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Changing landscape of nutrition and dietetics research? A bibliographic analysis of top-tier published research in 1998 and 2018

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Abstract

Objective: The current study sought to describe and compare study type, research design and translation phase of published research in nutrition and dietetic journals in 1998 and 2018.

Design: This was a repeat cross-sectional bibliographic analysis of Nutrition and Dietetics research. All eligible studies in the top eight Nutrition and Dietetics indexed journals in 1998 and 2018 were included. Two independent reviewers coded each study for research design (study type and study design) and translation phase (T0-T4) of the research using seminal texts in the field.

Setting: Not relevant.

Participants: Not relevant.

Results: The number of publications (1998, *n* 1030; 2018, *n* 1016) has not changed over time, but the research type, design and translation phases have. The proportion of intervention studies in 1998 (43·8 %) was significantly higher than 2018 (19·4 %). In 2018, more reviews (46·9 % *v.* 15·6 % in 1998) and less randomised trials (14·3 % *v.* 37·8 % in 1998) were published. In regard to translation phase, there was a higher proportion of T2–T4 research in 2018 (18·3 % *v.* 3·8 % in 1998); however, the proportion of T3/T4 (dissemination, implementation and population-level research) research was still low (<3 %). Our sensitivity analysis with the four journals that remained in the top eight journal across the two time periods found no differences in the research type, design and translation phases across time.

Conclusions: There was a reduction in intervention and T0 publications, alongside higher publication of clinical study designs over time; however, published T3/T4 research in Nutrition and Dietetics is low. A greater focus on publishing interventions and dissemination and implementation may be needed.

Keywords
Bibliometric
Research translation
Study design
Research focus
Implementation science

Dietary risk factors such as low intakes of fruits, vegetables and wholegrains, as well as excessive intakes of processed foods, contribute to high intakes of Na, fat and added sugars[1]. These dietary factors are the primary cause of death and disability for high-income countries globally[1,2]. As such, there is a large volume of research and specialist Nutrition and Dietetics journals focused on exploring methods for reducing disease burden related to dietary risk factors, ranging from basic science to the evaluation of public health policies in the community[3,4].

In well-developed research areas including Nutrition and Dietetics, public health experts have proposed that research focus should progress over time, such that findings are increasingly policy and practice relevant to

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facilitate translation into practice. Frameworks such as the Public Sequential Model proposed by Nutbeam in 1996[5] and Flay's Eight Phase of Research provide a way of conceptualising this progression[6,7]. Both Nutbeam and Flay's models suggest that, over time, there should be progression from research efforts to firstly understand the problem, to testing for efficacy, followed by replicability and ultimately dissemination[6–8]. This progression is similar to that described in the United States (US) National Institute of Health and Institute of Medicine, which describes five stages of research translation ranging from T0 to T4[9–11]. Although the scientific community recognises that research translation does not happen in a linear manner[12], these models provide a useful way to describe research type and its relevance to public health practice.

Bibliometric studies, where data are gathered from published sources[13], allow the characterisation of publications within a field, to describe research activity and assess progression. Such analyses have been used to critically examine the progression of research in many fields including Indigenous and rural health[14], physical activity[8], falls prevention[15], as well as smoking[16] and public health[17]. These studies have reported a lack of progression of research focus over time, with the overwhelming majority of studies being descriptive and focused on the earlier translation phases. For example, in physical activity research, there was little change in the proportion of descriptive research in the 20-year period between 1988–1989 and 2008–2009[8]. The majority of intervention studies in both time periods were efficacy focused relative to later stages of research translation[8].

To the authors' knowledge, an analysis of the progression of Nutrition and Dietetics research has not been conducted previously. This examination can provide an overview of the changes in publishing priorities and research foci and allows the identification of gaps in production of research evidence. Therefore, the primary aim of the current study was to describe the volume, research design and research translation phase of manuscripts published within the top eight ranked journals in the discipline of Nutrition and Dietetics and compare this across two time periods (1998 and 2018). Additionally, we also sought to assess these changes by journal focus (those that focused on a particular content area (i.e., lipids, obesity) *v*. Those that had a broader nutrition focus, and those with a public health focus as part of their scope *v*. Those that did not have public health as an area of focus).

