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Twenty-five years with the biopsychosocial model of low back pain - is it time to celebrate? A report from the Twelfth International Forum for Primary Care Research on Low Back Pain

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To the editor-in-Chief
Spine

Dear Sir,

We thank the reviewers for their comments and have amended the manuscript accordingly. Specifically:

1. Reviewer 1 requested that we comment on the comprehensiveness of the evidence described in the manuscript, considering the fact that it was based on key note presentations, albeit by world leaders, rather than systematic reviews. Reviewer 2 similarly requests that we acknowledge the possibility of a selection bias in presenting research findings. We agree with both reviewers, and have now added the following in the introduction:
   The evidence reviewed constitutes a synthesis of key-note presentations and discussions. Although citations are provided to illustrate the arguments, and where possible, we rely on evidence from systematic reviews, we recognise that possible bias and lack of comprehensiveness may be inherent in this review.

2. Reference 3 was incorrect, as spotted by reviewer 1. We apologise for this and have corrected it in the list and in the text.

3. The second sentence in the "biological" section has been amended. It now reads:
   These include the use of diagnostic imaging to quantify the degree of disk degeneration, vertebral marrow (Modic) changes, endplate lesions, and vertebral joint degeneration.

4. Reviewer 2 commented: "The biopsychosocial model such as introduced by Waddell in a Spine paper in 1987 is currently the prevailing paradigm in low back pain research. It hasn't been fully adopted in clinical practice so far according to the study authors despite the fact that many researchers nowadays take psychological and social factors into account when studying low back pain. This might be a problem of implementation but on the other hand we as researchers have to admit that we know very little. The explained variances of regression models in the field of low back pain are still low and treatment effect sizes small to modest, also in treatments addressing psychosocial factors. We still know very little about low back pain despite the biopsychosocial model and I miss that point when reading this paper."

   We have now inserted the following in the concluding paragraph:
   In taking stock of the current state of knowledge, it seems evident that vast gaps remain in our understanding about the aetiology, prognosis and effective interventions in back pain, despite the biopsychosocial model.

5. Reviewer 2 also requested that we amend the structure to the traditional structure of introduction, method, results and discussion. In this instance we disagree with this opinion. We believe that synthesis of key notes and discussions from the Forum cannot be captured in a formal methods section, nor does it lend itself to replication. We note that narrative reviews traditionally are structured under similar sub-headings to our preferred structure, and that similar syntheses from previous Forums published in Spine have been written in our preferred structure (e.g. Pransky et al., 2011).

6. Reviewer 2 requested that the conclusion be summerised as a list of bullet points. We note that this is already done under Key points.

7. We thank reviewer 3 for their positive comments and endorsement of the manuscript.

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No benefits in any form have been, or will be, received from a commercial party related directly or indirectly to the subject of this manuscript.

*Structured Abstract (300 words)

Study Design. An integrated review of current knowledge about the biopsychosocial model of back pain for understanding aetiology, prognosis and interventions, as presented at the plenary sessions of the
XII International Forum on LBP Research in Primary Care (Denmark 17-19 October 2012).
Objectives. To evaluate the utility of the model in reference to rising rates of back pain related disability, by identifying a) the most promising avenues for future research in biological, psychological and social approaches, b) promising combinations of all three approaches and c) obstacles to effective implementation of biopsychosocial based research and clinical practice.
Summary of Background Data. The biopsychosocial model of back pain has become a dominant model in the conceptualisation of the aetiology and prognosis of back pain, and has led to the development and testing of many interventions. Despite this back pain remains a leading source of disability worldwide.
Method. The review is a synthesis based on the plenary sessions and discussions at the XII International Forum on LBP Research in Primary Care. The presentations included evidence-based reviews of the current state of knowledge in each of the three areas (biological, psychological and social), identification of obstacles to effective implementation and missed opportunities, and identification of the most promising paths for future research.
Results. While there is good evidence for the role of biological, psychological and social factors in the aetiology and prognosis of back pain, synthesis of the three in research and clinical practice has been suboptimal.
Conclusion. The utility of the biopsychosocial framework cannot be fully assessed until we truly adopt and apply it in research and clinical practice.

*Key Points (3-5 main points of the article)

- It is 25 years since Gordon Waddell's seminal paper on the biopsychosocial model in back pain was published by SPINE.
- Back pain remains an alarming worldwide health problem and is now the leading cause of disability.
- This may be a consequence of the mostly restrictive way the biopsychosocial model in back pain has been understood and applied rather than a failure of the model itself.
- The utility of the biopsychosocial framework cannot be fully assessed until we truly adopt and apply it in research and clinical practice.

