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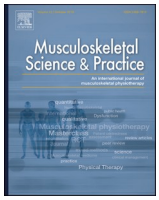

Original article

Determining people's attitudes and motivation towards their health in patients with low back pain using the Health Styles questionnaire. A test of feasibility and validity☆

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1. Introduction

Low Back Pain (LBP) is the leading musculoskeletal (MSK) complaint worldwide (Hartvigsen et al., 2018), with rising UK healthcare costs exceeding £1 billion and informal care exceeding £10 billion annually (Maniadakis and Gray, 2000). Biomedically targeted treatments including, manual therapy, exercise and adjunctive therapies, typically show low to moderate effect sizes alongside placebo treatments (Mansell et al., 2016). Cognitive functional therapies and models of behaviour change subsequently led to greater inclusion, but often poorly translated biopsychosocial approaches within physiotherapy (Cormack et al., 2023). Unfortunately, these approaches have failed to arrest the mounting burden of back pain, consequently people now suffer the highest number of years lived with disability across developing nations (Maher et al., 2017). People living in the most deprived areas, defined by their postcode, and characterised by poor education and low socioeconomic status, have been shown to receive an inequitable level of healthcare provision leading to greater reliance on hospitals, which is projected to inflate UK costs even further to £4.8 billion (PHE and England, 2021).

The STarT Back risk stratification tool is commonly used to allocate specific treatment approaches to people with LBP based on their risk of developing persistent symptoms (Forsbrand et al., 2018). It allocates them to either low, medium or high-risk groups depending on their profile of predominantly physical (low-risk), psychological (high-risk) or a combination of these traits (medium-risk) allocating resources on this basis. However, it neglects to consider the wider determinants of health (Chou et al., 2018), often leading to failed interventions and low levels of compliance (PHE and England, 2021). People living in the most socially deprived areas have been shown to receive inferior care (Wood et al., 2019), therefore tackling health inequalities requires a focus on people whose needs are greatest based on a complex mix of environmental and social factors (Chong et al., 2019).

Population segmentation, an instrument of Population Health Management (PHM) intended to achieve maximum patient impact (NHSE, 2018), maps people's motivation within the context of their environments and through different stages of their lives. The Healthy Foundations Lifestages segmentation model is embedded into an online tool called Health Styles, originally developed to influence mortality by targeting the unhealthiest behaviours in society (Wood et al., 2019). It maps people's motivation and developed strategies to help them change those behaviours. It allocates the population into five segments according to their attitude towards managing their own health rather than severity of pathology.

The allocated Health Styles include Health-conscious Realists (HCR) who are highly motivated individuals and feel in control of their health, are realistic and take a proactive long-term outlook to their lives. Balanced Compensators (BC) are also positive individuals who understand the impact that their actions have on their health. They compensate for any unhealthy behaviours but are risk averse. Hedonistic

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Immortals (HI) are generally healthy but do engage in riskier behaviours, having low motivation to change the behaviours they have. Live for Todays (LFT) take a short-term view of life. They do not feel good about themselves having an external locus of control making them resistant to change. Finally, Unconfident Fatalists (UF) are negative about most things and do not feel good about themselves. They feel that their health is out of their control being demotivated to change unhealthy behaviours, and have low self-esteem, often living in the most deprived areas (Chong et al., 2019). Understanding these features allows the provision of a tailored care, potentially reducing inequality, costs and improving outcomes (NHSE, 2018).

There is often a lack of alignment between segmentation and risk stratification, specifically regarding what they measure (Wood et al., 2023). Therefore, we wanted to investigate the feasibility of introducing population segmentation, using Health Styles, into a musculoskeletal (MSK) setting including people with non-specific chronic Low Back Pain (NSCLBP) defined as having no discernible structural cause and has persisted beyond three months (Maher et al., 2017). Specific objectives included 1. observing whether or not people are willing to complete Health Styles, 2. observing the distribution of segments of people with NSCLBP attending an MSK service, 3. observing any relationship between Health Styles and the STarT Back, level of deprivation, and healthcare utilisation, and 4. observe any relationship between Health Styles and the treatments received including number of consultations and reasons for discharge.

2. Methods

This feasibility study was a prospective observational cohort design. Ethical approval was obtained from the NHS Health Research Authority Ethics Committee and Health and Care Research Wales (Ref:20/NI/0036) and University ethics approval (Ref:26102).