Methods

Study design and sample

A repeat cross-sectional bibliographic study of research published in the top eight ranked Nutrition and Dietetics indexed journals was undertaken for 1998 and 2018. A bibliometric study, where the number and types of published literature are tabulated, enables the description of overall research activity and characterisation of the type of research undertaken in a particular field[18]. Firstly, we sampled published research articles from the top eight ranked Nutrition and Dietetics journals, as classified by Web of Science, InCites Journal Citation Reports[19], which are based on journal impact factor. As the impact factor is determined by average citation in the past 2 years, this sampling approach offers an insight into the research priorities of the field[20]. Nutrition and Dietetics journals cover a broad range of topics including general nutrition, nutrition and metabolism, nutrition science, clinical nutrition, nutritional biochemistry and resources related to dietetics, which covers the application of nutritional principles (see Table 1). Four of the eight journals were the same across both time points. All title and abstracts of articles from the eight journals published in 1998 and 2018 were downloaded. Four authors (J.J., N.P., A.B. and C.B.) undertook an initial screen using title and abstracts, where studies were included if they were published in English, presented new data (e.g., not editorials, letters without new data) and were not conference abstracts (see Fig. 1 for flow diagram outlining study selection process). This was confirmed in the full-text screen prior to data extraction.

Data extraction

All studies that met the above criteria were downloaded as full-text articles from e-Journal databases in August 2019. Four authors (J.J., N.P., A.B. and C.B.) independently extracted data using a standardised data extraction form. All data extractors were provided with a list of definitions (see online supplementary material, Supplemental Table S1–S5) and met prior to extraction to calibrate the data extraction processes. An additional reviewer conducted data extraction as a second reviewer for a portion (20 %) of the included studies to check data extraction (S.L.Y.). Differences were resolved via consensus or a third reviewer was consulted (S.L.Y.).

Measures

Studies were classified as descriptive/epidemiology, measurement or intervention using previous definitions of such research[8,21] (see online supplementary material, Supplemental Table S1). Seminal methodological texts[22–24] were used to classify the research design of included studies (see online supplementary material, Supplemental Table S2 and Table 2). The translational research phase was determined based on the National Institute of Health endorsed criteria (see online supplementary material, Supplemental Table S3)[11]. The research translational process was also defined using the Integrative Framework of Dissemination, Implementation and Translation criteria defined by Leppin and colleagues (see online supplementary material,

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Table 1 Top eight ranked journals indexed as Nutrition and Dietetics in 1998 and 2018

		1998		2018	
Journal	Scope	Volume and issues (IF)	*n*	Volume and issues (IF)	*n*
Progress in Lipid Research	Lipid biochemistry, chemistry, biotechnology, industry and medicine	Vol. 37 Issues: 1–6 (IF: 6·0)	14	Vol. 69–72 (IF: 12·54)	18
Annual Review of Nutrition	Energy metabolism, macronutrients, micronutrients, biochemistry, nutritional genomics, molecular and cell biology, clinical nutrition, comparative nutrition, nutritional anthropology, nutritional toxicology, nutritional microbiology, epidemiology and public health nutrition	Vol. 18 (IF: 5·13)	18	Vol. 38 (IF: 8·422)	18
American Journal of Clinical Nutrition	Primary research journal. Publishes the latest research on topics in nutrition, such as obesity, vitamins and minerals, nutrition and disease and energy metabolism	Vol. 68 Issues: 1–6 Supp Issues: S2, S4, S6 (IF: 3·417)	194	Vol. 107 and 108 Issues: 1–6 (IF: 6·568)	227
Critical Reviews in Food Science and Nutrition	Current technology, food science and human nutrition. Also, the application of scientific discoveries and the acquisition of knowledge related to nutrition, functional foods, food safety, and food science and technology	Vol. 38 Issues: 1–8 (IF: 2·167)	20	Vol. 58 Issues: 1–18 (IF: 6·704)	201
International Journal of Obesity	Biochemical, physiological, genetic, molecular, metabolic, nutritional, psychological and epidemiological aspects of obesity and related disorders	Vol. 22 Issues: 1–12 (IF: 3·003)	175	Not in top 8 in 2018	
Lipids	General area of lipid research, including chemistry, biochemistry, clinical nutrition and metabolism	Vol. 33 Issues: 1–12 (IF: 2·364)	148	Not in top 8 in 2018	
Obesity Research	Research intends to increase knowledge, stimulate research and promote better management of people with obesity	Vol. 6 Issues: 1–6 Supp Issue: S1 (IF: 2·265)	60	Not in top 8 in 2018	
Journal of Nutrition	Experimental nutrition in humans and other animal species and controversial issues in nutrition	Vol.128 Issue: 1–12 Supp Issue: S2, S12 (IF: 2·127)	401	Not in top 8 in 2018	
Advances in Nutrition	Nutrition-related research efforts directed towards biochemical, molecular and genetic studies utilising experimental animal models, domestic animals and human subjects. Includes, clinical nutrition, epidemiology, public health and nutritional education	Not in top 8 in 1998		Vol. 9 Issue 1–6 Supp Issue: S1, S4 (IF: 7·24)	65
Clinical Nutrition	Nutritional and metabolic care, and the relationship between nutrition and disease both in the setting of basic science and clinical practice	Not in top 8 in 1998		Vol. 37 Issue: 1–5, 6a, 6B (IF: 6·402)	299
International Journal of Behavioural Nutrition and Physical Activity	Devoted to understanding behavioural aspects of diet and physical activity. Includes multiple levels of analysis, including populations, groups and individuals. Includes epidemiology and behavioural, theoretical and measurement research areas	Not in top 8 in 1998		Vol. 15 Issue 1 (IF: 6·037)	126
Nutrition Reviews	Authoritative and critical literature reviews on current and emerging topics in nutrition science, food science, clinical nutrition and nutrition policy	Not in top 8 in 1998		Vol. 76 Issue: 1–12 Supp Issue: S1 (IF: 5·779)	61

