray vitamin D may be advantageous in such individuals, in comparison to vitamin D capsules/tablets, by providing an accelerated route of absorption. We have recently shown that oral spray vitamin D3 solution is equally effective in raising total 25(OH)D concentrations when compared to vitamin D3 capsules in healthy adults (Todd et al., 2016). Furthermore, Satia et al. (2015) have
demonstrated that oral spray vitamin D produced a significantly higher 25(OH)D concentration in Indian patients with intestinal malabsorption in comparison to a gelatin capsule following 30 days’ administration. To our knowledge oral spray supplementation has not been compared to alternative supplementation methods in those with gastrointestinal malabsorption in a western population.

**Objectives of the research project (400 words Max):**
In residential homes, vitamin D supplementation is increasingly being considered as an indicator and standard for responsible care and supplement use has been shown to be an important determinant of vitamin D status of elderly people residing on the Island of Ireland (McCarroll et al, 2015). While recent research suggests a positive impact of vitamin D therapy on fall prevention, there are no data with respect to vitamin D status in relation to bone health in residential homes in Northern Ireland. Therefore, this study will investigate the prevalence of vitamin D sufficiency in residential homes in Northern Ireland and examine its relationship to bone health. This study will also determine the efficacy of vitamin D supplementation in achieving optimal status using both supplements and a novel vitamin D spray for those with malabsorption complications.

**Methods to be used (400 words Max):**
This study will be conducted in conjunction with clinicians based within the Western Trust, Northern Ireland. Ethical approval will be sought prior to the commencement of the following studies.

**Study 1**
A cross-sectional analysis of vitamin D status of residents within care homes in Northern Ireland. The relationship between vitamin D status and bone mineral density and muscle strength will be investigated. Blood samples will be obtained from 100 care home residents throughout N. Ireland and analysed for vitamin D status [25-hydroxyvitamin D (25(OH)D) concentration]), parathyroid hormone and calcium analysis. Bone mineral density will be assessed by DXA using a portable peripheral DXA. Muscle strength (kg) will be measured using a hand-grip dynamometer (Stoelting, Illinois, USA). Confounding factors including age, medication use, dietary intake (assessed using a validated food frequency questionnaire) and medical history will be controlled for.

**Study 2**
A randomised placebo controlled intervention study with vitamin D 800 IU to see how effective it is at raising vitamin D status >50nmol/l. This study will determine vitamin D status at 0, 2, 6, 12 and 24 weeks in a total of 100 care home residents. Confounding factors including age, medication use, dietary intake (assessed using a validated food frequency questionnaire) and medical history will be controlled for. A secondary aim will be to determine the effect of supplementation on muscle strength,
BMD and fall rate. Blood markers and muscle strength will be assessed as outlined within study 1 at all time points. Fall rates will be determined by questionnaire. The effect of supplementation on bone health will be investigated by assessing bone turnover markers at all time points including bone specific alkaline phosphatase, serum crosslaps and P1NP.

Study 3
A randomised cross-over study will be conducted to compare the effect of oral spray and capsule supplementation on total 25-hydroxyvitamin D (25(OH)D concentrations in elderly care home residents that have been diagnosed with malabsorption syndrome. Participants (n=22) will be randomly assigned to receive either 800 IU vitamin D3 oral spray or 800 IU vitamin D3 capsules daily for 4 weeks. Following a 10-week washout period, participants will receive the alternative supplement for a final 4 weeks. Anthropometrics and fasted blood samples will be obtained before and after each supplementation period. Blood samples will be analysed for total 25(OH)D, creatinine, parathyroid hormone and adjusted calcium concentrations.

Study 4
Dietary analysis of menus within residential homes to determine vitamin D and calcium content of meals.

Study 5
A survey of drugs associated with adverse effects on bone health that are prescribed in residential homes in NI.