*Mini Abstract (50 words)

25 years after Gordon Waddell's seminal paper on the biopsychosocial model, back pain remains a worldwide health challenge. Whether this is a result of problems in the model or its understanding and application was explored at the International Forum for Primary Care Research on Low Back Pain.

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Key words

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Mini abstract

25 years after Gordon Waddell's seminal paper on the biopsychosocial model, back pain remains a worldwide health challenge. Whether this is a result of problems in the model or its understanding and application was explored at the International Forum for Primary Care Research on Low Back Pain.

Key points

- It is 25 years since Gordon Waddell's seminal paper on the biopsychosocial model in back pain was published by SPINE.
- Back pain remains an alarming worldwide health problem and is now the leading cause of disability.
- This may be a consequence of the mostly restrictive way the biopsychosocial model in back pain has been understood and applied rather than a failure of the model itself.
- The utility of the biopsychosocial framework cannot be fully assessed until we truly adopt and apply it in research and clinical practice.

Background

The state of the art

Gordon Waddell's seminal paper on the biopsychosocial model in back pain published by SPINE[1] marked a fundamental change in the conceptualization of back pain. The model suggests that back pain should be more broadly understood than is possible from a biomedical perspective alone, because for many individuals the main problem lies not with the common and frequently transient experience of pain, but rather in their own and society's perceptions and reactions to pain. Inappropriate reactions may include unnecessary avoidance of physical activity and social interactions, absenteeism from work, and high health care utilization.

The 25 year anniversary of Waddell's publication was a focus of the Forum for Research in Back Pain in Primary Care XII that was held in Odense, Denmark October 17-19 2012. The goal of the Forum is to share the latest concepts, methods, and results of research on low back pain diagnosis, evaluation, treatment, and disability prevention. The presentations described here addressed the three dimensions of the biopsychosocial model, how it has been applied, and promising areas for research to further develop this conceptual view of LBP. The evidence reviewed constitutes a synthesis of key-note presentations and discussions. Although citations are provided to illustrate the arguments, and where possible, we rely on evidence from systematic reviews, we recognize that possible bias and lack of comprehensiveness may be inherent in this review.

Back pain remains an alarming worldwide health problem and is now the leading cause of disability, with an estimated 632 million people affected.[2] When considering both death and disability, musculoskeletal conditions have the fourth greatest impact on the health of the world population and back pain accounts for nearly half of this. Disability due to musculoskeletal disorders is estimated to have increased by 45% from 1990 to 2010, and, with increasingly obese, sedentary and aging societies, is expected to increase even more in the

years to come.[3] Against this backdrop, one can hardly say that the introduction of the biopsychosocial model in research and practice has been a public health success. In fact, alongside with the increasing rates of disability, and against guideline advice, are increases in tests [4], and in the provision of biologic mono-therapies that are costly and mostly ineffective.[5] The question therefore is whether it is the model itself that has failed to deliver or whether it is the scientific and healthcare communities that have failed to adopt the model.

Discussion

Explaining the current status

Understanding the underlying principles of a condition is a prerequisite for designing effective interventions, and while we are still struggling to identify the precise biological basis for most back problems, there is good evidence to suggest that psychological constructs such as pre-existing somatization, depression, anxiety, fear avoidance beliefs, poor coping strategies and poor self-efficacy are significant predictors of outcomes such as more severe pain, greater functional disability and work loss. Similar constructs play a role in the transition from acute to persistent pain and disability.[6-8] Nevertheless results from trials testing interventions aimed at changing psychological factors have been disappointing[9] and findings from systematic reviews of psychological interventions for chronic pain groups show that effects are at best modest.[10]

Evidence also suggests that social and organizational factors influence the consequences of back pain such as work absenteeism, but only a few trials have evaluated the effect of social interventions.[11] Furthermore, regardless of whether interventions are based on biological, psychological or social approaches, results consistently show only small to moderate effects.[12]

One explanation may be that interventions in trials have rarely integrated all three components of the biopsychosocial model. In addition, some interventions that have attempted to integrate psychological methods into general practice and physiotherapy care have been compromised by delivery at suboptimal levels of dosage, content, fidelity and mode of delivery.[9]

Progress has also been compromised by lack of clarity about the selection of appropriate outcomes. Thus, the experience of back pain per se and the consequential disability and loss of social participation, such as work absence are often confused in studies. These domains of health status are only weakly associated and one should not be considered to be a proxy for the others.[13] For example, a certain level of back pain intensity may occur in one patient with significant pain-related disability and work absence, while another patient with an equal level of pain may continue to have an active life without loss of work participation. Thus in a study that used work participation as the outcome, the first patient would be classified as having a poor outcome and the second a good outcome, whereas in a study focusing on pain intensity, both would be classified as having a poor outcome. Such examples highlight the need for multi-domain assessment and interpretation in clinical studies.[1,14-16]