IF, impact factor; Vol., journal volume; Supp Issues, supplementary issues.

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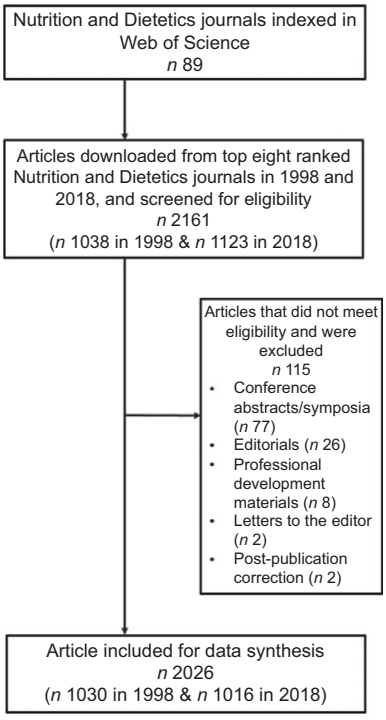

Fig. 1 Flow diagram of study selection process for inclusion

Supplemental Table S4)[25]. If studies were classified as implementation and dissemination research (T3 or T4), the researchers examined whether the manuscript included information regarding dissemination[11,26], implementation[26], adaptability[27], sustainability[28] and scaling-up[29] (see online supplementary material, Supplemental Table S5).

Statistical analysis

Analyses were conducted using STATA 14.2 (StatCorp.). The proportion of publications that were classified under each study type and research design was reported, together with 95 % CI. Pearson's χ^2 tests or Fisher's exact where values were < 5 were undertaken to compare the differences in proportion of studies between 1998 and 2018 as appropriate. Statistical tests were two-tailed with an α of 0·05. Further, as there were differences in the type and scope of articles included in 1998 and 2018, we undertook a number of subgroup analyses by journal scope (focused on a specific content area (including obesity and lipids, *n* 4 journals) *v.* Nutrition more broadly (*n* 8 journals), and by those that included public health/behavioural nutrition (*n* 4 journals) as a focus and those that did not (*n* 8 journals)). Additionally, we undertook a sensitivity analysis to examine the trends in the four

Table 2 Study type, design and translational research phase for studies published in the top eight ranked Nutrition and Dietetics journals in 1998 and 2018