Participants were recruited between April and August 2021 from three Primary Care, community based MSK Physiotherapy facilities in the North West of England. Data collection was significantly affected by the COVID-19 pandemic resulting in the temporary closure of all NHS facilities and staff redeployment. Upon re-opening, patient numbers had significantly reduced causing a much smaller sample size than intended. However, sample sizes of at least fifty participants have been recommend for feasibility studies which was achieved (Sim and Lewis, 2012).

Consecutive adult patients who self-referred or were referred by their General Practitioner (GP) with NSCLBP were invited to take part. Inclusion criteria were age more than sixteen years old and having a primary complaint of NSCLBP (Beneciuk et al., 2013), with or without leg pain. Patients were excluded if already receiving treatment or pending investigations for specific causes of LBP, reporting one or more red flags, had objective neurological loss of function representing radiculopathy, (sensation [dermatomal], power [myotomal] or reflexes), recent subluxation or fracture of the spine over the last twelve months or had pregnancy related back pain.

Due to COVID-19 restrictions all participants received their initial consultation by telephone. Subsequent contacts were agreed between the treating physiotherapist and the participant dependent on need. Patients were given two weeks to complete the STarT Back and Health Styles electronically issued on initial contact (Sowden et al., 2012). Data were entered onto the Electronic Patient Record (EPR) system by the treating physiotherapist. Participant data was downloaded, anonymised, and analysed by GD once the course of treatment had concluded.

2.1. STarT back tool

The STarT Back is a risk stratification tool validated for use in primary care settings for people with a complaint of back pain with or without leg pain (Forsbrand et al., 2018; Robinson and Dagfinrud, 2017). Nine questions allow stratification into one of three segments (Low, Medium, or High) according to risk of poor prognosis, and allocated treatment programmes according to physical and psychosocial disability (Beneciuk et al., 2013; Robinson and Dagfinrud, 2017). Combining physical and psychosocial factors, it has strong internal consistency (Fritz et al., 2011; Giusti et al., 2021), test-retest reliability (Fritz et al., 2011; Hill et al., 2011) and construct validity (Fritz et al., 2011; Giusti et al., 2021; Hill et al., 2011). It was shown to have no floor or ceiling effect (Hill et al., 2011).

2.2. Health Styles and lifestage

Health Styles is underpinned by the Health Foundations Lifestages Segmentation Model, which in partnership with academic and commercial research agencies, developed a robust health segmentation model (Williams et al., 2011). Development involved large-scale surveys of 4928 people across the ages of 16–74 in England. Validated by Fifty two focus groups and forty five in-depth immersive interviews (La Placa et al., 2014) showing it to be robust and reliable in segmenting the population with a high degree of accuracy (88%) (Williams et al., 2011). It offers clinician and patient insight into the needs, lifestyles and motivations of individuals and groups within society. There are nineteen questions about motivation taken from existing validated measures (Williams et al., 2011), and six about lifestage, identifying five different types of people showing very different health behaviours and attitudes. Secondly, it offers intervention approaches for each segment. Thirdly, it identifies people's life stage, and index of multiple deprivation through postcode.

2.3. Index of multiple deprivation

Index of Multiple Deprivation (IMD) is a valuable tool for identifying and addressing socio-economic inequalities. It combines various indicators to provide a comprehensive measure of deprivation across multiple domains (MHCGL (Ministry of Housing and communities and Local Government), 2019; Author/Organisation).

However, researchers note limitations such as reliance on potentially outdated data and the focus on relative rather than absolute deprivation (Qi et al., 2022) There is also the need for regular updates and complementary measures to enhance its accuracy and effectiveness (Qi et al., 2022). The IMD transitioned from using quintiles to deciles with the release of the 2015 IMD (Department for Communities and Local Government, 2015) This change allowed for a more granular analysis of deprivation by dividing areas into ten equal groups instead of five. The aim of using IMD was to identify the level of deprivation in which an individual lives, not to identify a deprived person, or measuring affluence (Department for Communities and Local Government, 2015).

2.4. Statistical analysis

Data from the EPR were downloaded into Microsoft Excel and analysed using IBM SPSS (version 26). IMD deciles were collapsed to quintiles to correspond with the Healthy Foundation Life-stage Segmentation modelling (1 = least deprived and 5 = most deprived).

