

Priced Out and Sitting Still: Cost-Related Non-Adherence and Sedentary Lifestyle as Independent Predictors of Arthritis Pain Severity in Nigeria

*Timi Fiekumo Buseri¹, Obah Tiyenema Grace², Keme Kelvin Yenagoa³, Ruth Ebiegberi Obidake²

¹Department of Clinical Pharmacy and Pharmacy Practice, Faculty of Pharmaceutical Sciences, Bayelsa Medical University

²Department of Pharmacy, Federal Medical Centre (FMC) Yenagoa Bayelsa State

³Department of Social and Public Health Pharmacy Faculty of Pharmaceutical Sciences Bayelsa Medical University

*Corresponding Author

DOI: <https://doi.org/10.51584/IJRIAS.2026.11090003>

Received: 12 September 2026; Accepted: 17 September 2026; Published: 29 September 2026

ABSTRACT

Background: Arthritis pain control depends on both sustained medication use and an active lifestyle, yet the cost of treatment and habitual physical inactivity are each plausible, independent barriers to pain control in out-of-pocket-financed health systems. Whether these two modifiable factors operate as genuinely separate risk factors — or merely proxy for one another — has not been tested jointly in a single model.

Objective: To determine whether cost-related medication non-adherence (CRN) and physical activity lifestyle each independently predict pain severity among arthritis patients in a tertiary hospital in Yenagoa, Bayelsa State, Nigeria, when modelled together.

Methods: Cross-sectional secondary analysis of 128 adults with rheumatoid arthritis, osteoarthritis, gout, or spondylosis. CRN (four-point ordinal scale) and physical activity lifestyle (sedentary/moderately active/very active) were entered simultaneously into a multivariable binary logistic regression for severe/worst pain (numeric rating ≥ 7 vs. 0–6), adjusting for age, gender, education, income, proportion of income spent on treatment, and arthritis diagnosis (dummy-coded; gout and spondylosis combined owing to a small, outcome-homogeneous spondylosis subgroup).

Results: CRN and lifestyle were not significantly correlated with one another (Spearman $\rho = -.065$, $p = .469$); this indicates no detectable monotonic association in this sample and is consistent with, but does not on its own prove, separate underlying constructs. Both remained independently associated with severe/worst pain after mutual adjustment: each one-category increase in CRN raised the odds of severe/worst pain by 79% (AOR=1.79, 95% CI 1.11–2.90, $p = .018$), while each one-step increase in activity level lowered the odds by 77% (AOR=0.23, 95% CI 0.075–0.686, $p = .009$). Gout/spondylosis carried markedly higher odds than osteoarthritis (AOR=21.83, 95% CI 1.83–260.93, $p = .015$, imprecise given small subgroup). The combined model (pseudo- $R^2 = .249$) outperformed either single-predictor model (pseudo- $R^2 = .193$ and $.167$, respectively).

Conclusion: Cost-related non-adherence and sedentary lifestyle are independently and non-redundantly associated with arthritis pain severity in this cross-sectional sample. Because the two were uncorrelated here, an intervention addressing only one is unlikely, on current evidence, to fully address the other; both financial-protection and activity-promotion interventions are likely needed, in parallel, to meaningfully reduce pain burden in this population.

Keywords: cost-related non-adherence; physical activity; sedentary lifestyle; arthritis; pain severity; Nigeria

INTRODUCTION

Arthritis — rheumatoid arthritis, osteoarthritis, gout, and spondylosis — is a leading global cause of chronic pain and disability. Two modifiable, non-pharmacological-adjacent factors are repeatedly implicated in how much pain a patient ultimately experiences: whether they can afford to take their medication as prescribed, and whether they remain physically active despite their diagnosis. Both have strong international evidence bases in isolation, but they have never, to our knowledge, been examined together in the same statistical model within a single population — leaving open the possibility that one is simply a proxy for the other (e.g., patients too poor to afford treatment may also be too unwell or too occupationally constrained to stay active), which would have very different policy implications than if they are truly independent.

