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REVIEW ARTICLE

EVIDENCE-BASED NUTRITION

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The evidence-based approach has recently been implemented to translate the vast body of literature available into effective action aimed at addressing the pressing nutritional problems that affect populations.

In this paper, the first in a series on the topic, the meaning of evidence-based nutrition (EBN) is clarified and the broad outlines of how to review and interpret both individual papers and reviews of a collection of papers is discussed.

The objectives of the EBN approach and the steps to follow in the process are outlined. A useful checklist for the critical appraisal of research papers is given and criteria for reviewing reviews of all relevant available information are discussed. The benefits of the EBN approach are highlighted.

Sometimes it feels as if we are drowning in information, yet at the same time we do not appear to be able to make the best use of all this information to solve problems. We know we should read more papers, but feel increasingly pressed by all the other things we have to do in our work. We need some help to guide us through the vast body of information which helps us to do our jobs better, whether we are looking after patients, doing research or engaged in public health and policy. Evidence-based nutrition (EBN) may be a way forward. Such an approach has been followed in the most recent dietary recommendations to treat high serum cholesterol levels¹ and obesity.²

This paper has two purposes: firstly to clarify what is meant by EBN, and secondly to discuss the broad outline of how to review and interpret both individual papers and reviews of collections of papers.

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THE CONCEPT OF EVIDENCE-BASED NUTRITION

The *British Medical Journal* has played a leading role in describing evidence-based medicine and systematic reviews.^{3,4} A recent supplement to the *American Journal of Epidemiology* covers the issues extrapolating from epidemiology to policy.⁵ We have also discussed these issues recently in *Public Health Nutrition*.^{6,7} The Cochrane Collaboration and the electronic database, the Cochrane Library, provide a great deal of information about reviews of intervention studies and randomised controlled trials.⁸

The phrase, 'evidence-based nutrition', has been derived from evidence-based public health or medicine and can be defined as 'the application of the best available systematically assembled evidence in setting nutrition policy and practice'.⁴

EBN provides an objective framework in which to gather and review all available evidence to help inform policy and clinical practice. Politicians like the sound and approach of EBN because it is seen as a helpful way to develop policy and ultimately to save money by eliminating inefficient practices. That is not to say that an objective review of all available evidence is the only basis upon which politicians and leaders make decisions. It clearly is not, but it is important for those of us engaged in research and practice to be clear about the role of evidence in decision making, and to differentiate opinion from 'fact', as far as 'facts' can be defined.

Nutritional epidemiology is about measuring the health risks of nutritional exposures; public health relies upon such risk estimates to make judgements about what to do to reduce the burden of risks in the community. Ultimately it is a wider community decision as to what level of risk for various factors is acceptable in our society. An evidence-based approach is required to inform this discussion — decision makers and the public need to have the information presented to them in as simple and clear a manner as possible, without being patronised. Government may decide to act on reducing some risks without direct public involvement, as demonstrated by the fortification of foods compared with advice to eat foods rich in the nutrients that are being used in the fortification.

Practitioners may initially feel threatened by an EBN approach because of the implicit criticism that what they have done in the past has been unscientific and subjective. The reality is that much of current medical practice is not based on a review of all available scientific evidence about the best approach.³ Some practitioners argue that their skill is a mix of technical competence, based on what they were taught and have learnt, and the application of the science to the art of fitting the evidence to the particular circumstances of the individual patient. The two are not incompatible; ideally an evidence-based approach can make a real difference to the effective treatment and prevention of real problems in the individual and community. Decision making should not be by

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anecdote, press cuttings, expert opinion, or cost minimisation.³ Some may dislike this new approach because it is challenging; it is about accepting that we as individuals do not know everything and that things change. Some criticise the approach as reductionist, where a set formula is applied to all problems and an answer comes out the other end. This denies the skill and judgement needed to follow an EBN approach outlined below.

STEPS IN THE EVIDENCE-BASED APPROACH

1. Define the question being asked: is it answerable, do you know what the answer would mean, and would the answer be helpful? Which population, what exposure and what outcome are to be assessed?

THIS IS VITAL AND THE MOST IMPORTANT STEP. WHAT FOLLOWS MAKES NO SENSE UNLESS THIS IS CLEAR.

2. Gather all the relevant literature using a structured search strategy; clear inclusion and exclusion criteria should be established; search should not be restricted by language and should include unpublished literature where possible.