Participant characteristics were presented using appropriate measures of central tendency and variance, radar and bar chart, and box and whisker plots. Pearson's Chi-square tests were used for categorical data to test the relationship between Health Styles and the STarT Back groups, mode of treatment delivery (Telephone/virtual face to face/face to face), type of treatment and reason for discharge. A 2-Tailed Spearman's rho test was used for ratio data to test for relationships between Health Styles and level of deprivation (IMD), and the number of treatments, Did Not Attend (DNA's) and Unable To Attend (UTA's). 95% confidence interval and an alpha of 0.05 were set for all statistical tests.

3. Results

132 consecutive patients with NSCLBP met the studies inclusion/

exclusion criteria and were invited to participate. Of these, n = 59 were excluded following their initial assessment needing to be diverted to other specialist services for further assessment/management for specific causes of LBP, while n = 3 (4%) did not consent to take part. A total of n = 70 participants were eligible and consented to participate. Throughout the study, n = 4 (6%) participants were lost to follow-up, leaving n = 66 included in the final analysis.

More females (62%) than males (38%) took part, although with similar mean ages of 51 (±14) and 52 (±14) years, respectively (Table 1). More participants were from the most deprived areas and at low-moderate risk of developing NSCLBP. Most attended all appointments via telephone, receiving two appointments which included advice, education, exercise and were discharged because they were happy to manage themselves.

Table 1
Patient demographics.

	(n =)	%
Sex		
Female	41	62
Male	25	38
Age (years, mean ± SD)		
Female	51 ± 14	
Male	52 ± 14	
Index of Multiple Deprivation (IMD)		
1 (least deprived)	10	14
2	10	14
3	14	19
4	14	19
5 (most deprived)	25	34
STarT Back tool		
Low risk	25	35
Moderate risk	25	35
High risk	22	30
Attendance		
Did Not Attend (DNA)		
0	60	82
1	9	12
2	2	3
3	2	3
Unable To Attend (UTA)		
0	71	97
1	2	3
Mode of Treatment		
Telephone	43	59
Virtual face to face	4	5
Face to face	26	36
Number of Treatments Received		
0	1	1
1	7	10
2	20	27
3	15	21
4	14	19
5	8	11
6	4	6
7	3	4
8	1	1
Type of Treatments Received		
Advice/Education/Exercise	59	82
Exercise	3	4
Manual Therapy	1	1
Back Rehabilitation Programme	1	1
Advice/Back Rehabilitation Programme	7	10
Other	1	1
Reason for Discharge		
DNA	8	11
Completed BRP	2	3
SOS Self-managed	35	48
Improved	2	3
Ongoing	18	25
New problem	1	1
Requested Self-management	2	3
Onward referral	3	4
Awaiting vBRP	1	1
UTA	1	1

Modelling indicated the greatest proportion of the population are LFTs (Hill et al., 2011). The greatest proportion of patients visiting the service with NSCLBP were HCRs. On average, UFs and LFTs received the highest number of treatments. UFs had the highest rate of did not attend (DNA) and HI's the highest rate of unable to attend (UTA) (Table 2).

DNA = Did not attend, UTA=Unable to attend.

*Proportion of the population in each segment based on the original model (Williams et al., 2011).

3.1. Relationship between Health Style and STarT back

A significant relationship was found between the five motivational segments (Health Conscious Realists, Live For Today, Balanced Compensators, Hedonistic Immortals and Unconfident Fatalists) and three risk stratification groups (Low, Medium, High) (x2 = 49.8, p = 0.001) (Fig. 1). Each segment demonstrated various amounts of overlap reflecting the complexity of their characteristics.

Most HCRs fall into the low-risk group of the STarT Back (n = 16) with (n = 6) crossing over into the medium risk group. The BCs and HIs primarily fall into the medium risk group (n = 6, n = 8 respectively). The BCs also occupy the low-risk group (n = 3) with none in the high-risk. HIs occupy both the low and high-risk groups with (n = 1 and n = 4, respectively). The LFTs (n = 7) and UFs (n = 10) predominantly occupy the high-risk stratification group, with some participants falling into the medium and low risk groups (LFT n = 1 and n = 2, and the UF n = 1 and n = 1), respectively.

3.2. Interaction between Health Style and index of multiple deprivation

There was a low but significant correlation between population segments and IMD (r = 0.26, p = 0.05) (lower: 0.012 and upper: 0.478). HCRs are more likely to be from the least deprived areas (IMD = 1), followed by HIs, then BCs, whereas LFTs and UFs are more likely to live in the most deprived areas (IMD = 5) (Fig. 2).

3.3. Relationship between Health Styles and healthcare utilisation

Health Style was significantly associated with the mode of treatment delivery (X2 = 24.9, p = 0.002). This was established by selecting the treatment method reported within the EPR, that represented more than fifty percent of the course of treatments per subject.

