

Supplementary material

Change in different classes of chronic back pain suspicious of axial spondyloarthritis: a latent transition analysis of the SPACE cohort

Supplementary Table S1. Classes of participants with chronic back pain suspicious of axial Spondyloarthritis identified in the latent class analysis model including HLA-B27 status at baseline (n=702)

	Class 1 'axial' (p*=0.20, N†=140)	Class 2 'IBP + peripheral' (p*=0.10, N†=70)	Class 3 'at risk' (p*=0.35, N†=246)	Class 4 'no SpA' (p*=0.35, N†=246)
Sacroiliitis on MRI-SIJ (ASAS)	0.68	0.15	0.05	0.05
BME on MRI-Spine (≥5 lesions)	0.08	0.02	0.00	0.00
Definitive damage on X-SIJ (mNY)	0.12	0.00	0.00	0.02
≥1 syndesmophyte on X-Spine	0.04	0.18	0.10	0.08
Elevated CRP (>5mg/l)	0.48	0.37	0.15	0.23
Good response to NSAID ever	0.45	0.56	0.40	0.17
Peripheral arthritis ever	0.17	0.68	0.01	0.10
Dactylitis ever	0.05	0.36	0.00	0.03
Heel pain ever	0.12	0.83	0.20	0.06
Family history of SpA	0.48	0.50	0.61	0.22
HLA-B27 positivity	0.91	0.47	0.56	0.00
Psoriasis ever	0.10	0.44	0.06	0.09
Uveitis ever	0.14	0.09	0.11	0.00
Inflammatory bowel disease ever	0.01	0.11	0.04	0.12
Inflammatory back pain ever	0.74	1.00	0.77	0.48

ASAS, Assessment of SpondyloArthritis international Society; BME, bone marrow edema; CRP, C-reactive protein; MRI, magnetic resonance imaging; mNY, modified New York criteria; NSAID, non-steroidal anti-inflammatory drug; SIJ, sacroiliac joints; X-SIJ, radiograph of the sacroiliac joints; X-Spine, radiograph of the spine

Conditional probabilities (i.e. the probability of a feature being present in one of the classes, range: 0-1) were obtained using a latent class analysis model with full invariance on baseline data.

*Marginal probability of the latent class (i.e. a participant's probability of class membership)

†Participants categorized to one of the classes based on their posterior probability of class membership (with the class having the highest probability for each patient determining their assignment).

Cells are coloured in green whenever the conditional probability is ≥ 0.3. This cut-off was chosen to better visualize differences between the classes.

Supplementary Table S2. Classes of participants with chronic back pain suspicious of axial Spondyloarthritis identified in the latent class analysis model including HLA-B27 status at follow-up (n=702)

	Class 1 'axial' (p[*]=0.34, N[†]=239)	Class 2 'IBP + peripheral' (p[*]=0.10, N[†]=70)	Class 3 'at risk' (p[*]=0.21, N[†]=147)	Class 4 'no SpA' (p[*]=0.35, N[†]=246)
Sacroiliitis on MRI-SIJ (ASAS)	0.51	0.41	0.17	0.04
BME on MRI-Spine (≥5 lesions)	0.05	0.01	0.02	0.00
Definitive damage on X-SIJ (mNY)	0.12	0.03	0.00	0.02
≥1 syndesmophyte on X-Spine	0.08	0.19	0.19	0.09
Elevated CRP (≥5mg/l)	0.43	0.62	0.33	0.27
Good response to NSAID ever	0.68	0.92	0.89	0.22
Peripheral arthritis ever	0.08	0.88	0.13	0.07
Dactylitis ever	0.04	0.66	0.05	0.02
Heel pain ever	0.17	0.75	0.44	0.04
Family history of SpA	0.63	0.52	0.55	0.27
HLA-B27 positivity	0.96	0.66	0.24	0.06
Psoriasis ever	0.08	0.50	0.20	0.06
Uveitis ever	0.22	0.18	0.06	0.02
Inflammatory bowel disease ever	0.01	0.07	0.14	0.09
Inflammatory back pain ever	0.87	0.92	1.00	0.52

ASAS, Assessment of SpondyloArthritis international Society; BME, bone marrow edema; CRP, C-reactive protein; MRI, magnetic resonance imaging; mNY, modified New York criteria; NSAID, non-steroidal anti-inflammatory drug; SIJ, sacroiliac joints; X-SIJ, radiograph of the sacroiliac joints; X-Spine, radiograph of the spine

Conditional probabilities (i.e. the probability of a feature being present in one of the classes, range: 0-1) were obtained using a latent class analysis model on 2-year follow-up data.