3. Review all relevant available information using clear, explicit and transparent criteria; differentiate by type and quality of study.

4. Agree what evidence says (if possible *a priori* criteria to define an acceptable level of evidence that justifies going the next step).

5. Agree what evidence means (allowing for judgement about potential mechanisms, likely causal pathway, relevance to the context under study, and potential for impact on population health).

6. Agree what action should be taken.

7. Agree how to achieve changes (is there evidence about strategies that work?).

8. Evaluate impact of action on changes required and on desired outcome (is there evidence of impact?).

Asking the right question and identifying the best way to answer that question is the most critical step. Critical appraisal of information without a purpose or focus will ultimately be unhelpful; it is therefore still critical that the clinician or scientist is involved, because they probably know what the right question is — critical appraisal cannot be taken out of context and unthinkingly applied by technicians who do not understand the subject.

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Three types of evidence are therefore required:

1. Evidence about the scientific basis of recommendations (what the research says).
2. Evidence about strategies that have been shown to work (past experience).
3. Evidence of impact (are there realistic success criteria that

can be measured, does policy achieve these criteria, what does it cost).

In this series of papers we are going to focus on the first type of evidence; this does not mean that the other two are not important, because ultimately improving health is about applying what is known in the best possible way, and checking that what is done works.

OBJECTIVES OF THE EBN APPROACH

The point of formalising activity in this area is to help establish ground rules for good practice. The ultimate objective of an EBN approach is to ensure that the best informed judgement can be made as to what to do to solve problems, be they with a patient (practice) or population (policy). Clearly experience is helpful; if it worked once, it might work again. But it might not, and a more systematic and objective approach may save a lot of time and ultimately lives.

Over the past 20 years the number of original research papers has expanded almost exponentially, making it virtually impossible to keep up with the latest developments in all relevant areas of daily work. So what are the choices? We can give up trying to keep up with current literature and carry on doing what we have always done (even if it doesn't always work), or we can rely on other people to review the evidence for us. As clinical practice becomes busier, with less time for reading and reflection, practitioners will increasingly have to rely on reviews and syntheses done by others. It is therefore important to develop skills in how to review reviews. Not all reviews are equally helpful and judgement is required to differentiate between those that are worth reading, and therefore helpful, and those that are not. Most undergraduate professional courses pay little attention to developing critical appraisal skills, and while continuing professional development sometimes covers how to review papers, this tends to be rather limited. The aim of this series of papers is to help the reader to develop these critical appraisal skills.

REVIEWING PAPERS

There are two related but separate activities being discussed; reviewing individual papers and reviewing reviews. Clearly reviewing individual papers is a part of creating a review. The main points of each will be briefly discussed below. A review based on poor studies, or where the quality for studies has not been assessed, may be misleading.

Reviewing individual original research papers

Over the past 15 years of teaching we have found that the following checklist may be helpful when trying to appraise a paper critically (see also Greenhalgh³):

1. Is the paper of interest (check abstract; if yes proceed)

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2. What was done? (introduction, does this justify why the study was worth doing?)
3. What was the purpose of the study? (is there a clear aim/research question/hypothesis?)
4. How was the research question addressed? (methods)
 - (i) What is the study design; is it appropriate for the question?
 - (ii) Are methods described clearly?
 - I. Subject recruitment
 - a. Source of population (selection and inclusion criteria; sampling frame)
 - b. Response rate
 - c. Sampling size and power
 - II. Data collection
 - a. Appropriate for target population
 - b. Clear how exposure, outcome, and other variables measured
 - c. Validity of measures assessed
 - III. Bias in information and subject selection
 - IV. Statistical methods
 - a. Are they appropriate?
5. What are the results?
 - (i) Clearly presented
6. Discussion
 - (i) Reflects results
 - (ii) Fit with published literature
 - (iii) Self critical
7. Conclusion(s)/take home message(s)
 - (i) Are they justified?

The best test of a hypothesis is a double-blind randomised controlled trial. In reality, few nutritional studies achieve this benchmark of excellence, and in many respects given the complexity of dietary patterns it may not always be a relevant model to help us understand what we should do. In order to design an ideal study a measurable causal pathway is required in which we can measure the impact of changing one aspect of dietary exposure, while keeping everything else constant. Unless one resorts to a pharmaceutical approach this ideal cannot be achieved. Interpreting a pharmaceutical trial in public health terms is complex, because humans do not change or eat one dietary exposure in isolation from the rest of their diet. Humans also change their wider environment (infection, water supply, etc.) that may increase or reduce the metabolic requirements of a nutrient, or some other aspect of metabolism may be rate-limiting in different ways in different populations. Given that public health and policy is about making decisions that at the very least do no harm and ideally improve health, it

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is important to have evidence not only about what works in theory, but also about what works in practice. The role of other factors (effect modifiers and confounders) must be considered.