Telephone interventions were preferred by HCRs, BCs and HIs (Fig. 3). Only small numbers of HIs and UFs used online treatments via

Table 2
Distribution of outcomes by Health Style segment.

Segment	%	N (%)	(Mean ± SD, min-max)		
	Population of England[a]	Patients	Treatments	DNAs	UTAs
Health-conscious Realist HCR)	21	22 (33)	3 ± 1.5, 1-7	0.27 ± 0.5, 0-2	0
Live For Today (LfT)	25	10 (15)	4 ± 1.5, 1-6	0.30 ± 0.7, 0-2	0
Balanced Compensator (BC)	17	9 (14)	2 ± 1.4, 1-5	0.11 ± 0.3, 0-1	0
Hedonistic Immortal (HI)	19	13 (20)	3 ± 1.9, 1-8	0.08 ± 0.3, 0-1	0.15 ± 0.4, 0-1
Unconfident Fatalist (UF)	18	12 (18)	4 ± 1.6, 2-7	0.42 ± 0.9, 0-3	0

DNA = Did not attend, UTA=Unable to attend.

[a] Proportion of the population in each segment based on the Healthy Foundations Lifestages Segmentation Modelling (Robinson and Dagfinrud, 2017).

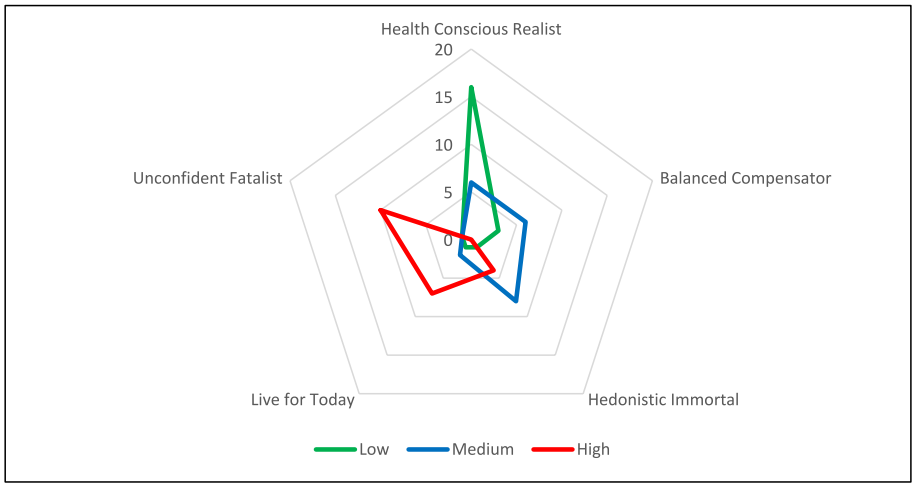

Fig. 1. Radar chart mapping the five Health Style motivational segments against the three STarT Back tool groups.

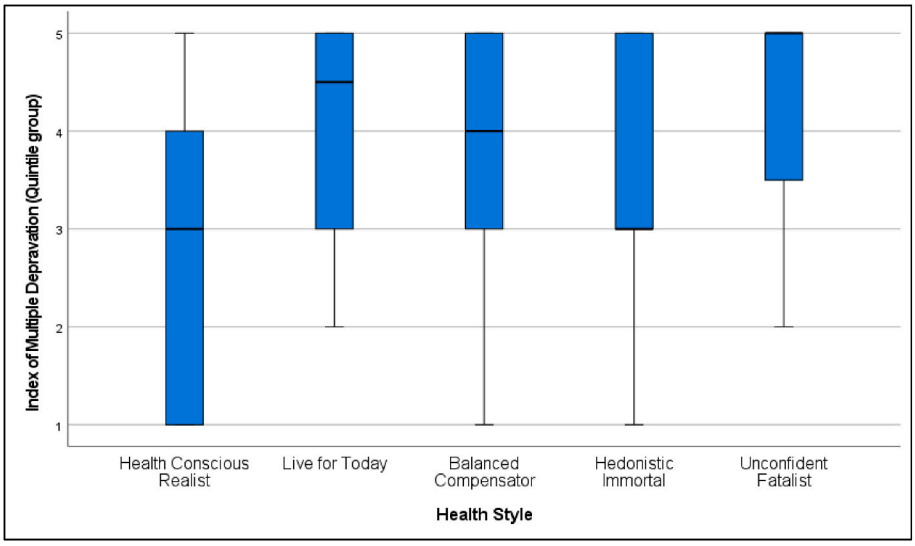

Fig. 2. Box-and-whisker plot showing the distribution of Index of Multiple Deprivation (IMD) within each motivation segment (1 = least deprived).

zoom. Face to face treatments were used by all Health Style segments, but generally preferred by UFs.