Finally within clinical practice, there is mostly little reward or opportunity for primary care practitioners to utilize a comprehensive biopsychosocial approach given current practice and payment structures. This may explain why practitioners appear reluctant to attempt to influence the social aspects of the pain experience, especially those related to work.[17] Even in the occupational health context of the USA, where there is sufficient payment and other incentives based on outcome evaluations, providers retreat to the 'safe' biological arena when faced with psychosocial problems.[18] Finally, training for most of the professions that treat back pain remains bio-medically focused and grounded in profession-specific tradition rather than on contemporary evidence.[19]

The biopsychosocial model: New and promising findings from the three components

Biological

The absence of established biomarkers of back pain has led to calls for increased efforts to understand the biological components of back pain.[20-22] These include the use of diagnostic imaging to quantify the degree of disk degeneration, vertebral marrow (Modic) changes, endplate lesions, and vertebral joint

degeneration.[23,24] These findings have shown positive associations with the presence and severity of back pain symptoms on a population level, but currently they are not a useful way of diagnostically classifying individual patients, nor of informing treatment choice.[25,26]

Spinal intersegmental motion assessment technology (e.g. quantitative video fluoroscopy,[27] kinematic MRI,[28] and tissue elastography[29] has now reached a level of sophistication that its application in research is likely to provide a greater understanding of the association between spinal biomechanical dysfunction and back pain. Using previous technology, it is possible to distinguish low back pain patients from healthy controls by comprehensive biomechanical analysis of trunk motion associated with standardized functional tasks.[30] However, there is considerable variability both within and between the populations with and without pain on these tasks and we have no knowledge about the role of spinal functional performance as a treatment effect modifier or prognostic factor. Currently, there is no evidence for a causal path between such manifestations, disability and pain.

Central nervous system sensitization and abnormal central processing of pain is emerging as an important biologic explanation for the persistence of pain.[31-35] There is even evidence that persistent back pain may alter brain morphology by reducing the volume of grey matter in the prefrontal area and the thalamus[33] and that such changes may be reversible once the pain is effectively treated.[36] Such mechanisms may explain the small to moderate effects of numerous evidence-based treatments, despite their being assumed to have very different mechanisms of action.[12,37] Early evidence suggests that it may be feasible to normalize pain processing through real time functional MRI feedback training.[38]

Another potentially important biological mechanism is epigenetics, which through interactions with environmental factors, controls the expression of genetic predispositions. Genetic factors have been shown to strongly influence various spinal pain phenotypes[39] and epigenetic modulation has been shown to be involved in the transition from acute to chronic pain,[40] in addition to the

degree of spinal disc degeneration.[41] Thus the ability to influence epigenetic expression in the future may lead to improvements in back pain treatment.[42]

Psychological

Challenges being addressed by research into psychological aspects of back pain can be divided into two broad goals: a) To better understand which psychological risk factors impact on which outcomes and b) To elucidate mechanisms related both to psychological dysfunction and to recovery.

In relation to both goals, an international consensus panel[43] recognized the need to standardize the predictors included in prospective cohort research investigating the transition from acute to persistent back pain. Identifying the unique contribution of factors within specific subgroups will require extremely large samples. In addition, the consortium recognized the potential impact of social arrangement, health structures and local cultural beliefs, which have been largely ignored in most previous research. Pooling of samples from international regions is now possible, and provides a promising avenue to address limitations in current knowledge.[44]

In addition, recent emerging evidence about practitioners beliefs[45], behaviours[46], and perceptions of their role, especially in reference to patient's work,[47] present both a potential and a challenge for future research, because it implies that practitioners may inadvertently play a role in maintaining patients' disability.

Finally, a promising direction is the inclusion of new psychological approaches that aim to increase acceptance of inevitable pain states and increase engagement with all aspects of life through changes in psychological flexibility, perceived values and mindfulness informed therapy.[48,49]

Social

Social factors including potential obstacles to recovery, in the form of legislation, compensation systems and social and economic conventions and infrastructures are perhaps the most neglected area of research in back pain. Furthermore,

when studied as outcomes, social factors have been typically measured as secondary outcomes, and in many cases studies have been insufficiently powered to draw reliable conclusions from their findings.

Measurement of social factors can be problematic, as they include factors operating both at an individual and at a group level. Thus they include factors relating to the individuals' status (such as employment), those relating to the individuals' perception and reaction to their status (such as job satisfaction), those relating to group level, including regional or national level (such as incapacity legislation), and those relating to the process at group level (such as the time and ease of obtaining incapacity benefit). While the former factors have been studied, comparisons between systems necessitate large samples and careful coding of complex systems to enable clarification of the role they might play in maintaining disability. Not surprisingly, the impact of compensatory systems on the rising rates of back pain-related disability remains unclear. Yet this is one of the most promising areas for future research, and register-based information collectable at the level of incapacity and welfare systems provide a comprehensive picture of how social structures influence disability at the societal level.