Scoring systems have been developed to appraise the quality of studies using the above type of framework.⁹ These scoring systems may be helpful in so far as they force the reviewer to go through each section of the paper systematically. Judgement is required to weigh up the relative strengths and weaknesses of each study. Bias in the way subjects are recruited and information gathered is the most serious flaw to look for in observational studies; in cohort studies loss to follow-up can seriously bias risk estimates; in case-control studies the major concern is the difficulty in recalling the relevant past exposure. For experimental studies the key issues are ensuring proper randomisation and allocation concealment, complete follow-up, compliance with treatment and assessor and participant blinding.

Reviewing reviews of original research papers

Two types of reviews may be defined

- Narrative (a selective review of papers not gathered or reviewed in a systematic manner)
- Systematic (based on a complete gathering and review of all relevant papers).

Unless the individual papers are properly reviewed, a review that tries to synthesise these papers will potentially draw flawed conclusions. Narrative and systematic reviews differ in two important ways: how the papers are gathered, and how they are subsequently dealt with in the review process. Systematic reviews should include a detailed search strategy and clear inclusion and exclusion criteria, and should differentiate between different types of studies. Pauling used a selective review of papers to support his view that large doses of vitamin C improve longevity and prevent colds. When a systematic approach was used to gathering all the available evidence there were more studies that showed no beneficial effect of vitamin C on the onset of colds than that showed a beneficial effect. This is not to imply that Pauling cheated, but he had an opinion that he wanted to support and so selected the data that fitted his beliefs. Advising the public to consume more vitamin C tablets was likely to be a waste of money, may prevent people from following other more effective courses of action, and may even be harmful. An EBN approach helps to ensure that biased conclusions are not drawn.

Systematic reviews can be used:

- at bedside
- in developing clinical guidelines
- evidence-based policy making
- for economic evaluation
- for registering ongoing studies.

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It should be pointed out that even a systematic evidence-based approach does not remove the need for judgement and reflection — there will never be absolute proof of any hypothesis, but there should be a clear distinction drawn between the way the evidence is gathered and reviewed and the interpretation the reviewer places on that evidence. While there should be debate as to what the evidence means, there should not be debate about the evidence *per se* — the basis of the debate, the evidence, should be presented clearly and transparently for all to see. All too often in the past progress in developing an understanding of the underlying biological phenomena being explored (i.e. trying to understand the causal pathway) has been lost and entangled in debate about the relative merits of the studies included or excluded. This ambiguity and confusion has often been exploited by vested interests. If we all agree beforehand what and how we will review a subject, there will be less room for confusion and manipulation.

One of the reasons often given by the public as to why they don't follow dietary advice to eat a more healthy diet is the perception that the experts never agree and are always changing their minds. This confusion is more imaginary than real, but it discredits the profession and more importantly limits the effectiveness of our work.¹⁰

Many reviews are restricted to one type of study (the randomised controlled trial). This may be ideal where there is a large body of literature available that uses this approach, and where the question being asked is appropriate for this type of design. In nutritional epidemiology there are few randomised controlled trials (ethically and practically impossible for some questions), and a review should also include and differentiate between findings from different types of epidemiological studies (ecological, cross-sectional, case-control, cohort), and between animal and mechanistic studies.

ELEMENTS OF A SYSTEMATIC REVIEW

The key elements of a systematic review are:

1. Formulate review question (define exposure and outcome and relevant population)
2. Define inclusion and exclusion criteria (for participants, exposures, outcomes, study designs)
3. Locate studies (consider search strategies — Medline and EMBase are not the same*; grey and unpublished, foreign language)
4. Select studies
5. Assess study quality (see individual study review for more details)
6. Extract data (how will data be presented and analysed)
7. Analyse and present results
(1 - 7 should be written into a review protocol)

* Only 34% overlap in journals covered by two databases.

8. Interpret results (limitations including potential publication and other biases; strength of evidence; applicability to relevant population; implications).

