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A publication for health professionals

Research under the magnifying glass

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Research is the backbone of evidence-based dietetic practice, even though challenges have been noted among South African dietitians.[1] Finding and critically analysing literature are the foundation of research competency[2] and essential nutrition and health literacy.[3,4]

On the one hand, there is an abundance of wisdom in health and nutrition journals. On the other hand, there is a widespread 'medical misinformation mess', which refers to the publication of medical research of poor quality. Health professionals seemingly lack awareness of this problem.[5] This may also be true for diet and nutrition publications in general and has been specifically highlighted for dairy intake, for example concerning bone health.[6]

Apart from academic journals, the Internet and social media have over the past decades become a primary source of information for health professionals and their clients/patients.[7-9] A deluge of information can swamp the gullible Internet user, making it even more challenging to distinguish between fake or flawed research versus studies that can be trusted. While digital nutrition promotion can be effective[10], nutrition messages perceived to be conflicting may lead to 'nutrition backlash'.[11] Nutrition professionals should avoid this at all costs.

This review aims to guide dietitians and nutrition professionals and equip them with tools to critically analyse nutrition and health research, with special reference to dairy and health. The intention is to empower the dietitian/nutritionist to provide authoritative nutrition care.

1. Scientific publications

1.1 Analyse the source and author(s)

Publications in peer-reviewed academic journals offer a sound basis of scientific quality. The international standing and prestige of a journal are determined by its circulation, citation indices and impact factor. In the Scimago Journal Rank Indicator of SCOPUS, a total of 128 journals from the field of nutrition are ranked (https://www.scimagojr.com, accessed 27 Sept 2020) . The *Annual Review of Nutrition*, the *American Journal of Clinical Nutrition* and *International Journal of Behavioral Nutrition and Physical Activity* occupy the top three places. The *South African Journal of Clinical Nutrition* is in place 87. We need to remember, however, that local relevance is sometimes more important than international standing and citation. A high citation index may be due to controversy or problematic matters related to a particular publication and not necessarily its scientific merit. Also, recently published articles will not have been cited yet. Consequently, the impact factors are annually updated. In South Africa, the Department of Higher Education and Training (www.dhet.gov.za) annually compiles a list of accredited journals which meet national standards.

Apart from the standing of the journal, the author list can indicate the credibility of a publication. It may be worthwhile to check the qualifications and affiliations of the contributor(s). Internationally, researchers can be formally registered (e.g. with an ORCiD). How often individual researchers are cited, is reflected by their so-called h-index. In South Africa, the National Research Foundation has a formal rating of local researchers based on a review of recent, sustained research outputs. More informal systems are also available (e.g. ResearchGate and Academia).

1.2 Evaluate the research design and methods

Once the standing of the journal and the authors have been ascertained, the content of the research publication should be evaluated. Here the focus should be on the methods section. Research designs and methods have traditionally been ranked in an evidence pyramid (Figure 1). Expert opinion, clinical textbook information, case series and reports are at the base of the hierarchy (lowest scientific validity), followed by observational research such as case-control and cohort studies. Randomised control trials are at the top of such direct or primary designs. Above these, at the apex – either attached to or separated from the pyramid – are systematic reviews and meta-analyses.

These designs pool the data from a number of primary studies and analyse them, much like a magnifying glass through which the other types of evidence are viewed.[12]
The boundaries between the levels of the pyramid are wavy and dashed (see middle section of Figure 1) to "upgrade or downgrade" the direct methods using the GRADE[13] (Grading of Recommendations, Assessment, Development and Evaluations) framework. Not all studies within a band are necessarily of equal quality.

High-quality studies are those that are suited to answer the research question or aim. Furthermore, they should comply with statistical considerations of sampling and data analyses, and contain clear descriptions of the population and site to

which the findings refer. For example, if the aim is to determine the prevalence of low dairy intake among South Africans in 2021, an observational (cross-sectional) study would be appropriate. A high-quality study of this nature would entail a sample that is representative of the South African population, appropriately taking geographic distribution, age, ethnicity etc. into account. On the other hand, a study aimed at determining the effect of yoghurt consumption on gastrointestinal discomfort of hospitalised elderly women with Crohn's disease calls for a randomised control trial, with a random selection/allocation of women admitted with Crohn's disease to the experimental group (which receives yoghurt) or the control group (which does not receive yoghurt). Apart from who receives the yoghurt, the experimental and control groups should be comparable in all respects.