4. Discussion

This feasibility study aimed to determine whether population segmentation using prospective data collection can be introduced locally in a specific population. This is important so that population health management can be implemented to influence personalised care and inform strategic planning (NHSE, 2018).

The first objective observed that people were willing to use Health Styles with their clinician. Labelling of segments is subjective and may affect willingness to participate (Wood et al., 2023). Whilst some (Wood et al., 2019) choose not to label their segments, the current study found that 96% consented to take part, completed the online tool, and disclosed their Health Style to the clinician. This is a strong indicator of acceptability to sharing this type of information. Attrition was 6% in the current study, which will inform future studies. We were unable to determine the reasons people either chose not to be contacted or not consent. More quantitative and qualitative research is needed to fully explore patient and clinician acceptability.

The second objective was to observe the distribution of segments attending the MSK service with NSCLBP. The largest segment of attending patients were HCRs, which is different to the largest segment in the population, which is LFTs (Williams et al., 2011). Local population segmentation profiles using the HFLS model have shown to differ to the national profile (Population Segmentation for COVID et al., 2023). Therefore, without accurate local data, public health planning and commissioning may not reflect and meet the needs of a locality (NHSE, 2016).

We know that if treatment is symptom driven, and everyone receives the same type of treatment, the outcome is only 30–60% effective (Vuik et al., 2016). Given that no two patients are alike, the creation of models of personalised care is prohibitively expensive and an intractable endeavour (Wood et al., 2019). It makes sense therefore, to be able to improve the health of a population, to understand the specific needs of different groups within that population and organise care around these groups.

Knowing the population attending your service and their motivation to live a healthy life provides a unique insight for providers. UFs were the lowest proportion of patients, but received the highest number of treatments, whereas HCRs were the highest proportion of patients, but received a lower number of treatments. Although high-needs patients are costly, lower-needs patients have shown to make up around 80% of

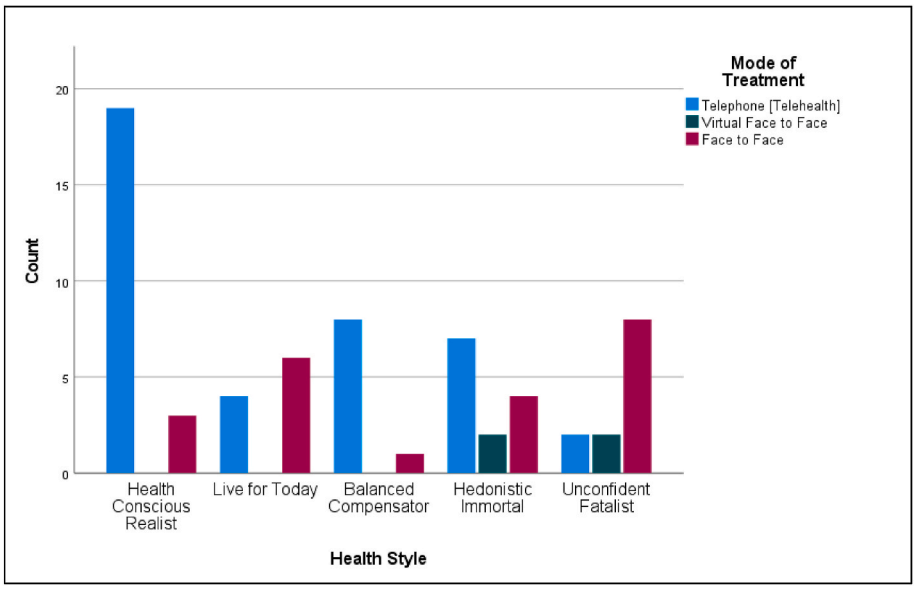

Fig. 3. Bar chart showing the mode of treatment within each Health Style segment.

the population but can be prime targets for prevention programmes (Chen et al., 2018). Continually collecting simple Health Style data is an opportunity for providers to understand the impact of, and reaction to certain changes in service provision, or epidemics such as COVID-19.