*Marginal probability of the latent class (i.e. a participant's probability of class membership)

†Participants categorized to one of the classes based on their posterior probability of class membership (with the class having the highest probability for each patient determining their assignment).

Cells are coloured in green whenever the conditional probability is ≥ 0.3. This cut-off was chosen to better visualize differences between the classes.

Supplementary Table S3. Classes of participants with chronic back pain suspicious of axial Spondyloarthritis identified in the latent class analysis model excluding HLA-B27 status at baseline (n=702)

	Class 1 'axial' (p*=0.14, N†=98)	Class 2 'IBP + peripheral' (p*=0.09, N†=63)	Class 3 'at risk' (p*=0.25, N†=176)	Class 4 'no SpA' (p*=0.52, N†=365)
Sacroiliitis on MRI-SIJ (ASAS)	0.63	0.20	0.11	0.10
BME on MRI-Spine (≥5 lesions)	0.12	0.01	0.00	0.00
Definitive damage on X-SIJ (mNY)	0.20	0.00	0.01	0.00
≥1 syndesmophyte on X-Spine	0.05	0.17	0.14	0.07
Elevated CRP (>5mg/l)	0.56	0.46	0.13	0.21
Good response to NSAID ever	0.56	0.47	0.64	0.13
Peripheral arthritis ever	0.14	0.82	0.07	0.06
Dactylitis ever	0.05	0.48	0.00	0.01
Heel pain ever	0.10	0.76	0.35	0.07
Family history of SpA	0.42	0.47	0.53	0.40
Psoriasis ever	0.14	0.44	0.13	0.05
Uveitis ever	0.13	0.08	0.15	0.03
Inflammatory bowel disease ever	0.02	0.12	0.04	0.08
Inflammatory back pain ever	0.70	0.92	0.97	0.52

ASAS, Assessment of SpondyloArthritis international Society; BME, bone marrow edema; CRP, C-reactive protein; MRI, magnetic resonance imaging; mNY, modified New York criteria; NSAID, non-steroidal anti-inflammatory drug; SIJ, sacroiliac joints; X-SIJ, radiograph of the sacroiliac joints; X-Spine, radiograph of the spine

Conditional probabilities (i.e. the probability of a feature being present in one of the classes, range: 0-1) were obtained using a latent class analysis model on baseline data.

*Marginal probability of the latent class (i.e. a participant's probability of class membership)

†Participants categorized to one of the classes based on their posterior probability of class membership (with the class having the highest probability for each patient determining their assignment).

Cells are coloured in green whenever the conditional probability is ≥ 0.3. This cut-off was chosen to better visualize differences between the classes.

Supplementary Table S4. Classes of participants with chronic back pain suspicious of axial Spondyloarthritis identified in the latent class analysis model excluding HLA-B27 status at follow-up (n=702)