	1998 (*n* 1030)			2018 (*n* 1016)			
	n	Proportion	95 % CI	*n*	Proportion	95 % CI	*P**
Study type							
Descriptive†	530	51·4	48·4, 54·5	764	75·2	72·4, 77·8	< 0·001
Measurement	49	4·8	3·5, 6·2	55	5·4	4·1, 7·0	
Intervention†	451	43·8	40·7, 46·9	197	19·4	17·0, 22·0	
Study design							
Systematic review/meta-analysis†	4	0·4	0·1, 0·9	155	15·3	13·1, 17·6	< 0·001‡,†
Non-systematic reviews†	157	15·2	13·1, 17·6	321	31·6	28·7, 34·5	
Randomised controlled trial‡	183	17·8	15·5, 20·2	133	13·1	11·1, 15·3	
Non-randomised trial†	206	20·0	17·6, 22·6	12	1·2	0·6, 2·1	
Cohort†	39	3·8	2·7, 5·1	146	14·4	12·3, 16·7	
Case control†	79	7·7	6·1, 9·5	28	2·8	1·8, 4·0	
Case series†	105	10·2	8·4, 12·2	33	3·2	2·2, 4·5	
Cross-sectional†	233	22·6	19·2, 24·3	148	14·6	12·5, 16·9	
Decision/cost effectiveness	1	0·1	0·02, 0·5	3	0·3	0·06, 0·9	
Qualitative/mixed methods	0	0	–	10	1·0	0·5, 1·8	
Other study design	23	2·2	1·4, 3·3	27	2·7	1·8, 3·8	
Translation phase							
T0†	844	81·9	79·5, 84·2	737	72·5	69·7, 75·3	< 0·001‡,†
T1†	147	14·3	12·2, 16·6	93	9·2	7·5, 11·1	
T2†	37	3·6	2·5, 4·9	160	15·7	13·6, 18·1	
T3†	1	0·1	0·02, 0·5	19	1·9	1·1, 2·9	
T4	1	0·1	0·02, 0·5	7	0·7	0·3, 1·4	
IFDIT translation process of research							
Basic research†	877	85·2	82·8, 87·3	740	72·8	70·0, 75·5	< 0·001‡,†
Pre-clinical research†	117	11·4	9·5, 13·5	88	8·7	7·0, 10·6	
Clinical research†	34	3·3	2·3, 4·6	167	16·4	14·2, 18·9	
Clinical implementation†	1	0·1	0·02, 0·5	16	1·6	0·9, 2·5	
Public health	1	0·1	0·02, 0·5	5	0·5	0·2, 1·1	

IFDIT, Integrative Framework of Dissemination, Implementation and Translation.
*Person's χ^2 statistical test for difference across time unless otherwise indicated.
†Fisher's exact test.
‡Indicates statistical significance ($P < 0·05$) based on 95 % CI.

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journals that remained the same between 1998 and 2018. This sensitivity analysis enabled us to assess the robustness of the results, and whether the inclusion of different journals impacted on overall findings.

Results

Overall, eighty-nine journals were indexed as Nutrition and Dietetics in Web of Science. The top eight journals were selected and 2161 articles were downloaded from these journals. One hundred fifteen articles that did not present new data (e.g., editorials (*n* 26), letters to the editor (*n* 2), post-publication correction (*n* 2), professional development material (*n* 8) and conference abstracts/symposia (*n* 77)) were excluded at title/abstract screening. A total of 2046 studies were included in the following data extraction (*n* 1030 from 1998 journals, *n* 1016 from 2018 journals) (see Fig. 1). The journal, scope, impact factor, volume and issue numbers for 1998 and 2018 are presented in Table 1. Four of the eight journals remained the same across both time points (Progress in Lipid Research, Annual Review of Nutrition, American Journal of Clinical Nutrition and Critical Reviews in Food Science and Nutrition).

Overall

Study type and study design

The majority of research was classed as descriptive in both 1998 and 2018; however, there was a significant decline in intervention studies between 1998 and 2018 (43·8 % in 1998 and 19·4 % in 2018) and significant increases in descriptive research (51·4 % in 1998 and 75·2 % in 2018). In 1998, the most common study designs were cross-sectional studies (22·6 %), followed by non-randomised trials (20·0 %) and randomised controlled trials (17·8 %). In 2018, the most common study design was non-systematic reviews (31·6 %), followed by systematic reviews and meta-analyses (15·3 %) and cross-sectional studies (14·6 %). All other study designs accounted for < 10 % of publications. Shifts for all study characteristics were significantly different across time ($P < 0·001$).

Across the two time points, there were changes in the proportion of systematic reviews (increase from 0·4 % in 1998 to 15·3 % in 2018), non-systematic reviews (increase from 15·2 % in 1998 to 31·6 % in 2018), randomised controlled trials (decrease from 17·8 % in 1998 to 13·1 % in 2018), non-randomised trials (decrease from 20·0 % in 1998 to 1·2 % in 2018), cohort (increase from 3·8 % in 1998 to 14·4 % in 2018) and cross-sectional studies (decrease from 22·6 % in 1998 to 14·6 % in 2018) (see Table 2).

Broad nutrition focus and specific content area

When assessing by journals that had a broad nutrition focus, we found similar trends to the overall sample (*n* 633 in 1998 and *n* 997 in 2018). There were similar declines in intervention research from 45·7 % in 1998 to 19·8 % in 2018 and increases in descriptive research (48·3 % in 1998 to 74·7 % in 2018), as well as similar increases in systematic reviews and cohort studies. However, among journals that focused on a specific content area (i.e., lipids, obesity), the proportion of descriptive (56·4 % in 1998, 58·4 % in 2018) and intervention (40·8 % in 2018, 38·9 % in 2018) research, as well as study designs remained largely unchanged across time (see Table 3).