In sub-Saharan Africa, arthritis was long considered rare, a view now attributed to under-ascertainment: a systematic review of arthritis prevalence in Africa found population-based data scarce and called for further study of the continent's true burden.¹ A Nigerian peri-urban community survey found musculoskeletal pain in a majority of respondents,² confirming substantial, if under-documented, burden. Nigeria's health system is financed predominantly out-of-pocket, making the cost of chronic arthritis medication a recurring barrier to adherence: international evidence links such cost-related non-adherence (CRN) to worse outcomes, including higher hospital-related costs in early arthritis independent of baseline disease activity,³ and a broader economic review confirming out-of-pocket payment is negatively associated with adherence in rheumatoid arthritis.⁴ Separately, physical activity and exercise have been shown to reduce pain, fatigue, and disease activity in rheumatoid arthritis,⁵ a position formalised in the 2018 EULAR recommendations for physical activity in inflammatory arthritis and osteoarthritis,⁶ despite most people with arthritis remaining physically inactive.⁷

Novelty and gap. No published study appears to have modelled cost-related non-adherence and physical activity lifestyle together as simultaneous, mutually-adjusted predictors of arthritis pain severity, in Nigeria or elsewhere. This matters clinically: if the two factors are correlated (e.g., poverty driving both non-adherence and inactivity), a single financial intervention might address both; if they are independent, as we hypothesised, both financial-protection and activity-promotion interventions are separately necessary. This study addresses that gap directly, in a Niger Delta tertiary hospital population, and additionally resolves a limitation of examining each factor in isolation — namely, that an apparent effect of one could simply reflect uncontrolled confounding by the other.

METHODS

This cross-sectional secondary analysis used structured-questionnaire data from 128 adult patients with physician-diagnosed rheumatoid arthritis, osteoarthritis, gout, or spondylosis attending outpatient clinics at a tertiary hospital in Yenagoa, Bayelsa State. Both CRN and physical activity lifestyle were assessed via interviewer administration, as part of a structured questionnaire delivered face-to-face by trained study personnel during outpatient clinic visits, rather than by self-completion; this approach was chosen to minimise missing data and reading-literacy barriers in this population. CRN was assessed with a single item on how much treatment cost affects adherence (“not at all” to “a lot”, coded 1–4), adapted from the brief self-report approach used in the U.S. National Health Interview Survey, the standard national surveillance instrument for this construct,⁸ with wording adjusted for local comprehensibility and interviewer-administered delivery rather than applied verbatim. Physical activity lifestyle was assessed by interviewer classification into sedentary, moderately active, or very active (coded 1–3), adapted from the “Exercise Vital Sign” approach used in routine clinical care, which has demonstrated construct validity against accelerometry,⁹ with category descriptions similarly adapted for interviewer-administered use in this setting. As single-item, interviewer-administered adaptations rather than the original validated instruments, both measures should be regarded as pragmatic screening-level indicators; their local psychometric properties (e.g., inter-rater reliability) have not been separately established, which we address further in the limitations. Pain was self-rated on a 0–10 numeric rating scale (NRS), a validated instrument with established reliability and criterion validity in musculoskeletal and rheumatological populations,¹⁰ and dichotomised a priori into mild/moderate (0–6) versus severe/worst (7–10). Covariates were age band, gender, education, monthly income band, proportion of monthly income spent on treatment, and arthritis diagnosis. The original data collection received institutional ethical approval and informed consent; data used here were fully de-identified.

Analyses were conducted in Python (pandas, SciPy, statsmodels). Spearman correlation first tested whether CRN and lifestyle were related to one another. Both predictors were then entered simultaneously into a multivariable binary logistic regression for severe/worst pain, adjusting for all covariates above; arthritis diagnosis (nominal, not ordinal) was dummy-coded (reference: osteoarthritis [OA]), with gout and spondylosis combined into one “other” category because the spondylosis subgroup (n=6) showed no outcome variation (all severe/worst), which would otherwise produce an unstable, separation-affected estimate. A secondary ordinal logistic regression on the full four-band pain outcome (mild/moderate/severe/worst) was fitted as a robustness check. Adjusted odds ratios (AOR) with 95% confidence intervals (CI) are reported for the binary model; significance was set at $p<.05$.

RESULTS

Table 1 summarises the sample (N=128): 57.8% female, 50.0% rheumatoid arthritis. Cost affected adherence “a lot” for 41.4% of patients; most (73.4%) described themselves as moderately physically active. Overall, 75.7% reported severe/worst pain.