In all designs, valid instruments/methods/parameters must be used and evidence of quality control during data collection (reproducibility) provided. This refers, for example, to how intake of dairy or yoghurt (the so-called exposures in the two mentioned examples) is assessed, or how gastrointestinal discomfort (the outcome in the second example) is measured in the experimental and control groups. It follows that there can be better (higher up in the pyramid of Figure 1) and inferior studies within a design band.

Research design specialists[e.g.14] sometimes prefer a circular arrangement of designs as opposed to the pyramid hierarchy. In such an arrangement, human experimental methods like randomised control trials are complemented by real-life, observational studies. Initial exposure–outcome links seek confirmation by basic (laboratory-based) experiments (for example in metabolic wards) that shed light on mechanisms and dose–effect relationships. Indications of quantities (doses) are important for quantitative dietary guidelines, e.g. the amount of yoghurt to be consumed per day to be effective for a patient who has Crohn's disease.

Even though systematic reviews are highly rated and valued by dietitians/nutritionists,[15] the methodological quality of systematic reviews cannot be taken for granted either.[16] The quality of reporting of systematic reviews can be judged with a tool called AMSTAR.[17] The overall strength of evidence can be judged using several other available tools.[18] Numerous international organisations have adopted this method of pooling and rating all available research to rank the ***strength*** *of the totality of current evidence* linking a particular exposure (e.g. dairy) to a particular health outcome (e.g. colorectal cancer). A cause–effect relationship should only be inferred if numerous different types of well-designed studies consistently and plausibly link an exposure in a dose–response manner to an outcome.

1.3 Appraising scientific publications: some tools and examples

From the above, it follows that ultimately, professionals must take responsibility for judging the quality of evidence. This means that they must have the knowledge and skills to critically appraise research publications in the interest of furthering science and delivering quality nutrition care.

Various tools for the critical appraisal of scientific health-related articles have been published.[e.g19–21]

Some tools aim to be universally applicable,[22] others are specific for particular research designs. For the latter, over 430 different reporting guidelines are available in the **EQUATOR** Network (**E**nhancing the **QUA**lity and **T**ransparency **O**f health **R**esearch) available at https://www.equator-network.org from the University of Oxford. Examples from this huge selection are the STROBE Statement for observational studies (such as a cross-sectional study on the prevalence of low dairy intake mentioned above), and the CONSORT Statement for randomised control trials, which would subsume studies such as one on the effect of yoghurt on gastrointestinal discomfort.

Online training for performing critical appraisals is available at http://www.casp-uk.net. Where the focus is on establishing whether a food is related to health, the **PROCLAIM** (**PRO**ving the efficacy of foods and food constituents for health **CLAIM**s) tool is a guide to weighing the evidence.[23] This would, for example, apply to studies that examine the effect of dairy on bone health.

Appraisal tools typically start with a quick review of the title and abstract. For intervention studies, such as studies on the relationship between or effect of dairy on a particular aspect of health, the acronym **VIAGRA**[24] can be helpful:

- **V**alidity: The **ABCDE** key applies – **A**ssignment and accounting for loss to follow-up (sampling and participant details from recruitment to end); **B**lindness (did participants know whether they were in the experimental or the control group?); **C**ontrols; **D**emographics; **E**quality of treatment. Characterisation (clear definition) of the exposure (intervention, such as *yoghurt* intake) and the outcome (endpoint, such as *gastrointestinal discomfort*) also belong here.
- **I**mportance: Was the study important and the effects *clinically* meaningful? This means that statistical significance (typically indicated by a P-value) does not necessarily translate into practical significance. We need to be particularly careful when the P-value is close to 0,05.
- **A**pplicability: Can this research be applied to your patients or a wider group? If a study was, for example, done on hospitalised elderly women diagnosed with Crohn's disease, it may not apply to other populations.
- **GR**eatness (of benefit): What is the number needed to make a difference? The statistics (i.e. power calculations to detect 'minimally important clinical difference') need to be appropriate. Small or very large studies have to be carefully interpreted for generalisability and relevance respectively.
- **A**cceptability: Is it ethical and acceptable in other healthcare settings? Who funded it?