Included a public health focus and did not include a public health focus

For journals that included a public health focus (*n* 18 in 1998, *n* 270 in 2018), there were large increases in intervention research (from 0 % in 1998 to 17·8 % in 2018) in contrast to the overall sample and across all study designs. For journals that did not include a public health focus (*n* 1012 in 1998, *n* 746 in 2018), the observed changes were similar to the overall sample with decreases in intervention research (44·6 % in 1998 to 20 % in 2018) and increases in descriptive research (50·6 % in 1998 to 74·1 % in 2018), and similar changes in types of study design (see Table 3).

Translation phase

Overall

For both years, the majority of research was in the T0 phase and consisted of basic research. There was a significant difference in percentage of T0-focused publications (81·9 % in 1998 *v.* 72·5 % in 2018) and basic research (85·2 % in 1998 *v.* 72·8 % in 2018). Additionally, there was a higher proportion of research focused on clinical research in 2018 (16·4 % *v.* 3·3 % in 1998) (Table 2). A total of twenty-eight studies were classed as T3 and T4 (two in 1998 and twenty-six in 2018). The specific areas of examination for T3/T4 studies in 2018 were dissemination (*n* 9), implementation (*n* 17), adaptation of guidelines (*n* 1), sustainability (*n* 2) and scaling-up (*n* 7).

Broad nutrition focus and targeted focus

When assessing by journals that had a broad nutrition focus, we found similar trends to the overall sample (*n* 633 in 1998 and *n* 997 in 2018). There were similar declines in T0-focused research from 86·6 % in 1998 to 72·0 % in 2018 and basic science research (88·5 % in 1998 to 72·3 % in 2018), as well as increases in clinical research. Similarly, there was increase in T3/4 research from zero in 1998 to 2·6 % in 2018. Among journals that focused on a particular nutrition area (i.e., lipids, obesity), there were no changes in translation phase and translation process of research between 1998 and 2018.

Included a public health focus and did not include a public health focus

For journals that included a public health focus (*n* 18 in 1998, *n* 270 in 2018), there were large decreases in T0

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Table 3 Study type, design and translational research phase for studies published in the top eight ranked Nutrition and Dietetics journals in 1998 and 2018 by subgroups