Table 1. Sample Characteristics (N = 128)

Variable	Category	n (%)
Age	≥ 44 / 45–64 / ≥ 65 years	18 (14.1) / 68 (53.1) / 42 (32.8)
Gender	Male / Female	54 (42.2) / 74 (57.8)
Education	$\leq$ Primary / Secondary / $\geq$ Tertiary	36 (28.2) / 54 (42.2) / 38 (29.6)
Monthly income	$< \text{N}50\text{k}$ / $\text{N}50\text{--}199\text{k}$ / $\geq \text{N}200\text{k}$ / N/A	14 (10.9) / 64 (50.0) / 19 (14.8) / 31 (24.2)
Arthritis diagnosis	RA / OA / Gout / Spondylosis	64 (50.0) / 44 (34.4) / 14 (10.9) / 6 (4.7)
Cost-related adherence	Not at all / A little / Moderately / A lot	20 (15.6) / 28 (21.9) / 27 (21.1) / 53 (41.4)
Physical activity lifestyle	Sedentary / Moderately active / Very active	13 (10.2) / 94 (73.4) / 21 (16.4)
Pain severity	Mild / Moderate / Severe / Worst	11 (8.6) / 20 (15.6) / 67 (52.3) / 30 (23.4)

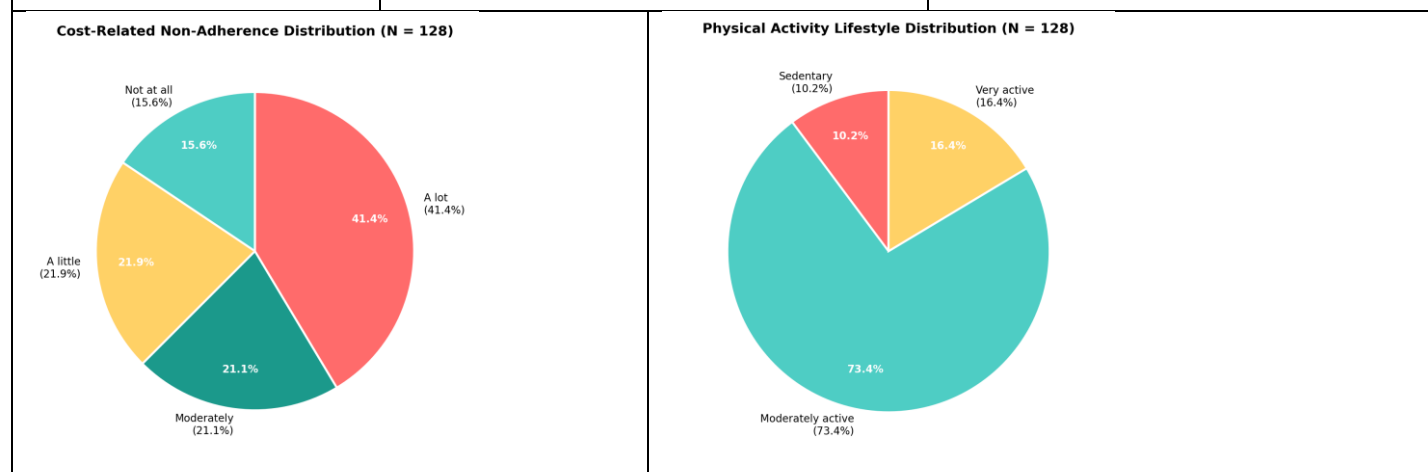


Figure 1 (left). Cost-related non-adherence (CRN) category distribution (N=128). Figure 2 (right). Physical activity lifestyle distribution (N=128).

CRN and lifestyle were not significantly correlated with one another (Spearman $\rho=-.065$, $p=.469$). A non-significant Spearman correlation indicates only that no monotonic association was detected between the two variables in this sample; it does not, by itself, prove that they are independent constructs, since it cannot rule out

nonlinear relationships, shared confounding, interaction effects, or other forms of dependence. We treat the absence of a detectable bivariate correlation as consistent with, rather than proof of, separate underlying constructs, and rely on the mutually adjusted regression below to assess whether each factor carries non-redundant information about pain severity. Each was, however, separately and significantly associated with pain severity at the bivariate level: CRN category ($\chi^2=25.90$, $df=9$, $p=.002$), with severe/worst pain rising from 50.0% (“not at all”) to 88.7% (“a lot”); and lifestyle category ($\chi^2=16.69$, $df=6$, $p=.011$), with severe/worst pain falling from 92.3% (sedentary) to 52.4% (very active).