	Class 1 'axial' (p[*]=0.09, N[†]=63)	Class 2 'IBP + peripheral' (p[*]=0.11, N[†]=77)	Class 3 'at risk' (p[*]=0.52, N[†]=365)	Class 4 'no SpA' (p[*]=0.28, N[†]=197)
Sacroiliitis on MRI-SIJ (ASAS)	1.00	0.38	0.24	0.02
BME on MRI-Spine (≥5 lesions)	0.21	0.01	0.00	0.01
Definitive damage on X-SIJ (mNY)	0.34	0.04	0.02	0.02
≥1 syndesmophyte on X-Spine	0.15	0.19	0.12	0.07
Elevated CRP (≥5mg/l)	0.84	0.58	0.32	0.25
Good response to NSAID ever	0.92	0.93	0.69	0.18
Peripheral arthritis ever	0.05	0.84	0.08	0.09
Dactylitis ever	0.06	0.59	0.03	0.03
Heel pain ever	0.09	0.76	0.28	0.03
Family history of SpA	0.45	0.52	0.58	0.28
Psoriasis ever	0.14	0.47	0.11	0.06
Uveitis ever	0.14	0.17	0.14	0.02
Inflammatory bowel disease ever	0.03	0.08	0.08	0.08
Inflammatory back pain ever	0.88	0.94	0.92	0.44

ASAS, Assessment of SpondyloArthritis international Society; BME, bone marrow edema; CRP, C-reactive protein; MRI, magnetic resonance imaging; mNY, modified New York criteria; NSAID, non-steroidal anti-inflammatory drug; SIJ, sacroiliac joints; X-SIJ, radiograph of the sacroiliac joints; X-Spine, radiograph of the spine

Conditional probabilities (i.e. the probability of a feature being present in one of the classes, range: 0-1) were obtained using a latent class analysis model on 2-year follow-up data.

*Marginal probability of the latent class (i.e. a participant's probability of class membership)

†Participants categorized to one of the classes based on their posterior probability of class membership (with the class having the highest probability for each patient determining their assignment).

Cells are coloured in green whenever the conditional probability is ≥ 0.3. This cut-off was chosen to better visualize differences between the classes.

Supplementary Table S5. Goodness of fit of the latent class analysis (LCA) models with HLA-B27 status at baseline

	Parameters	LL	AIC	BIC	aBIC	Entropy	p value
2-class	31	-4330.968	8723.935	8865.107	8766.676	0.521	0.0159
3-class	47	-4239.466	8572.932	8786.967	8637.732	0.699	0.0133
4-class	63	-4206.308	8538.615	8825.513	8625.475	0.657	0.1050
5-class	79	-4174.918	8507.836	8867.597	8616.755	0.727	0.0741

aBIC, sample size adjusted Bayesian information criterion; AIC, Akaike information criterion; BIC, Bayesian information criterion; LL, log-likelihood.

Bold, highlights the final model selected.

The p-value is given for the Lo-Mendell-Rubin adjusted likelihood ratio test, which compares the model with the model with n-1 classes (p<0.05 means that the model fits the data better than the n-1 classes model)

Supplementary Table S6. Goodness of fit of the latent class analysis (LCA) models with HLA-B27 status at 2-year follow-up

	Parameters	LL	AIC	BIC	aBIC	Entropy	p value
2-class	31	-4570.029	9202.057	9343.229	9244.797	0.655	0.0000
3-class	47	-4474.989	9043.979	9258.014	9108.779	0.690	0.0022
4-class	63	-4428.606	8983.211	9270.109	9070.071	0.731	0.0015
5-class	79	-4387.325	8932.650	9292.411	9041.570	0.775	0.0348

aBIC, sample size adjusted Bayesian information criterion; AIC, Akaike information criterion; BIC, Bayesian information criterion; LL, log-likelihood.

Bold, highlights the final model selected.

The p-value is given for the Lo-Mendell-Rubin adjusted likelihood ratio test, which compares the model with the model with n-1 classes (p<0.05 means that the model fits the data better than the n-1 classes model)

Supplementary Table S7. Goodness of fit of the latent class analysis (LCA) models without HLA-B27 status at baseline

	Parameters	LL	AIC	BIC	aBIC	Entropy	p value
2-class	29	-3865.706	7789.412	7921.476	7829.395	0.778	0.0000
3-class	44	-3819.028	7726.057	7926.430	7786.721	0.649	0.0268
4-class	59	-3788.712	7695.424	7964.107	7776.769	0.603	0.0199
5-class	74	-3771.696	7691.392	8028.383	7793.418	0.669	0.4468

aBIC, sample size adjusted Bayesian information criterion; AIC, Akaike information criterion; BIC, Bayesian information criterion; LL, log-likelihood.