The third objective was to observe relationships between each Health Style and STarT Back, level of deprivation, and healthcare utilisation. It was reassuring to find a relationship between the Health Styles and the STarT Back as they both include elements of psychometric profiling. Cross-over between health segments and risk groups was evident, explained by variation in traits and the differences in precision when comparing the five segments with only three risk groups. HCRs were associated with the low-risk group, as they are both highly motivated and feel in control of their lives. In contrast, UFs, who typically have higher levels of anxiety and depression and feel out of control of their health, were associated with the high-risk group, primarily dominated by psychological drivers (Sowden et al., 2012).

Despite the STarT Back exploring fatalism and long-term perspectives, it may still neglect to consider peoples most important health beliefs, disconnecting these factors from social circumstance. Being able to target and influence long term health behaviours rather than interim illness may ultimately culminate in better long-term outcomes (Chong et al., 2019). The STarT Back has shown to provide acceptable prediction for disability up to one year, but not predictive or discriminative values for future pain (Robinson and Dagfinrud, 2017).

The association found between Health Style and IMD is indicative of the social inequalities that impair healthcare (Marmot et al., 2020). Those with high levels of motivation living in positive environments (HCRs) tend to thrive, whilst those with low levels of motivation, living in negative environments (UFs) are only just surviving. However, providing services solely based on deprivation may also be inadequate as BCs and LFTs occupy the most deprived areas (IMD≥4) which does not fit this model. However, LFTs are more negatively motivated making them survivors, whereas BCs are more positively motivated making them fighters. Adopting the same treatment approach with both groups could result in different levels of adherence and ineffective outcomes leading to poor resource allocation.

Social inequality is a primary driver of MSK pain and dysfunction, with a negative trajectory and higher perceived pain intensity being associated with lower social classes (Chen et al., 2018). The social determinants of health have created regional differences within communities propagating spiralling public health costs (Marmot et al., 2020). Targeting those living in the poorest/most deprived areas with the lowest health motivation would allow a system of healthcare that delivers care to the most socially disadvantaged social groups in a holistic manner and consider more of the multifactorial influences in health and LBP.

Health Style was significantly associated with the mode of treatment delivery. More face-to-face consultations were delivered to UFs and LFTs, characterised by negative thoughts, low motivation to act, often feeling depressed and out of control. These groups are most resistant to change and exhibit care seeking behaviours, often exploiting the provision of care (Qi et al., 2022). It is possible UFs and LFTs received face-to-face contacts to satisfy both the participant and therapist needs for greater reassurances, ultimately utilising more healthcare. In contrast, HCRs and BCs received more consultations by telephone. Both HCRs and BCs are realistic, generally in control of their own health, and so have little need for external cues often gained from multiple face-to-face consultations and passive therapies (Hill et al., 2011). Regarded as having high self-efficacy and resilience may also suggest why non-attendance in this group was observed. Understanding this might help personalise care for these individuals in the future.

4.1. *Strengths and limitations*

The prospective design demonstrated the usability of Health Styles between clinician and patient and its potential for personalisation of care. Future studies might investigate its potential for scaling up its application at a policy level when embedded into an EPR system (PHE and England, 2021). The generic nature of Health Styles allows it to be used across all healthcare settings, including social care. Simplicity is key to achieving buy-in for segmentation from senior decision makers (Wood et al., 2019). This study has shown that data could be incorporated clinically and analysed simply.

Limitations include the number of participants recruited, which was much lower than expected due to the global restrictions from the COVID-19 pandemic. Following the pandemic, uncertainty about personal safety and a lack of understanding about healthcare regulations may have led to a reduction in people's willingness to attend face to face consultations, possibly opting for telephone consultations instead. These issues will need to be addressed in future studies when there is less fear of physical contact and services have fully normalised.

Although a generic tool, we applied rigorous exclusion criteria to define the population and compare it to the STarT Back, this further limited participant numbers. We were unable to determine the reasons

people either chose not to be contacted or not to consent. The number of DNAs and UTAs were relatively low and existed in all Health Styles. We were unable to explore the reason for non-attendance but should be a focus of future research. This might also have been an unforeseen consequence of the COVID-19 pandemic. This could be mitigated by developing more studies now that public confidence in face to face services is restored. Whilst the data collection period was relatively short, sufficient numbers were achieved to imply feasibility. Future studies should use a longer data collection period in order to gain a larger and more representative population sample.