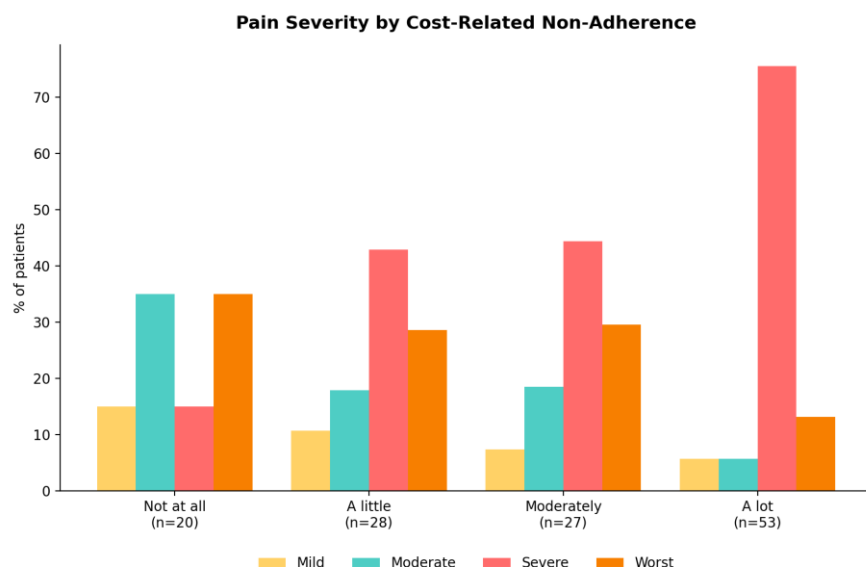


Figure 3. Pain severity (%) by cost-related non-adherence category.

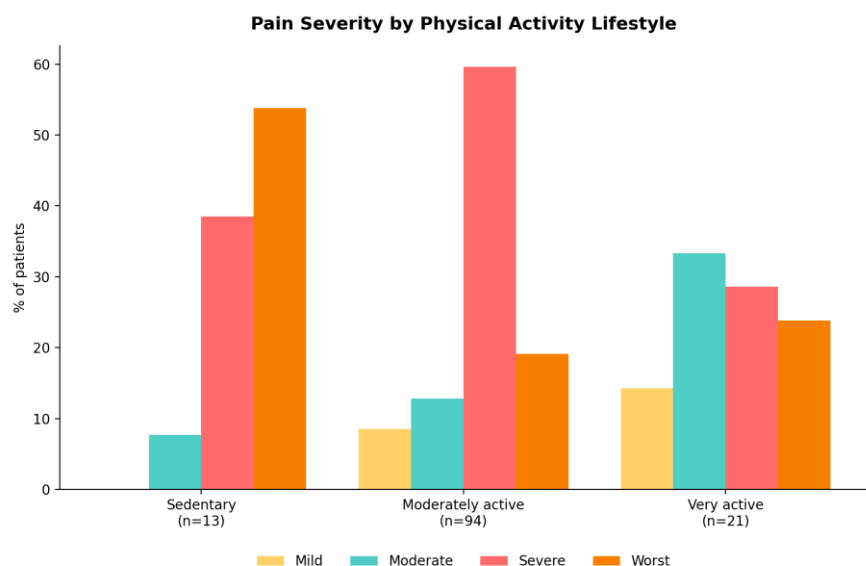


Figure 4. Pain severity (%) by physical activity lifestyle category.

Combined Multivariable Model

Table 2 presents the combined binary logistic regression model, with CRN and lifestyle entered simultaneously alongside all covariates. The overall model was significant (likelihood-ratio $p<.0001$) and explained more variance (pseudo- $R^2=.249$) than either single-predictor model reported in our companion analyses (CRN-only pseudo- $R^2=.193$; lifestyle-only pseudo- $R^2=.167$), consistent with the two factors contributing non-redundant explanatory power. CRN showed an independent, statistically significant association with severe/worst pain after adjustment for lifestyle: each one-category increase in CRN was associated with 79% higher odds of severe/worst pain (AOR=1.79, 95% CI 1.11–2.90, $p=.018$). Physical activity lifestyle showed an independent

inverse association with severe/worst pain after adjustment for CRN: each one-step increase in activity level lowered the odds of severe/worst pain by 77% (AOR=0.23, 95% CI 0.075–0.686, $p=.009$). The combined gout/spondylosis category carried markedly higher odds than OA (AOR=21.83, 95% CI 1.83–260.93, $p=.015$), though this estimate is imprecise given the small subgroup ($n=20$); RA did not differ significantly from OA. Age, gender, education, monthly income, and proportion of income spent on treatment were not independently significant once both focal predictors were included.

