**Supporting information**

**Table S1.** Vitamin A and RBP4 levels in different phenotype characteristics of UC patients

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Group** | **Vitamin A (mg/L)** | ***P vitamin A*** | **RBP4 (ng/mL)** | ***P RBP4*** |
| **Disease duration (years)** |  |  |  |  |
| ≤3 (n=49) | 0.244 ± 0.065 | 0.121 | 133.21 (110.36-142.16) | 0.143 |
| ＞3 (n=54) | 0.221 ± 0.084 | 103.42 (57.63-154.4) |
| **Disease severity** |  |  |  |  |
| Mild (n=22) | 0.25 (0.22-0.28) | 2e-06 | 137.88 (131.09-142.15) | 1.06e-07 |
| Moderate (n=45) | 0.26 (0.22-0.32) | 130.66 (100.72-161.94) |
| Severe (n=36) | 0.17 (0.13-0.22) | 61.3 (46.84-106.4) |
| **Therapy** |  |  |  |  |
| 5-ASA (n=33) | 0.26 (0.22-0.29) | 0.0045 | 134.36 (127.66-142.16) | 0.0541 |
| 5-ASA+Corticosteroids (n=46) | 0.2383 ± 0.0902 | 113.24 (60.21-150.05) |
| 5-ASA+Immunosuppressants (n=24) | 0.1892 ± 0.0743 | 81.09 (55.96-115.18) |

Abbreviations: UC, Ulcerative Colitis; 5-ASA, 5-aminosalicylate

**Table S2.** Gender-specific analysis of vitamin A and RBP4 levels across different disease severity groups

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Disease Severity** | **Gender** | **Vitamin A (mg/L）** | ***P*vitamin A** | **RBP4 (ng/mL)** | ***P*RBP4** |
| Mild | Male (n=7) | 0.23 ± 0.03 | 0.12 | 135.88 ± 4.06 | 0.2926 |
| Female (n=15) | 0.27± 0.07 | 140.58 (101.22-155.28) |
| Moderate | Male (n=14) | 0.29 ± 0.1 | 0.1835 | 145.57 ± 50.51 | 0.8733 |
| Female (n=31) | 0.26 ± 0.07 | 140.58 (101.22-155.28) |
| Severe | Male (n=13) | 0.18 ± 0.05 | 0.765 | 86.73 ± 36.72 | 0.3396 |
| Female (n=23) | 0.18 ± 0.09 | 51.84 (44.42-103.16) |

**Table S3** Multivariable analysis of factors associated with disease severity

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Coefficient** | **Std. Error** | **z-value** | ***P*-value** | **95% CI** |
| Vitamin A | -14.7991 | 18.785 | -0.788 | 0.431 | [-51.617, 22.019] |
| RBP4 | 0.026 | 0.026 | 1.014 | 0.311 | [-0.024, 0.076] |
| Age | 0.0037 | 0.048 | 0.077 | 0.938 | [-0.090, 0.098] |
| Gender | 2.1198 | 1.742 | 1.217 | 0.224 | [-1.294, 5.534] |
| BMI | 0.3207 | 0.652 | 0.492 | 0.623 | [-0.957, 1.598] |
| ESR | 1.0514 | 0.416 | 2.528 | 0.011 | [0.236, 1.866] |
| CRP | -3.3437 | 4.187 | -0.799 | 0.425 | [-11.551, 4.863] |
| SII | -0.0028 | 0.008 | -0.331 | 0.74 | [-0.019, 0.014] |
| NLR | 3.5438 | 1.737 | 2.04 | **0.041** | [0.139, 6.948] |
| PLR | -0.0355 | 0.064 | -0.559 | 0.576 | [-0.160, 0.089] |
| MLR | 5.178 | 4.364 | 1.187 | 0.235 | [-3.374, 13.730] |
| NAR | -25.8188 | 29.891 | -0.864 | 0.388 | [-84.405, 32.767] |
| LCR | 1.6602 | 1.105 | 1.502 | 0.133 | [-0.506, 3.827] |
| CAR | 114.0836 | 117.173 | 0.974 | 0.33 | [-115.572, 343.739] |

Abbreviations: UC, Ulcerative Colitis; CRP, C-reactive protein; ESR, Erythrocyte sedimentation rate; CAR, C-Reactive Protein-to-Albumin Ratio; MLR, Monocyte-to-Lymphocyte Ratio. P <0.05 was considered statistically significant.