5. Conclusions

Having a greater understanding of a person's healthcare motivation, including individual traits, rather than physical manifestations of LBP may be important. Patients and clinicians are willing to use population health segmentation using Health Styles, which can also easily be incorporated into service-level data allowing personalisation at an individual level. Health Styles do correlate with previously established risk groups within MSK settings identified by the STarT Back. Therefore, using Health Styles within MSK settings would afford a broader understanding of people by including health motivation in the context of their social, environmental and economic circumstances when designing reliable and valid interventions. It shows potential for scaling up in subsequent studies with sufficiently larger subject populations and may help to inform strategic planning. Further research should fully explore this along with patient and clinician acceptability, so that it may inform PHM at neighbourhood and systems levels.

CRediT authorship contribution statement

G Davies: Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **P.C. Goodwin:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Formal analysis, Conceptualization.

References

Author/Organisation. Office for health improvement and disparities year: 2024 title of document: OHID guidance - indices of multiple deprivation. Available at: file:///C:/Users/55060697/Downloads/OHID_20Guidance_20-_20Indices_20of_20Multiple_20Deprivation.pdf. (Accessed 14 August 2024).

Beneciuk, J.M., Bishop, M.D., Fritz, J.M., et al., 2013. The STarT back screening tool and individual psychological measures: evaluation of prognostic capabilities for low back pain clinical outcomes in outpatient physical therapy settings. Phys. Ther. 93 (3), 321–333. https://doi.org/10.2522/ptj.20120207.

Chen, Y., Campbell, P., Strauss, V.Y., Foster, N.E., Jordan, K.P., Dunn, K.M., 2018. Trajectories and predictors of the long-term course of low back pain: cohort study with 5-year follow-up. Pain 159 (2), 252–260. https://doi.org/10.1097/j.pain.0000000000001097.

Chong, J.L., Lim, K.K., Matchar, D.B., 2019. Population segmentation based on healthcare needs: a systematic review. Syst. Rev. 8 (1), 202. https://doi.org/10.1186/s13643-019-1105-6.

Chou, L., Cicuttini, F.M., Urquhart, D.M., et al., 2018. People with low back pain perceive needs for non-biomedical services in workplace, financial, social and household domains: a systematic review. J. Physiother. 64 (2), 74–83. https://doi.org/10.1016/j.jphys.2018.02.011.

Cormack, B., Stilwell, P., Connix, S., Gibson, J., 2023. The Biopsychosocial model is lost in translation: from misrepresentation to an enactive modernization. Physiotherapy Theory and Practice An Int. J. Phy. Therapy 9, 11. https://doi.org/10.1080/09593985.2022.2080130.

Department for Communities and Local Government, 2015. English index of multiple deprivation 2015 – guidance. Retrieved from. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/464430/English_Index_of_Multiple_Deprivation_2015_-_Guidance.pdf.

Forsbrand, M.H., Grahn, B., Hill, J.C., Petersson, I.F., Sennehed, C.P., Stigmar, K., 2018. Can the STarT Back Tool predict health-related quality of life and work ability after an acute/subacute episode with back or neck pain? A psychometric validation study in primary care'. Br. Med. J. 8, 1–9. https://doi.org/10.1136/bmjopen-2018-021748.

Fritz, J.M., Beneciuk, J.M., George, S.Z., 2011. Relationship between categorization with the STarT Back Screening Tool and prognostic variables for people receiving physical therapy. Phys. Ther. 91 (5), 722–732.

Giusti, E.M., Varallo, G., Abenavoli, A., Manzoni, G.M., Aletti, L., Capodaglio, P., Castelnuovo, G., Maggiani, A., 2021. Factor structure, validity, and reliability of the STarT back screening tool in Italian obese and non-obese patients with low back pain. Front. Psychol. 12, 740851. https://doi.org/10.3389/fpsyg.2021.740851.

Hartvigsen, J., Hancock, M.J., Kongsted, A., et al., 2018. What low back pain is and why we need to pay attention. Lancet 391 (10137), 2356–2367. https://doi.org/10.1016/S0140-6736(18)30480-X.

Hill, J.C., Whitehurst, D.G., Lewis, M., Bryan, S., Dunn, K.M., Foster, N.E., et al., 2011. Comparison of stratified primary care management for low back pain with current best practice (STarT Back): a randomised controlled trial. Lancet 378 (9802), 1560–1571.

La Placa, V., McVey, D., MacGregor, E., Smith, A., Scott, M., 2014. The contribution of qualitative research to the Healthy Foundations life-stage segmentation. Crit. Publ. Health 24 (3), 266–282. https://doi.org/10.1080/09581596.2013.797068.