		1998 (*n* 1030)			2018 (*n* 1016)			
Subgroup	Study type	*n*	Proportion (%)	95 % CI	*n*	Proportion (%)	95 % CI	*P**
Broad nutrition focus	Descriptive	306	48·3	44·4, 52,3	745	74·7	71·9, 77·4	< 0·001
	Intervention	289	45·7	41·7, 49·6	197	19·8	17·3, 22·4	
	Measurement	38	6·0	4·3, 8·1	55	5·5	4·2, 7·1	
Targeted topics	Descriptive	224	56·4	51·4, 61·4	19	100	–	< 0·001†,‡
	Intervention	162	40·8	35·9, 45·8	0	0	–	
	Measurement	11	2·8	1·4, 4·9	0	0	–	
Public Health inclusive focus	Descriptive	18	100	–	211	78·1	72·7, 83·9	0·088†,‡
	Intervention	0	0	–	48	17·8	13·4, 22·9	
	Measurement	0	0	–	11	4·1	2·1, 7·2	
Non-public health inclusive focus	Descriptive	512	50·6	47·5, 53·7	553	74·1	70·8, 77·2	< 0·001†,‡
	Intervention	451	44·6	41·5, 47·7	149	20·0	17·2, 23·0	
	Measurement	49	4·8	3·6, 6·4	44	5·9	4·3, 7·8	
	Study design	*n*	Proportion (%)		*n*	Proportion (%)		*P* value
Broad nutrition focus	Case control	39	6·2	4·4, 8·3	28	2·8	1·8, 4·0	< 0·001†,§
	Case series	70	11·1	8·7, 13·8	33	3·3	2·3, 4·6	
	Cohort	15	2·4	1·3, 3·9	146	14·6	12·5, 17·0	
	Cross-sectional	98	15·5	12·8, 18·5	148	14·8	12·7, 17·2	
	Non-randomised trial	120	19·0	16·0, 22·2	12	1·2	0·06, 2·1	
	Non-systematic review	128	20·2	17·2, 23·6	302	30·3	27·4, 33·3	
	Other	22	3·5	2·2, 5·2	27	2·7	1·7, 3·9	
	Randomised controlled trial	139	22·0	18·8, 25·4	133	13·3	11·2, 15·6	
	Systematic review/meta-analysis	2	0·3	0·04, 1·1	155	15·5	13·2, 17·9	
	Decision and cost effectiveness	0	0	–	3	0·3	0·06, 0·9	
	Qualitative/mixed methods	0	0	–	10	1·0	0·5, 1·9	
Targeted topics	Case control	40	10·1	7·3, 13·5	0	0	–	< 0·001†,§
	Case series	35	8·8	6·2, 12·0	0	0	–	
	Cohort	24	6·0	3·9, 8·9	0	0	–	
	Cross-sectional	135	34·0	29·4, 38·9	0	0	–	
	Decision and cost effectiveness	1	0·3	0·006, 1·4	0	0	–	
	Non-randomised trial	86	21·7	17·7, 26·0	0	0	–	
	Non-systematic review	29	7·3	4·9, 10·3	19	100	–	
	Other	1	0·3	0·006, 1·4	0	0	–	
	Randomised controlled trial	44	11·1	8·2, 14·6	0	0	–	
	Systematic review/meta-analysis	2	0·5	0·06, 1·8	0	0	–	
Public Health inclusive focus	Non-systematic review	18	100	–	96	35·6	29·8, 41·6	0·001†,‡
	Case control	0	0	–	1	0·4	0·009, 2·1	
	Case series	0	0	–	5	1·9	0·6, 4·3	
	Cohort	0	0	–	16	5·9	3·4, 9·5	
	Cross-sectional	0	0	–	45	16·7	12·4, 21·7	
	Decision and cost effectiveness	0	0	–	1	0·4	0·009, 2·1	
	Non-randomised trial	0	0	–	2	0·7	0·09, 2·7	
	Other	0	0	–	10	3·7	1·8, 6·7	
	Qualitative/mixed methods	0	0	–	1	0·4	0·009, 2·1	
	Randomised controlled trial	0	0	–	28	10·4	7·0, 14·6	
	Systematic review/meta-analysis	0	0	–	65	24·1	19·1, 29·6	
Non-public health inclusive focus	Case control	79	7·8	6·2, 9·6	27	3·6	2·4, 5·2	< 0·001†,§
	Case series	105	10·4	8·6, 12·4	28	3·8	2·5, 5·4	
	Cohort	39	3·9	2·8, 5·2	130	17·4	14·8, 20·3	
	Cross-sectional	233	23·0	20·5, 25·7	103	13·8	11·4, 16·5	
	Decision and cost effectiveness	1	0·1	0·003, 0·5	2	0·3	0·03, 1·0	
	Non-randomised trial	206	20·4	17·9, 23·0	10	1·3	0·6, 2·5	
	Non-systematic review	139	13·7	11·7, 16·0	225	30·2	26·9, 33·6	
	Other	23	2·3	1·4, 3·4	17	2·3	1·3, 3·6	
	Randomised controlled trial	183	18·1	15·8, 20·6	105	14·1	11·7, 16·8	
	Systematic review/meta-analysis	4	0·4	0·1, 1·0	90	12·1	9·8, 14·6	
	Qualitative/mixed methods	0	0	–	9	1·2	0·5, 2·3	
	Translation phase	*n*	Proportion (%)		*n*	Proportion (%)		*P* value
Broad nutrition focus	T0	548	86·6	83·7, 89·1	718	72·0	69·1, 74·8	<0·001†,‡
	T1	58	9·2	7·0, 11·7	93	9·3	7·6, 11·3	