Table 2. Combined Multivariable Logistic Regression for Severe/Worst Pain (N = 128)

Predictor	AOR	95% CI	p
Cost-related non-adherence (per category)	1.79	1.11–2.90	.018*
Physical activity lifestyle (per category)	0.23	0.075–0.686	.009*
Age band (per category)	1.31	0.81–2.11	.266
Gender (female vs. male)	1.76	0.61–5.06	.293
Education (per category)	1.12	0.63–2.00	.700
Monthly income band (per category)	1.10	0.86–1.41	.450
Income proportion on treatment (per category)	1.38	0.85–2.24	.194
Arthritis diagnosis: gout/spondylosis vs. OA	21.83	1.83–260.93	.015*
Arthritis diagnosis: RA vs. OA	0.73	0.24–2.18	.571

* $p<.05$. AOR = adjusted odds ratio; outcome = severe/worst pain (≥ 7) vs. mild/moderate (0–6). Diagnosis dummy-coded (ref: OA); gout/spondylosis combined owing to small spondylosis subgroup. Model χ^2 $p<.0001$; pseudo- $R^2=.249$.

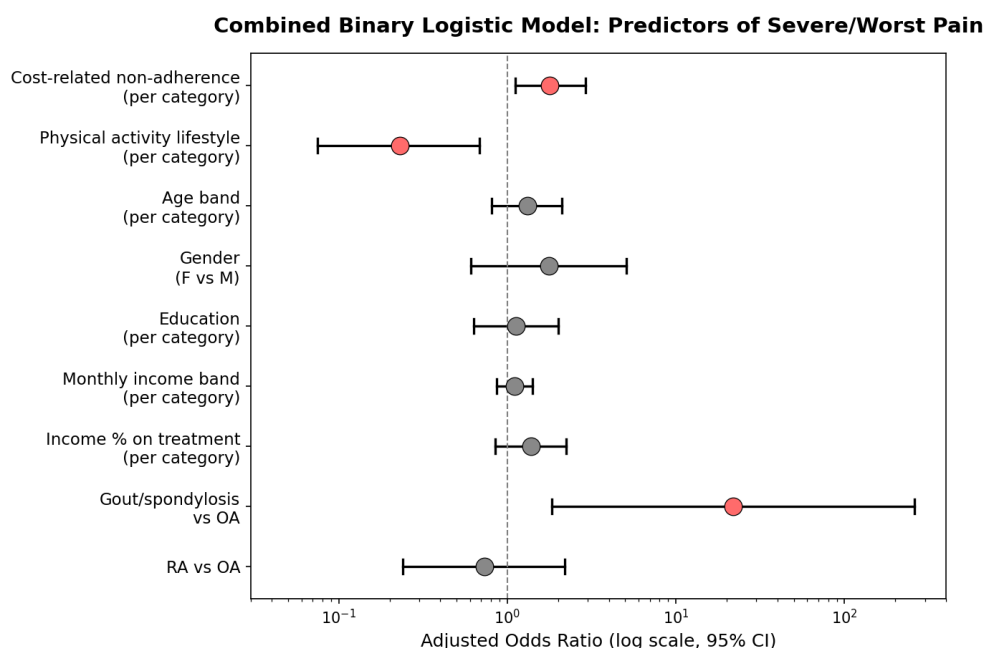


Figure 5. Adjusted odds ratios (95% CI), combined binary logistic model (cf. Table 2). Red markers denote $p<.05$.