Maher, C., Underwood, M., Bruchbinder, R., 2017. Non-specific low back pain. Lancet 89. https://doi.org/10.1016/S0140-6736(16)30970-9, 763-747.

Maniadakis, N., Gray, A., 2000. The economic burden of back pain in the UK. Pain 84 (1), 95–103. https://doi.org/10.1016/S0304-3959(99)00187-6.

Mansell, G., Hall, A., Toomey, E., 2016. Behaviour change and self-management intervention in persistent low back pain. Best Pract. Res. Clin. Rheumatol. 30, 994–1002. https://doi.org/10.1016/j.berh.2017.07.004.

Marmot, M., Allen, J., Boyce, T., Goldblatt, P., Morrison, J., 2020. Health Equity in England: the Marmot Review 10 Years on.

MHCGL (Ministry of Housing, communities and Local Government), 2019. The English indices of deprivation (2019) Online at. https://dera.ioe.ac.uk/id/eprint/34264/1/IoD2019_Research_Report.pdf. (Accessed 14 August 2024).

NHSE, 2016. Improving outcomes through Personalised Medicine: working at the cutting edge of science to improve patients' lives. Gov.UK. https://www.england.nhs.uk/wp-content/uploads/2016/09/improving-outcomes-personalised-medicine.pdf.

NHSE, 2018. Population health management flatpack: a guide to starting population health management. Gov.UK. https://imperialcollegehealthpartners.com/wp-content/uploads/2018/07/Population-Health-Management-Flatpack-Version-1.0-Final-Sent.pdf.

PHE, 2021. In: England, P.H. (Ed.), Place-based Approaches for Reducing Health Inequalities: Main Report. Gov.UK.

Population Segmentation for COVID-19 Vaccine Outreach: A Clustering Analysis and Implementation in Missouri Chessen EG, Ganser, M.E., Paulish, C.A., Malik, A., Wishner, A.G., Turabelidze, G., Glenn, J., 2023. J. Publ. Health Manag. Pract. 29 (4), 563–571. https://doi.org/10.1097/PHH.0000000000001740.

Qi, X., Jia, Y., Pan, C., et al., 2022. Index of multiple deprivation contributed to common psychiatric disorders: a systematic review and comprehensive analysis. Neurosci. Biobehaviour. Rev. 140 (Sep), 104806. https://doi.org/10.1016/j.neubiorev.2022.104806. PMID: 35926729.

Robinson, H.S., Dagfinrud, H., 2017. Reliability and screening ability of the StarT Back screening tool in patients with low back pain in physiotherapy practice, a cohort study. BMC Muscoskel. Disord. 18, 232. https://doi.org/10.1186/s12891-017-1553-x.

Sim, J., Lewis, M., 2012. The size of a pilot study for a clinical trial should be calculated in relation to considerations of precision and efficiency. J. Clin. Epidemiol. 4. https://doi.org/10.1016/j.jclinepi.2011.07.011, 2878-291.

Sowden, G., Hill, J.C., Konstantinou, K., Khanna, M., Main, C.J., Salmon, P., Somerville, S., Wathall, S., Foster, N.E., IMPaCT Back study team, 2012. Targeted treatment in primary care for low back pain: the treatment system and clinical training programmes used in the IMPaCT Back study (ISRCTN 55174281). Fam. Pract. 29 (1), 50–62. https://doi.org/10.1093/fampra/cmr037. Feb; Epub 2011 Jun 27. PMID: 21708984; PMCID: PMC3261797.

Vuik, S.I., Mayer, E., Darzi, A., 2016. A quantitative evidence base for population health: applying utilisation-based cluster analysis to segment a patient population. Popul. Health Metrics 14. https://doi.org/10.1186/s12963-016-0115-z.

Williams, B., McVey, D., Davies, L., MacGregor, E., 2011. The Healthy Foundations Lifestages Segmentation Research Report No.1: Creating the Segmentation Using a Quantitative Survey of the General Population of England.

Wood, R.M., Murch, B.J., Betteridge, R.C., 2019. A comparison of population segmentation methods. Oper. Res. Health Care 22. https://doi.org/10.1016/j.orhc.2019.100192.

Wood, R.M., Budiman, T.A., Hassey, N., et al., 2023. Development and practical use of a risk-sensitive population segmentation model for healthcare service planning: application in England. Int. J. Healthc. Manag. https://doi.org/10.1080/20479700.2023.2232980.