Once a study has passed the above general principles, a detailed topic- and study design-specific analysis follows.

2. Grey literature, internet and other digital information

Publications in the so-called 'grey literature' (e.g. policy documents, scientific reports by professional and other organisations) can provide valuable information, but we need to be extra critical to ascertain their scientific quality. Information about the author (relevant qualification, acknowledged affiliation, funding and potential conflict of interest, etc.) can be helpful and should be declared. The format, delivery and form of access (printed or electronic; subscription vs open access) are no longer helpful for differentiating science from pseudoscience or misinformation. While information in textbooks was formerly generally accepted, this is not necessarily true anymore, and it may have to be verified. It is tempting to consider more recent publications as overriding previous work, yet research design (see 1.2) is more important: a poorly conducted study with

non-validated instruments of an inferior design, even if published in the current year, is not better by default!

According to 'infodemiology' (information epidemiology) most patients – especially if they are younger, have a higher educational level and are female – tend to search the Internet before consulting health professionals.[25] Googling has become a household word, yet a systematic review has demonstrated the suboptimal quality of online health information.[7] In instances that a website reports high-quality and accurate health information, it is typically challenging for a lay audience to understand.[26]

Numerous general guidelines are available for evaluating internet sources, e.g. https://www.monash.edu/rlo/quick-study-guides/evaluating-web-pages; https://guides.library.jhu.edu/evaluate/internet-resources.

For more scientific appraisal of online health information, numerous quality scales have been developed. A widely used tool for this purpose is called DISCERN.[7,27] It can be adapted to various scenarios, and typically consists of 15–16 questions organised into two sections. The questions in the first section focus on the *reliability* of the information. The second section deals with the *quality* of the information, followed by a final, overall rating. The DISCERN tool has already been applied in the field of human nutrition where researchers[e.g.28] have found that renal diet information on websites was mostly of poor quality, included major shortcomings, tended to be impractical and required high health literacy.

The role of the nutrition professional is increasingly to refer clients to sites that have already been evaluated for content accuracy, quality and readability. Table 1 provides some criteria and their practical explanations.

Social media are a form of Internet use allowing users to create and share information (e.g. Twitter, Instagram and Facebook), collaboratively develop content (e.g. wikis, blogs) or network on an advanced level (e.g. Second Life, podcasts). In contrast to read-only Internet, social media enable interaction between health care professionals and clients.[30] A dietitian/nutritionist now must be able to craft and communicate quality content, and also has to acquire 'e-professionalism', i.e. professional attitudes and behaviours expressed through digital media.[30]

It appears that health professionals tend to use social media to gather information for themselves but are sceptical of its value for communicating with patients, particularly due to privacy concerns and misconceptions about the characteristics of social media users.[31] Copyright infringements and loss of professional image are other concerns raised by dietitians.[32]

It may be assumed that the COVID-19 pandemic has accelerated the use of remote communication and is likely to have influenced nutrition care delivery. Apart from learning to critically evaluate the quality, reliability and trustworthiness of the online information, dietitians and nutritionists need to be upskilled in respect of time management and technical issues[30] to remain professionally competent and relevant.[32]

Nutrition professionals find the emergent mobile health (mHealth) tools both helpful and challenging, because these technologies (including apps) must be evaluated. General criteria comprise their usability, visual design, user engagement, content, behaviour change/persuasive design, influence of social presence, therapeutic alliance, classification, credibility/accountability, cost and privacy/security. A recent, targeted position statement offers practical guidance to allergies (including food allergies).[33]