**Table S4 Multivariable logistic regression analysis of vitamin A and RBP4 with adjusted covariates**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Estimate** | **OR** | **Std. Error** | **z-value** | ***P*-value** | **95% CI** |
| **Model 1: Adjusted for MLR** | | | | | | |
| (Intercept) | 3.738 | 42.012 | 1.129 | 3.312 | 0.001 | [5.316,462.264] |
| Vitamin A | -5.319 | 0.005 | 3.983 | -1.335 | 0.182 | [1.388e-06,10.023] |
| RBP4 | -0.003 | 0.997 | 0.005 | -0.621 | 0.535 | [0.988,1.007] |
| MLR | -1.551 | 0.212 | 0.843 | -1.841 | 0.066 | [3.902e-02,1.132] |
| **Model 2: Adjusted for PLR** | | | | | | |
| (Intercept) | 2.715 | 15.106 | 0.882 | 3.080 | 0.002 | [2.901,94.403] |
| Vitamin A | -3.347 | 0.035 | 3.637 | -0.920 | 0.357 | [2.239e-05,41.201] |
| RBP4 | -0.003 | 0.997 | 0.005 | -0.591 | 0.555 | [0.988,1.007] |
| PLR | -0.001 | 0.999 | 0.001 | -0.748 | 0.455 | [0.997,1.002] |
| **Model 3: Adjusted for Age** | | | | | | |
| (Intercept) | 3.018 | 20.443 | 1.05 | 2.876 | 0.004 | [2.847,180.233] |
| Vitamin A | -2.546 | 0.078 | 3.642 | -0.700 | 0.485 | [5.043e-05,94.334] |
| RBP4 | -0.004 | 0.996 | 0.005 | -0.803 | 0.422 | [0.987,1.006] |
| Age | -0.016 | 0.985 | 0.018 | -0.875 | 0.381 | [0.951,9.508e-01] |
| **Model 4: Adjusted for BMI** | | | | | | |
| (Intercept) | -2.643 | 0.071 | 6.193 | -0.427 | 0.670 | [2.111e-07,9614.103] |
| Vitamin A | -3.423 | 0.033 | 3.642 | -0.940 | 0.347 | [2.065e-05,38.707] |
| RBP4 | -0.002 | 0.998 | 0.005 | -0.534 | 0.594 | [0.989,1.007] |
| BMI | 0.229 | 1.258 | 0.279 | 0.824 | 0.410 | [0.742,2.238] |
| **Model 5: Adjusted for CAR** | | | | | | |
| (Intercept) | 3.085 | 21.878 | 1.068 | 2.890 | 0.004 | [2.962,201.460] |
| Vitamin A | -4.698 | 0.009 | 3.992 | -1.177 | 0.239 | [2.791e-06,21.190] |
| RBP4 | -0.003 | 0.997 | 0.005 | -0.663 | 0.508 | [0.988,1.007] |
| CAR | -2.753 | 0.064 | 2.861 | -0.962 | 0.336 | [2.570e-04,24.614] |
| **Model 6: Adjusted for CRP** | | | | | | |
| (Intercept) | 3.069 | 21.513 | 1.069 | 2.870 | 0.004 | [2.885,197.290] |
| Vitamin A | -4.597 | 0.01 | 3.969 | -1.158 | 0.247 | [3.228e-06,22.471] |
| RBP4 | -0.003 | 0.997 | 0.005 | -0.664 | 0.506 | [0.988,1.007] |
| CRP | -0.104 | 0.901 | 0.113 | -0.927 | 0.354 | [0.725,1.138] |
| **Model 7: Adjusted for ESR** | | | | | | |
| (Intercept) | -10.834 | 1.972e-05 | 3.365 | -3.22 | 1.282e-03 | [7.562e-09,5.212e-03] |