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Table 3 *Continued*

Subgroup	Study type	1998 (*n* 1030) *n*	Proportion (%)	95 % CI	2018 (*n* 1016) *n*	Proportion (%)	95 % CI	*P**
	T2	27	4·3	2·8, 6·1	160	16·0	13·8, 18·5	
	T3	0	0	–	19	1·9	1·2, 3·0	
	T4	0	0	–	7	0·7	0·3, 1·4	
Targeted topics	T0	296	74·6	70·0, 78·8	19	100	–	0·081†,‡
	T1	89	22·4	18·4, 26·8	0	0	–	
	T2	10	2·5	1·2, 4·6	0	0	–	
	T3	1	0·3	0·006, 1·4	0	0	–	
	T4	1	0·3	0·006, 1·4	0	0	–	
Public health inclusive focus	T0	18	100	–	188	69·6	63·8, 75·1	0·090†,‡
	T1	0	0	–	22	8·1	5·2, 12·1	
	T2	0	0	–	54	20·0	15·4, 25·3	
	T3	0	0	–	5	1·9	0·6, 4·3	
	T4	0	0	–	1	0·4	0·009, 2·0	
Non-public health inclusive focus	T0	826	81·6	86·4, 90·4	549	73·6	70·3, 76·7	< 0·001†,‡
	T1	147	14·5	12·4, 16·8	71	9·5	7·5, 11·9	
	T2	37	3·7	2·6, 5·0	106	14·2	11·8, 16·9	
	T3	1	0·1	0·003, 0·5	14	1·9	1·0, 3·1	
	T4	1	0·1	0·003, 0·5	6	0·8	0·3, 1·7	
	IFDIT translation process of research	*n*	Proportion (%)		*n*	Proportion (%)		*P* value
Broad nutrition focus	Basic research	560	88·5	85·7, 90·9	721	72·3	69·4, 75·1	< 0·001†,‡
	Pre-clinical research	49	7·7	5·8, 10·1	88	8·8	7·1, 10·8	
	Clinical research	0	0	–	1	0·1	0·003, 0·6	
	Clinical implementation	0	0	–	16	1·6	0·9, 2·6	
	Public health	0	0	–	5	0·5	0·2, 1·2	
Targeted topics	Basic research	317	79·8	75·6, 83·7	19	100	–	0·213†,‡
	Pre-clinical research	68	17·1	13·6, 21·2	0	0	–	
	Clinical research	10	2·5	1·2, 4·6	0	0	–	
	Clinical implementation	1	0·3	0·006, 1·4	0	0	–	
	Public health	1	0·3	0·006, 1·4	0	0	–	
Public health inclusive focus	Basic research	18	100	–	191	70·7	64·9, 76·1	0·129†,‡
	Pre-clinical research	0	0	–	19	7·0	4·3, 10·8	
	Public health	0	0	–	2	0·7	0·09, 2·7	
	Clinical research	0	0	–	1	0·4	0·009, 2·0	
	Clinical research	0	0	–	55	20·4	15·7, 25·7	
	Public health	0	0	–	2	0·7	0·09, 2·7	
Non-public health inclusive focus	Basic research	859	84·9	82·5, 87·0	549	73·6	70·3, 76·7	< 0·001†,‡
	Pre-clinical research	117	11·6	9·7, 13·7	69	9·2	7·3, 11·6	
	Clinical implementation	1	0·1	0·003, 0·5	14	1·9	1·0, 3·1	
	Clinical research	34	3·4	2·3, 4·7	111	14·9	12·4, 17·6	
	Public health	1	0·1	0·003, 0·5	3	0·4	0·08, 1·2	

IFDIT, Integrative Framework of Dissemination, Implementation and Translation.
*Person's χ^2 statistical test for difference across time unless otherwise indicated.
†Indicates statistical significance ($P < 0·05$) based on 95 % CI.
‡Fisher's exact test.
§Fisher's exact test with Monte Carlo simulated *P*-value.

research (100 % in 1998 to 69·6 % in 2018) and basic science research accompanied by small increases in the proportion of T3/T4 research (from 0 % in 1998 to 2·3 % studies overall in 2018). Notably, only 0·7 % of published research across both time points was public health focused. For journals that did not include a public health focus (*n* 1012 in 1998, *n* 746 in 2018), the observed changes were similar to the overall sample with decreases in T0 research (81·6 % in 1998 to 73·6 % in 2018) and increases in T3/T4 research (0·2 % in 1998 to 2·7 % in 2018), and increases in clinical research designs (3·4 % in 1998 to 14·9 % in 2018).

Sensitivity analysis (only limited to journals that remained the same across both time points)

The analysis was repeated with the four journals that remained the same across both time points. For these journals, we found no changes in study type with similar proportion of descriptive, intervention and measurement research across time ($P = 0·178$). We found similar increases in cohort study (4·5 % in 1998 to 11·2 % in 2018) and systematic reviews (from 0·4 % in 1998 to 11·2 % in 2018) to the broader sample. Notably, there was no T3/T4 research published in these journals across both time points (see online Supplementary material, Supplemental Table S6).

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Discussion

The current study sought to provide an overview of the changes in types of research published in highly cited Nutrition and Dietetic journals over a 20-year period. The period of time which it takes research to be translated from bench to bedside is commonly cited as 17 years[30]. In covering this period of time, it was hypothesised that there would be an increase in intervention and translational and implementation study designs. Consistent with previous studies[8,16,17], the majority of published research in these journals were descriptive across both time points. However, there was a significantly higher percentage of intervention research in 1998 (43·8 %) compared with 2018 (19·4 %). Such a decline was unexpected as other bibliographic studies examining physical activity and smoking research have documented either an increase or no change in percentage of intervention studies published[8,16]. It is possible that many of the interest areas in Nutrition and Dietetics research are emerging and may require epidemiological examination prior to undertaking clinical trials.