Table 1

Criteria for evaluating nutrition health sites

Criteria	Practical explanation
Read disclosure statements, check credentials and affiliations of authors.	Is the author appropriately qualified for the topic under discussion? For example, a PhD in architecture or computer science does not make the author appropriately qualified in human nutrition. Paid authorship should be declared. Is the author linked to a reputable/independent institution?
Who owns and sponsors the website?	Industry interests can influence information presented or omitted. Commercial food and nutrition-related websites can easily be one-sided and overrule basic principles of good nutrition and health.
Is there a financial tie between the information and the sponsor?	Since financial links can result in a conflict of interest and bias, author–industry relationships should be guided by clear principles of scientific integrity.[29]
Is there an address on the website? Are the goals of the website explicitly stated?	Transparency is critical for informed decision-making by the consumer. The consumer should be able to make inquiries.
Is the topic covered clearly and comprehensively?	To judge this, dietitians and nutritionists must be familiar with the topic. The process of publication of the information (for example by peer review) can be helpful. Consulting and referring clients to sites that were independently reviewed (for example with DISCERN7), including the evidence thereof, is another possibility.
Do other sites confirm the information?	If multiple sources agree, the likelihood of credibility increases; However, these other sources/sites must also meet the other criteria in this list.
Is the site relevant locally and regularly updated?	While fundamentals tend to remain the same, contexts differ and applications change over time. For example, an American website caters for the American setting. Dairy products and circumstances in South Africa differ. The products may have a different composition, and labelling regulations may change over time. South Africans have a different food culture and different nutrition and health challenges.

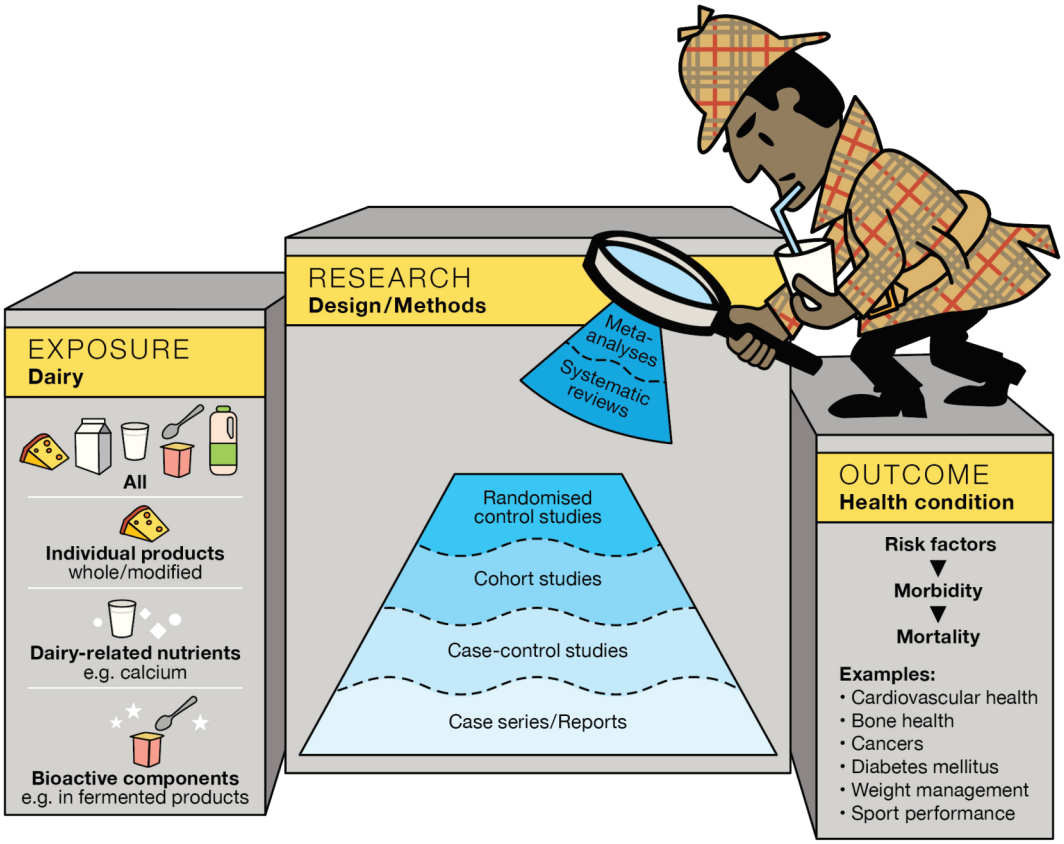

Figure 1
The magnifying glass for judging evidence linking dairy to health/disease (pyramid adapted from Murad et al.[12])

3. Dairy and health research under the magnifying glass

In addition to the general principles of determining good science in a research article, the critical appraisal of studies specifically related to dairy and health further requires special attention to certain matters.