Ordinal Robustness Check

A secondary ordinal logistic regression on the full four-band pain outcome (mild/moderate/severe/worst) showed physical activity lifestyle remained robust across the entire ordinal range (coefficient= -1.00 , $p=.006$), whereas CRN did not reach significance in this model (coefficient= 0.10 , $p=.578$). This pattern is consistent with the bivariate data (Figure 3): CRN's effect is concentrated specifically at the threshold between moderate and severe/worst pain — patients for whom cost affects adherence “a lot” cluster disproportionately in the severe category rather than being spread proportionally across all four bands — whereas lifestyle shows a smoother, graded association across the full severity spectrum. We therefore treat the binary model (Table 2), built around a clinically meaningful ≥ 7 cut-point, as the primary analysis, and note the differing functional form as a substantive finding in its own right rather than a modelling inconsistency.

DISCUSSION

When modelled together, cost-related non-adherence and physical activity lifestyle each remained independently and significantly associated with severe/worst pain, and the two were not significantly correlated with one another ($\rho=-.065$, $p=.469$). This is the central contribution of this analysis: the mutually adjusted associations, together with the absence of a detectable bivariate correlation, make it less plausible that either factor's association with pain was wholly attributable to the other acting as a proxy (for example, poorer patients being both less able to afford medication and less able to engage in leisure-time activity because of long working hours), although residual and unmeasured confounding cannot be excluded in an observational, cross-sectional design. Instead, the data are consistent with a picture in which financial access to treatment and habitual physical activity contribute separately to pain severity, each potentially warranting its own intervention; confirming a causal, rather than associational, basis for this would require longitudinal or interventional data. This finding is consistent with, and extends, separate international literatures on CRN^{3,4} and on physical activity^{5,6,7} in arthritis, neither of which has previously tested whether the two operate independently of one another.

The markedly higher explanatory power of the combined model (pseudo- $R^2=.249$) relative to either single-predictor model (.193 and .167) is itself informative: it indicates that CRN and lifestyle capture different portions of the variance in pain severity, reinforcing the non-redundancy finding from the correlation analysis. The differing functional form uncovered in the ordinal robustness check — lifestyle remaining significant as a graded factor across the full pain spectrum, versus CRN losing significance once the outcome was modelled ordinally rather than at the single severe/worst cut-point — should be interpreted cautiously, since it could reflect a genuine difference in how these factors relate to pain across its full range, reduced statistical power in the ordinal model, or sensitivity of CRN's effect to how the outcome is categorised, and we cannot adjudicate between these explanations with the present data. One tentative, hypothesis-generating interpretation is that lifestyle may act as a graded, dose-response factor across the pain spectrum, whereas CRN's association may be concentrated closer to the boundary into severe/worst pain; any underlying mechanism (e.g., cumulative effects on joint stability, inflammation, and central pain modulation for lifestyle, versus a cost-barrier threshold effect for CRN) is speculative and would need to be tested directly in future studies rather than inferred from this pattern alone.

Contribution to knowledge: this is, to our knowledge, the first study to jointly model cost-related non-adherence and physical activity lifestyle as simultaneous correlates of arthritis pain severity in any setting, showing that both are independently and non-redundantly associated with pain severity and that, together, they explain more variance than either alone. It also directly addresses a limitation common to single-predictor arthritis pain studies — including our own companion analyses of each factor in isolation — by reducing, though not eliminating, the likelihood that either factor's association with pain reflected mutual confounding by the other, two of the most commonly cited modifiable risk factors in the literature.

Limitations: the cross-sectional design precludes causal inference in either direction (e.g., severe pain could plausibly reduce both adherence and activity, rather than the reverse). CRN and lifestyle were measured with brief, single-item, interviewer-administered measures adapted from established surveillance/screening precedent^{8,9} rather than multi-item instruments such as MMAS-8 or IPAQ; the adaptation and interviewer-administered delivery mean these items' local reliability (e.g., inter-rater consistency) and validity have not been separately established, and social-desirability or interviewer-related bias cannot be excluded. The combined

gout/spondylosis subgroup (n=20) yielded an imprecise diagnosis effect estimate. The hospital-based sample limits generalisability, and disease duration, DAS28 scores, comorbidity, and BMI were not captured.

CONCLUSION AND RECOMMENDATIONS

Cost-related non-adherence and sedentary lifestyle are independently and non-redundantly associated with pain severity among arthritis patients in this Niger Delta tertiary hospital population, both modifiable factors of clear clinical and policy relevance. Because the two were uncorrelated in this sample, neither a purely financial nor a purely behavioural intervention alone is likely, on current evidence, to be sufficient; both plausibly need to be addressed in parallel to meaningfully reduce pain burden, though the cross-sectional design means this should be confirmed by future longitudinal or interventional studies before firm causal conclusions are drawn.