Bold, highlights the final model selected.

The p-value is given for the Lo-Mendell-Rubin adjusted likelihood ratio test, which compares the model with the model with n-1 classes (p<0.05 means that the model fits the data better than the n-1 classes model)

Supplementary Table S8. Goodness of fit of the latent class models without HLA-B27 status at 2-year follow-up

	Parameters	LL	AIC	BIC	aBIC	Entropy	p value
2-class	29	-4137.202	8332.403	8464.467	8372.386	0.594	0.0021
3-class	44	-4068.307	8224.614	8424.987	8285.278	0.697	0.0000
4-class	59	-4026.086	8170.172	8438.854	8251.517	0.696	0.3571
5-class	74	-4007.820	8163.639	8500.631	8265.665	0.743	0.1150

aBIC, sample size adjusted Bayesian information criterion; AIC, Akaike information criterion; BIC, Bayesian information criterion; LL, log-likelihood.

Bold, highlights the final model selected.

The p-value is given for the Lo-Mendell-Rubin adjusted likelihood ratio test, which compares the model with the model with n-1 classes (p<0.05 means that the model fits the data better than the n-1 classes model)

Supplementary Table S9. Goodness of fit of the 4-4 latent transition analysis (LTA) model (n=702)

	Parameters	LL	AIC	BIC	aBIC	Entropy
2-class	31	-7836.760	15735.52	15876.69	15778.26	0.902
3-class	50	-7520.651	15141.30	15369.00	15210.24	0.962
4-class	71	-7271.991	14685.98	15009.31	14783.87	0.969
5-class	94	-7099.051	14386.10	14814.17	14515.70	0.975

aBIC, sample size adjusted Bayesian information criterion; AIC, Akaike information criterion; BIC, Bayesian information criterion; LL, log-likelihood.

Bold, highlights the final model selected.

Supplementary Table S10. Goodness of fit of the 4-4 latent transition analysis (LTA) model in the population with complete follow-up (n=384)

	Parameters	LL	AIC	BIC	aBIC	Entropy
2-class	31	-4460.800	8983.601	9106.071	9007.712	0.946
3-class	50	-4282.948	8665.897	8863.429	8704.786	0.953
4-class	71	-4161.883	8465.766	8746.262	8520.989	0.972
5-class	94	-4074.762	8337.523	8708.884	8410.635	0.979

aBIC, sample size adjusted Bayesian information criterion; AIC, Akaike information criterion; BIC, Bayesian information criterion; LL, log-likelihood.

Bold, highlights the final model selected.

Supplementary Table S11. Observed baseline characteristics per latent class in the population with complete follow-up (n=384) after data imputation