At least three questions should be asked when determining whether dairy is related to a health outcome:

- What was the *research* design/method?
- What dairy food (*exposure*) was studied?
- What health condition (*outcome*) was the focus?

Figure 1 is a framework that links these questions. The research design and methods are at the centre, connecting the exposure and the outcome. Critical appraisal requires putting all three elements under a magnifying glass.

3.1 Research designs/methods

As discussed in Section 1.2, the value of quantitative research in health sciences is primarily judged by the study design and execution, illustrated in the centre of Figure 1. The design is dictated by the research question. Research design expertise is required here. The field of investigation, i.e. the exposure and the outcome that is studied, largely influences the methods (including techniques and parameters) used in the execution. Content and methodological experts are influential here.

3.2 Exposures

Defining and measuring dairy intake deals with the second question to be asked when an association between dairy and disease is of interest (Figure 1). As a dietary exposure, dairy products comprise a diverse and complex group of foods. Studies vary in terms of how they define and collect dairy consumption data.[34] Sometimes dairy is studied as one food group within the whole diet, but often individual dairy products are investigated; individual products may have different relationships to health and disease. An example is a meta-analysis that specifically focused on fermented dairy products and found that they were associated with a lowered overall risk of developing cancer.[35]

The terminology and classification related to dairy are ambiguous and not consistent across research studies. This makes a comparison of the findings from different studies challenging. Usually, but not always, butter is excluded from the dairy food group. This becomes important when, for example, the relationship between dairy and dyslipidaemia is studied. When the focus is on the *food level*, specific forms of individual dairy products are often investigated based on their fat content. The full-cream, low-fat and fat-free versions of a dairy product may therefore have different health effects.

Numerous studies have investigated dairy-associated *nutrients* such as calcium and vitamin D. However, care should be taken to ascertain whether calcium from the diet and/or from supplements was investigated. Since the fortification of dairy with vitamin D is not compulsory in South Africa, generalisation from international studies should be done with caution.

In recent times, the focus has sometimes been on *bioactive components* in dairy. This includes the role of certain dairy products in modulating the human gut microbiome, which, in turn, may affect the association with certain cancers.[36]

Even if the dietary exposure (i.e. the dairy component that is assessed) is clearly defined, its measurement and interpretation are not straightforward, particularly in retrospective (e.g. case-control) studies. The disease process (outcome) may stretch over years and nutrition can play a role at many stages. Recall or reporting bias can then become a real threat. A whole diet – and not only dairy – plays a role in the aetiology of disease. When one dietary component is changed, something else (e.g. energy intake) may automatically change. This may cause a confounder or modifier effect. The diet may contain protective as well as

causative factors, further complicating matters. Quantifying intake (i.e. how much dairy was consumed) and establishing dose–response associations are a considerable challenge in all dietary studies. Applying biochemical markers to dietary (e.g. dairy) intake have the advantage of objectivity, but they are still in the developmental stage. Cost prohibits their widespread use.

3.3 Outcomes

The third element in the framework in Figure 1, the health outcomes, also needs to be precisely defined. Not only do different diseases have different links to dairy, but it should also be clear whether the outcome being measured refers to risk indicators (e.g. low-density lipoprotein or LDL), morbidity (e.g. a cardiovascular incident) or mortality (e.g. dying from cardiovascular disease).

Conclusion

Performing research is not easy, yet quality research forms the backbone of nutrition care.

The critical appraisal of research has become an art and a science in itself. It involves an analysis of the research question and the study design and execution, followed by appropriate statistical evaluation and interpretation and substantiated conclusions. Analysing strengths and weaknesses and declaring conflicts of interest are essential, ultimately leading to valid, reliable and useful results.

Quality nutrition care requires that the dietitian/nutritionist must be able to appraise scientific articles. In addition, the information that is widely available on the Internet and other sources must be scrutinised.

We need to develop digital scholarship and a detective's attitude (magnifying glass) to debunk pseudo-science, direct our clients and patients to credible sources and translate the information to valid and personally relevant and understandable information. Sensationalist claims must be carefully weighed against any real gain.

Health care professionals must at all times adhere to the basic tenet: First do no harm.

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