1. Clinics should routinely screen for both cost-related non-adherence and physical activity lifestyle at every visit, since a patient may be at risk from either, both, or neither factor.
2. Health insurance coverage (including the National Health Insurance Authority scheme) should be expanded to include arthritis medicines, addressing the financial-access pathway directly.
3. Structured, supervised exercise-referral pathways should be piloted for arthritis patients in Niger Delta tertiary hospitals, addressing the behavioural-activity pathway in parallel rather than as an alternative.
4. Because the two risk factors were not correlated and each remained independently associated with pain severity after adjustment, interventions targeting only one (e.g., a medication subsidy alone, or an exercise programme alone) should not be assumed to also resolve the other.
5. Future prospective, multi-centre studies should jointly model additional modifiable factors (e.g., disease duration, comorbidity, BMI) alongside CRN and lifestyle using validated instruments (MMAS-8, IPAQ) to refine these effect estimates.

Conflict of Interest

The authors declare that they have no conflict of interest, financial or otherwise, in relation to the research, authorship, and/or publication of this article.

REFERENCES

1. Usenbo A, Kramer V, Young T, Musekiwa A. Prevalence of arthritis in Africa: a systematic review and meta-analysis. *PLoS ONE*. 2015;10(8):e0133858.
2. Adelowo OO, Olaosebikan BH, Wright KO, Sunday OO, Adediji OA. Epidemiology of rheumatic and musculoskeletal diseases in a Nigerian peri-urban community: COPCORD stage 1 model. *Reumatologia*. 2022;60(6):366–375.
3. Pasma A, Schenk C, Timman R, et al. Does non-adherence to DMARDs influence hospital-related healthcare costs for early arthritis in the first year of treatment? *PLoS ONE*. 2017;12(2):e0171070.
4. Economics of non-adherence to biologic therapies in rheumatoid arthritis [Review]. *PubMed PMID*: 25227187.
5. Metsios GS, Kitas GD. Physical activity, exercise and rheumatoid arthritis: effectiveness, mechanisms and implementation. *Best Pract Res Clin Rheumatol*. 2018;32(5):669–682.
6. Rausch Osthoff AC, Niedermann K, Braun J, et al. 2018 EULAR recommendations for physical activity in people with inflammatory arthritis and osteoarthritis. *Ann Rheum Dis*. 2018;77:1251–1260.
7. Physical activity of older patients with rheumatoid arthritis [Review]. *PMC12198336*; 2025.
8. Kennedy J. Using cost-related medication nonadherence to assess social and health policies. *Am J Public Health*. 2018;108(2):200–202.
9. Coleman KJ, Ngor E, Reynolds K, et al. Initial validation of an exercise “vital sign” in electronic medical records. *Med Sci Sports Exerc*. 2012;44(11):2071–2076. See also: Kuntz JL, Young DR, Saelens BE, et al. Validity of the exercise vital sign tool to assess physical activity. *Am J Prev Med*. 2021.

10. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: VAS Pain, NRS Pain, McGill Pain Questionnaire, SF-MPQ, CPGS, SF-36 BPS, and ICOAP. *Arthritis Care Res (Hoboken)*. 2011;63(Suppl 11):S240–S252.
11. Ipingbemi AE, Erhun WO, Adisa R. Pharmacist-led intervention in treatment non-adherence and associated direct costs among ambulatory type 2 diabetes patients in southwestern Nigeria. *BMC Health Serv Res*. 2021;21:988.
12. Effects of lifestyle physical activity and sedentary behaviour interventions on disease activity and health outcomes in rheumatoid arthritis: a systematic review with meta-analysis. *BMC Rheumatol*. 2023.
13. Within-person pain variability and physical activity in older adults with osteoarthritis from six European countries. *Arthritis Res Ther*. 2019;21:16.
14. Biologic DMARD access and medication cost-related nonadherence in rheumatology patients in Canada: a cross-sectional survey. *medRxiv [Preprint]*. 2023.01.20.23284839.
15. Centers for Disease Control and Prevention (CDC). About Physical Activity and Arthritis. Atlanta: CDC; 2025.