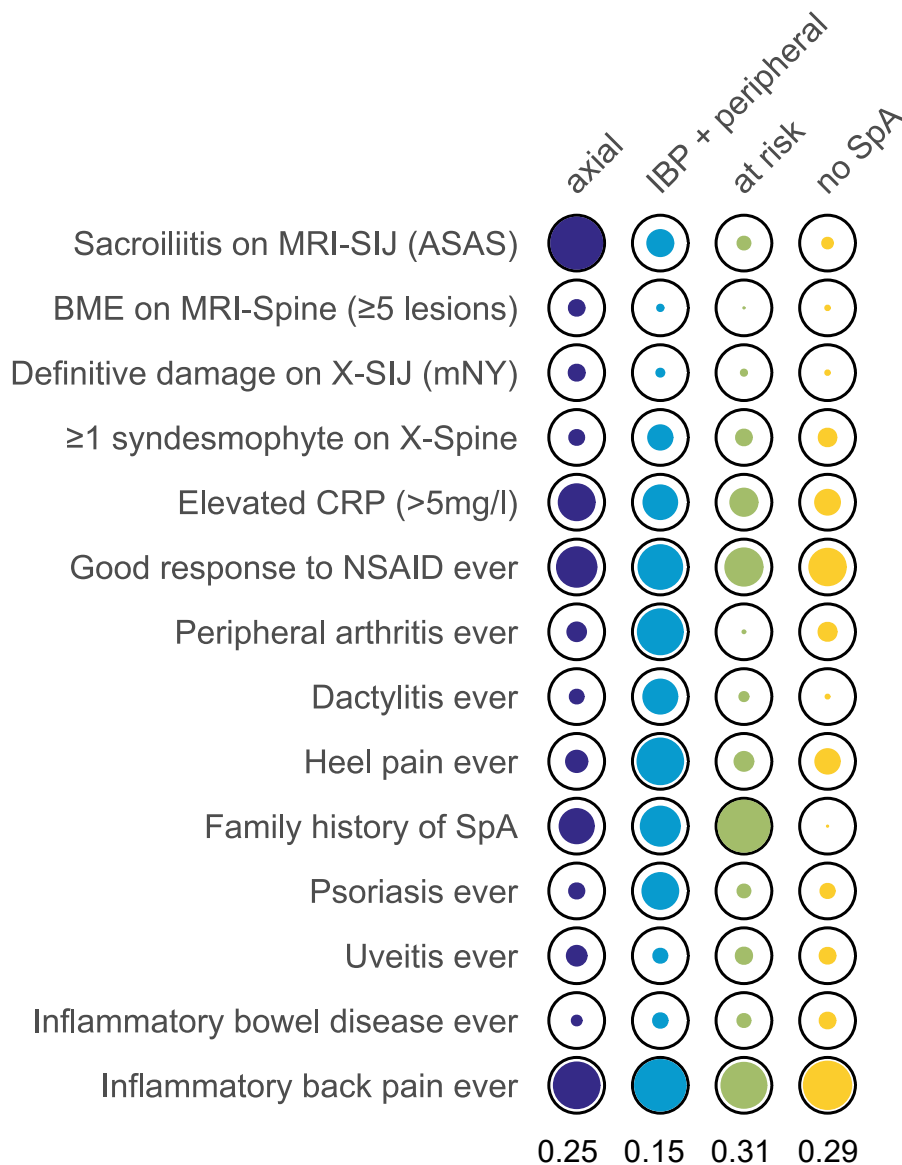
Characteristic	Class 1 'axial' (n=97, 25%)	Class 2 'IBP + peripheral' (n=58, 15%)	Class 3 'at risk' (n=119, 31%)	Class 4 'no SpA' (n=110, 29%)
Age, years	29 (7)	31 (8)	30 (8)	31 (8)
Male	57 (59%)	28 (48%)	37 (31%)	45 (41%)
Body mass index (kg/m ²)	24 (4)	25 (5)	24 (4)	25 (5)
Duration of back pain (months)	14 (7)	12 (6)	13 (7)	14 (7)
Imaging features of SpA				
Sacroiliitis on MRI-SIJ (ASAS)	97 (100%)	10 (17%)	0 (0%)	0 (0%)
Definitive damage on X-SIJ (mNY)	7 (7%)	1 (2%)	2 (2%)	1 (1%)
BME on MRI-Spine (≥5 lesions)	9 (9%)	1 (2%)	0 (0%)	1 (1%)
≥1 syndesmophyte on X-Spine	7 (7%)	12 (21%)	9 (8%)	12 (11%)
Clinical features of SpA				
Peripheral arthritis ever	11 (11%)	45 (78%)	0 (0%)	11 (10%)
Dactylitis ever	5 (5%)	22 (38%)	1 (1%)	0 (0%)
Heel pain ever	13 (13%)	46 (79%)	15 (13%)	21 (19%)
Psoriasis ever	8 (8%)	26 (45%)	6 (5%)	8 (7%)
Uveitis ever	12 (12%)	3 (5%)	10 (8%)	10 (9%)
Inflammatory bowel disease ever	4 (4%)	5 (9%)	7 (6%)	9 (8%)
Inflammatory back pain ever	72 (74%)	56 (97%)	82 (69%)	91 (83%)
Elevated CRP (>5mg/l)	39 (40%)	22 (38%)	27 (23%)	21 (19%)
HLA-B27 positive	78 (80%)	29 (50%)	66 (55%)	44 (40%)
Family history of SpA	43 (44%)	32 (55%)	119 (100%)	0 (0%)
Good response to NSAID ever	39 (40%)	30 (52%)	45 (38%)	44 (40%)