Skills required of applicant (200 words Max):

- BSc or higher in a health related discipline e.g. Nutrition or Biomedical Science
- Strong communication and organisation skills
- Experience of phlebotomy, blood processing and analysis of vitamin D would be an advantage
- Excellent interpersonal skills (particularly in recruiting and retaining study subjects)
- Team working skills
- Able to use his/her initiative and work under pressure and anti-social hours
- Willing to learn new skills and techniques, including laboratory techniques
- Good record keeping
- Ability to deal effectively with administrative tasks

References (Maximum of ten references):

Onder, et al, 2009 JBMR; Volume 23, Number 7, 2008 Vitamin D Receptor Polymorphisms and Falls Among Older Adults Living in the Community: Results From the iLSIRENTE Study.


Bistra I Veleva, Victor G Chel and Wilco P Achterberg Efficacy of daily 800 IU vitamin D supplementation in reaching vitamin D sufficiency in nursing home residents: cross-sectional patient file study. BMC Geriatrics 2014, 14:103


Ethical Approval/Animal licence(s) Required - YES
Animal licence(s) Required - NO

If YES – please explain if this is currently in place or outline plans for obtaining such approval.

Ethical approval will be sought from ORECNI prior to commencing this PhD.
Use of Core Facilities including BBRU
If yes, please ensure that appropriate costings are obtained from Dr Le Roy Dowey and provided below

VITAMIN D ANALYSIS AND ILAB USAGE FOR BIOCHEMICAL ANALYSIS
TANITA SCALES
MSD PLATE READER
Please identify how this project addresses/meets the research priorities of the Biomedical Sciences Research Institute/ Research Group:

The proposed research will be conducted within the Northern Ireland Centre for Food and Health (NICHE) and expands on the group’s ongoing vitamin D research, a core area of research within NICHE and within the BMSRI. The BMSRI NICHE Group has been at the forefront of vitamin D research over the past decade. Our research has led to changes in the dietary intake guidelines on the international stage, most notably in the U.S by the Institute of Medicine, the international body responsible for agenda setting of dietary recommendations worldwide. Our work has also been crucial in shaping UK and Irish Health Service reports on vitamin D assessment and this project will contribute significantly to the Health of the Elderly in Northern Ireland. In addition the results from this project will provide preliminary data for the researchers involved to source Horizon 2020 funds under the ‘Healthy Aging’ calls.

Please provide a list of the titles you submitted for this year’s round of undergraduate student projects (or provide details of extenuating circumstances which prevented the submission of titles):

EM MCSORLEY (currently on maternity leave) – co-supervised with Dr P Allsopp
An investigation into the potential anticancer activity of the Irish brown seaweed Ascophyllum nodosum
An investigation into the potential anticancer activity of the Irish brown seaweed Palvetia canaculata
An investigation into the potential anticancer activity of the Irish brown seaweed Ulva intestinalis

PJ MAGEE
An assessment of the sports nutrition knowledge of athletes in Ireland (x4 students).
Assessment of the hydration status and nutritional knowledge of athletes (x2 students).

Please provide a list of the externally funded grants you have received within the last 3 years (print out from RO Required to be appended): See attached.

Project Costing:
Please identify the cost of undertaking the project and highlight current externally funded projects that align with this proposed project [Project Title, funding source, amount and effective dates].

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<th>Year 2</th>
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<td>£20,450</td>
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<td>£26000</td>
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Identify Source of Funding for the project and Confirmation that funds are available:

It is the intention of the supervisors to apply for match funds from the Western Trust as well as grants from Osteoporosis UK to support this PhD. The lead (EMCS) and co-supervisor (PM) have consultancy money they can dedicate to this project if required.

Signed: ________________________________  (Lead Supervisor)

Anticipated Project Funding [please tick relevant box(es)]:

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<tr>
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<td>Self funding</td>
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NOTE: Self funded students:
It is intended to advertise as many PhD projects on the web as possible (suitable for overseas self-funded students). Please note that all PhD projects for the 2016-2017 intake (including all projects to be offered to overseas self-funded students) should be included in this submission process.

Research Group Leader:
Research Group Leaders should sign to confirm that the project proposal aligns with the overall Research Group and RI strategy:

I confirm that this application meets the research strategy of the Research Group and has my support:

Signature: ___________________________________________________

(Appropriate Research Group Leader)

Date: ________________________________________________________