The percentage of published reviews accounted for almost half of all publications in 2018. As findings from reviews are more highly cited[17], this is likely reflective of the sampling frame, which included the top-cited journals. The predominance of non-systematic reviews in 2018, however, is surprising. Although both types of reviews seek to provide an overview of the literature, systematic reviews may provide less biased answers to policy and practice questions as they are typically accompanied with pre-registration or detailed protocols to reduce selective reporting of the literature. However, they are also typically more resource intensive to undertake[31] which may have accounted for the predominance of non-systematic reviews.

Understanding the spread of published literature as it relates to the translational phases (T0-T4) helps us grasp priority publication areas for top-cited journals. The balance of T0 and basic research against clinical research publications was slightly shifted in 2018, with a small decrease in the former and small increase in the latter. Despite this shift, T3/T4 research accounted for < 3 % of all audited publications and the amount of intervention research was reduced by over half to < 20 % in 2018. Although dissemination and implementation research (T3/T4 research) and cost-effectiveness research are particularly useful for informing policy and practice, they typically require greater time, resources and are more complex relative to other research. While researchers recognise the need and importance for this type of research, there are significant time and resources needed to develop effective partnerships with policy makers, stakeholders and end-users to undertake this work, and the current model of incentivising academic publication does not reward undertaking such research[32]. Changes to funding schemes such as that already undertaken in the USA[33] and Australia[34] (e.g., special calls for funding of rigorous intervention research in priority health areas, funding support to develop partnerships between researchers and practitioners or policy makers) may assist in better aligning research output with research use and impact into the future. Further, while many highly ranked journals dedicated to publishing reviews in nutrition exist, there are none dedicated to publishing T3/T4 nutrition-related research. This makes it challenging for researchers and practitioners in the field to identify such research, and in turn, reduces the citation of such manuscripts.

The scope of a journal does appear to impact the types of research published over time. In our subgroup analysis, we found that the types of research published remained largely similar as the overall sample for journals with a broad nutrition focus, those without an explicit public health focus and the four journals that were consistent over time. Journals with a targeted focus area (i.e., focused on lipids, obesity specifically) showed consistency for the types and translation stages of publications over time, while public health-focused journals showed large decreases in descriptive and T0 research accompanied by increased intervention and T3/T4 research. This suggests that the study type differences observed are largely due to the inclusion of broader nutrition focus journals and those without a public health focus. Notably, there was an absence of T3/T4 publications at both time points in the four consistent top-cited journals and points to a major barrier for publishing implementation research in journals where it could have real and wide-reaching impact on academic inquiry and practice.

Limitations

The findings of the current study need to be interpreted in the context of the study design. Firstly, the included studies were sampled from just a fraction of all Nutrition and Dietetics journals (eight out of eighty-seven); thus, it is unlikely that these findings represent all published Nutrition and Dietetic research. Furthermore, the top eight ranked journals differed between 1998 and 2018, with only four of them being the same at both time points. Our sensitivity analysis found that there were no changes in the study designs and translation phase of published manuscripts for these journals, suggesting that any changes across trend were accounted for by the inclusion of the four different journals in 2018. The sampling frame focused on the top ranking and most cited Nutrition and Dietetics journals. It is therefore likely that data from more specialist journals (e.g., Implementation Science, Translational Behavioural Medicine) or more public health-focused journals (e.g., Public Health Nutrition, Journal of Nutrition Education and Behaviour and Journal of Academic Nutrition and Dietetics), which may publish a higher volume of translational Nutrition and Dietetics research, would differ from the journals described here. Indeed, our additional

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analysis suggests that the scope of journals is likely to have influenced the type of published research.

Conclusions

Over the 20-year period from 1998 to 2018, the study design and translation phase of publications changed across top-cited nutrition and dietetic journals as did the actual journals that made up the top-cited list. While this change was expected, the direction of change was somewhat surprising. A notable shift has occurred towards publishing reviews and clinical studies, with less intervention and basic sciences research in these journals, which is potentially due to editorial direction in nutrition journals with a broader focus. Despite expert consensus that research should ideally progress into dissemination and implementation research over time, we found only a small number of T3/T4 studies published in 2018. Encouragingly, publishing in the field of Nutrition and Dietetics is slowly moving towards translation-type studies with small significant changes over time. Further increases however are needed as improvements in dietary outcomes at a population level rely on the development of clinically effective research to be implemented and disseminated at a population level.

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Supplementary material

For supplementary material accompanying this paper visit https://doi.org/10.1017/S1368980021000136

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