There is emerging evidence that social factors contribute substantially to disability beyond the factors operating at the level of individuals.[11,50,51] For instance, Anema et al[50] compared sustainable return to work rates between six different countries and found that differences in applied work interventions, job characteristics and social disability systems were more important than medical interventions, patient and injury related factors in explaining the large between country differences.[50] In addition, the findings indicated that longer delays before assigning permanent incapacity benefits, and availability of financial support for partial return to work were associated with more favorable outcomes. Eliminating compensation for pain and suffering after a whiplash injury in one Canadian province was associated with a decreased incidence of those injuries as well as improved prognosis for patients.[52] Research on workers with chronic musculoskeletal pain showed that personal and work-related

factors were more important than pain as determinants of work ability and staying at work.[53] Taken together, the evidence suggests that the less engagement and investment patients have with disability compensation systems, and the more they are supported in work resumption, the better their outcomes.

The positive impact of engaging the workplace in preventing work disability and supporting return to work in LBP is a consistent finding.[54,55] Key components include early and supportive communication from the workplace, arrangements to ensure a safe return to work within the physical capabilities of the worker, and ongoing support from supervisors and co-workers. Some of these interventions are most effective if primarily focused in the workplace, and thus have the benefit of avoiding an overly medical /disease orientation in management of a condition that does not benefit greatly from medical interventions.[56,57] In those with more chronic work disability, multi-faceted interventions involving workers, employers, and health care providers, along with a return to work coordinator, may be required to achieve positive results .[58,59] Many approaches found to be effective are not easily evaluated in a RCT, and thus the evidence is sometimes interpreted as weak, despite consistency of findings across studies, countries, and conditions.[60] The high cost of work disability for workers, employers, and society has led to conclusions that diffusion of these principles into general practice is a priority.[61]

In addition, recent qualitative studies have indicated that employer perceptions about when an employee should return to work after a period of sick leave because of back pain may result in longer periods off work than necessary[62], suggesting that there is scope to intervene also at the employer level. Of importance, that study identified problems associated with processes within workplaces, healthcare, vocational rehabilitation, and workers compensation, which operate to extend absence from work in patients. Lack of communication between the different systems is at the core of increased disability, an observation reflected in Waddell's call[63] for all stake holders to get onside if disability is to be meaningfully reduced.

Conclusions

A *synthesis of new directions*

The Forum concluded with a discussion on the opportunities for future research and applications of the biopsychosocial model. One new and promising direction is stratified care for back pain, where patients are screened for known biopsychosocial risk factors using reliable and valid tools, and then referred to interventions designed to target their specific problem and risk profile.[64] The challenge is to develop appropriately validated instruments that stratify patients into streams of care that optimize their chance of a good outcome. Such research is underway but needs further development, testing, and wider validation, especially with respect to measuring social determinants of work disability outcomes .[64-66]. This approach may also eventually allow us to target the particular needs of subgroups in the population, such as older people, for whom back pain can lead to social isolation and reduction in physical activity or younger people, for whom preventing long-term work-related disability may change their life trajectory.[11] Lifespan research is also needed to clarify the changing impact of psychological factors at different points in a person's life course, including childhood and adolescence.[67,68] Forum participants stressed the importance of distinguishing between psychological and social domains in both research and clinical practice.

Another approach is influencing beliefs and behaviours at the population level where mass media campaigns may be useful if delivered efficiently.[69] Whether at the population or individual person level, meaningful reduction in the burden of back pain will require integrating strategies, for example: seeking input and active engagement from stakeholders such as employers to the design of interventions; increasing incentives for appropriate clinician responses to social factors; and shifting public perceptions of the role of active self-management.

Lastly, clarity about which predictors of outcome are prognostic factors and which are potential treatment effect modifiers[70] may help guide best practice

treatment and the prevention of disability. Some factors exert an influence on outcome regardless of treatment while some only influence response to specific treatments. Applying such information to identifiable subgroups of patients and at the individual patient level will require focused research and methodology development but may be well worth the effort. Interventions for some high-risk groups may be complex and costly, but expensive care that is appropriately targeted may still prove to be cost-effective.

In taking stock of the current state of knowledge, it seems evident that vast gaps remain in our understanding about the aetiology, prognosis and effective interventions in back pain, despite the biopsychosocial model. In our view, the biopsychosocial model has not failed to explain back pain - what has failed is the mostly restrictive way it has been understood and applied. Forum discussants concluded that the utility of the biopsychosocial framework cannot be fully assessed until we truly adopt and integrate it into research and clinical practice.

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