ASAS, Assessment of SpondyloArthritis international Society; BME, bone marrow edema; CRP, C-reactive protein; HLA-B27, Human leukocyte antigen B27; MRI, magnetic resonance imaging; mNY, modified New York criteria; NSAID, non-steroidal anti-inflammatory drug; SIJ, sacroiliac joints; X-SIJ, radiograph of the sacroiliac joints; X-Spine, radiograph of the spine

Participants were individually categorized to one of the classes (obtained from the latent transition analysis) based on their posterior probability of class membership (with the class having the highest probability for each patient determining their assignment)

Mean (SD) or n (%)

Data for BMI available for 369 (96%) participants, for Back pain duration for 381 (99%) participants

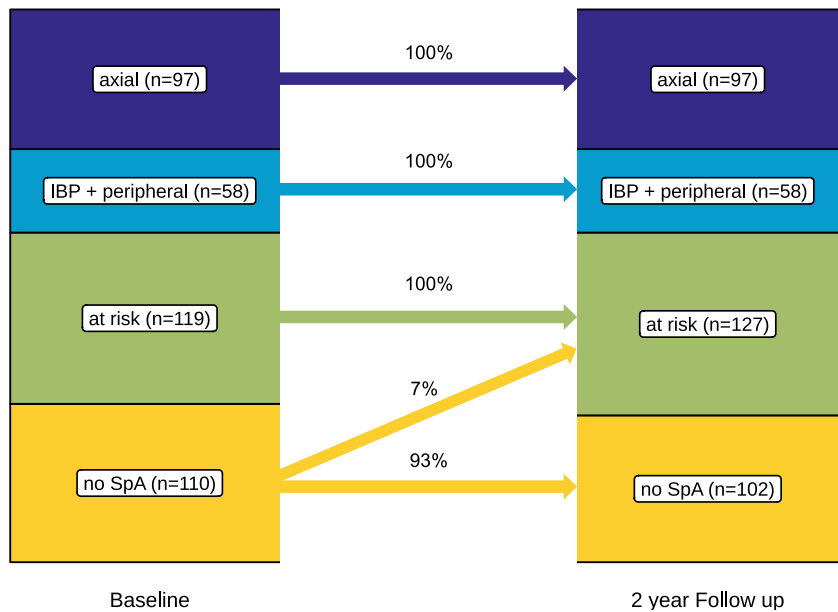


Supplementary Figure S1. Graphical demonstration of the conditional and marginal probabilities of the 2-year latent transition model in the population with complete follow-up (LTA, n=384)

ASAS, Assessment of SpondyloArthritis international Society; BME, bone marrow edema; CRP, C-reactive protein; IBP, inflammatory back pain; MRI, magnetic resonance imaging; mNY, modified New York criteria; NSAID, non-steroidal anti-inflammatory drug; SIJ, sacroiliac joints; SpA, spondyloarthritis; X-SIJ, radiograph of the sacroiliac joints; X-Spine, radiograph of the spine

The circles represent the conditional probability for a feature in a respective class, with a higher probability corresponding to a fuller circle. A full circle represents 100% and an empty circle 0% probability. The colors represent the four classes. The numerical values for conditional and marginal probabilities are reported in table 4 in the main manuscript.

The numbers in the last row represent the marginal probabilities i.e. the percentage of participants that according to the LTA belong to one of the classes.



Supplementary Figure S2. Diagram showing class change over 2 years according to transitional probabilities (LTA analysis) in the population with complete follow-up.

IBP, inflammatory back pain; SpA, spondyloarthritis

Transitional probabilities were generated using the 4-class latent transition model with 384 patients.