A key part of developing the review protocol is to consider all the possible sources of bias that may affect the review, and then agree on a protocol that minimises the potential sources of bias. It is important to build in checks to the way observers select and report studies. Ideally at least two colleagues should blind cross-check each step.

When compiling a systematic review the following should be considered when drawing conclusions:

- Type of epidemiological study
- Consistency of results between studies (in terms of direction and size of effect, related to level of exposure)
- Generalisability (external validity)
- Quality of studies reviewed
- Plausible mechanisms for associations.

Many epidemiological studies report some sort of statistical association, which is often described as suggesting a causal relationship between exposure and outcome. Before such an assertion can be made it is essential to consider the potential influences of chance, bias and confounding on the purported causal pathway.

SYSTEMATIC REVIEWS AND META-ANALYSES

Meta-analysis is a statistical synthesis (pooled) of numerical results from several studies that address the same question. It is not the same as a systematic review. A meta-analysis may be based on all available studies collected systematically or it may not. One of the biggest issues in undertaking such an analysis is agreeing on the comparability of data collected. From our experience it is very difficult in many nutritional studies (compared with pharmacological experimental studies) to be sure that both the exposure and the outcome measures used are comparable across studies. Where data are comparable there are a number of advantages of undertaking a pooled meta-analysis. Firstly, a single number summary of the overall estimate of effect is helpful for policy makers; secondly, a pooled estimate based on data from a number of studies will have smaller confidence intervals and greater statistical power, and thirdly a test of heterogeneity may reveal important variation between studies that highlights potentially important interaction. For example, if the effect of an exposure is only evident at high intakes, or in people with high levels of outcome measures, or in older people or post-menopausal women, insight may be gained about underlying biology. If there is heterogeneity between studies (greater between study variability, than within study variability), a pooled overall estimate is not a fair reflection of the findings.

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CONCLUDING REMARKS

Many of the points raised in this article will be addressed in more detail in subsequent papers. The main objective of this paper is to raise awareness about EBN. We believe that if this approach was more widely adopted we would make more rapid progress in translating the vast body of literature currently available into effective action aimed at addressing the pressing problems that affect our population. This approach will also highlight gaps in our knowledge and give direction to future research. Finally, if an EBN approach is agreed, it will reduce the possibility of vested interests being able to distort the interpretation of research findings. In South Africa, with limited financial and human resources available, it is essential that best use is made of both for the improvement in health of the people of South Africa.

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PLEASE ANSWER ALL THE QUESTIONS (Mark the ONE correct choice)

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|---|---|
| <p>1. The evidence-based nutrition approach has been followed in the most recent dietary recommendations to treat high serum cholesterol levels and obesity.</p> <p>[a] True
[b] False</p> <p>2. Evidence-based nutrition can be defined as:</p> <p>[a] Dietary recommendations based on anecdotal reports and expert opinion.
[b] Application of the best available systematically assembled evidence.</p> <p>3. All current medical practice is based on a review of all available scientific evidence about the best approach.</p> <p>[a] True
[b] False</p> <p>4. The evidence-based nutrition approach is followed by:</p> <p>[a] Applying a set formula to all problems and answers come out at the other end.
[b] Asking the right question, review all relevant available information and agree what the evidence means.</p> <p>5. Improving health is about applying what is known in the best possible way, and checking that what is done works.</p> <p>[a] True
[b] False</p> <p>6. The ultimate objective of an evidence-based approach is:</p> <p>[a] To apply strategies that have worked in the past.
[b] To ensure that the best informed judgement could be made as</p> | <p>to what to do to solve problems.</p> <p>7. The best test of a hypothesis is a:</p> <p>[a] Double blind randomised control trial
[b] Case study</p> <p>8. One of the reasons often given by the public as to why they don't follow dietary advice to eat a more healthy diet is the perception that the experts never agree.</p> <p>[a] True
[b] False</p> <p>9. When compiling a literature review the following should be considered when drawing conclusions:</p> <p>[a] Quantity of studies reviewed.
[b] Quality of studies reviewed.</p> <p>10. A meta-analysis is a:</p> <p>[a] Systematic review of results from several studies.
[b] Statistical synthesis of numerical results from several studies.</p> <p>11. In all nutritional studies both the exposure and the outcome measures used are comparable across all available studies.</p> <p>[a] True
[b] False</p> <p>12. An evidence-based approach can make a real difference to the effective treatment and prevention of problems in the individual and community.</p> <p>[a] True
[b] False</p> |
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