| Vitamin A | 4.195 | 66.35 | 5.939 | 0.706 | 0.48 | [6.614e-04,1.559e+07] |
| RBP4 | 0.019 | 1.019 | 0.010 | 1.923 | 0.054 | [1.003,1.043] |
| ESR | 0.366 | 1.442 | 0.092 | 3.981 | **6.857e-05** | [1.245,1.799] |
| **Model 8: Adjusted for Gender** | | | | | | |
| (Intercept) | 2.482 | 11.963 | 0.866 | 2.866 | 0.004 | [2.391,73.523] |
| Vitamin A | -3.122 | 0.044 | 3.596 | -0.868 | 0.385 | [3.112e-05,48.564] |
| RBP4 | -0.003 | 0.997 | 0.005 | -0.620 | 0.535 | [0.988,1.007] |
| Gender | -0.077 | 0.926 | 0.523 | -0.147 | 0.884 | [0.316,2.521] |
| **Model 9: Adjusted for LCR** | | | | | | |
| (Intercept) | 2.915 | 18.44 | 0.886 | 3.288 | 0.001 | [3.649,120.838] |
| Vitamin A | -5.914 | 0.003 | 4.125 | -1.434 | 0.152 | [5.329e-07,6.873] |
| RBP4 | -0.004 | 0.996 | 0.005 | -0.822 | 0.411 | [0.987,1.007] |
| LCR | 0.131 | 1.140 | 0.088 | 1.491 | 0.136 | [0.986,1.402] |
| **Model 10: Adjusted for NAR** | | | | | | |
| (Intercept) | 2.656 | 14.242 | 1.013 | 2.622 | 0.009 | [2.172,119.229] |
| Vitamin A | -3.537 | 0.029 | 3.828 | -0.924 | 0.355 | [0.000,45.629] |
| RBP4 | -0.002 | 0.998 | 0.005 | -0.508 | 0.611 | [0.988,1.008] |
| NAR | -0.873 | 0.418 | 2.369 | -0.369 | 0.712 | [0.005,66.213] |
| **Model 11: Adjusted for NLR** | | | | | | |
| (Intercept) | 2.501 | 12.190 | 0.831 | 3.008 | 0.003 | [2.584,69.080] |
| Vitamin A | -3.161 | 0.042 | 3.613 | -0.875 | 0.382 | [2.857,47.614] |
| RBP4 | -0.003 | 0.997 | 0.005 | -0.590 | 0.555 | [0.988,1.007] |
| NLR | -0.018 | 0.982 | 0.069 | -0.265 | 0.791 | [0.861,1.141] |
| **Model 12: Adjusted for SII** | | | | | | |
| (Intercept) | 2.488 | 12.034 | 0.826 | 3.011 | 0.003 | [2.575,67.372] |
| Vitamin A | -3.174 | 0.042 | 3.619 | -0.877 | 0.381 | [2.773e-05,47.459] |
| RBP4 | -0.003 | 0.997 | 0.005 | -0.595 | 0.552 | [0.988,1.007] |
| SII | -3.68E-05 | 0.999 | 0.0002 | -0.23 | 0.818 | [0.999,1.000] |

Abbreviations: OR, Odds Ratios; CI: Confidence Interval; CRP, C-reactive protein; ESR, Erythrocyte sedimentation rate; SII, Systemic Immune-inflammation Index; NLR, Neutrophil-to-Lymphocyte Ratio; PLR, Platelet-to-Lymphocyte Ratio; NAR, Neutrophil-to-Albumin Ratio; CAR, C-Reactive Protein-to-Albumin Ratio; MLR, Monocyte-to-Lymphocyte Ratio; LCR, Lymphocyte-to-C-Reactive Protein Ratio. *P* <0.05 was considered statistically significant

Table S5 VIF for each variate in multivariable logistic regression models with vitamin A or RBP4 as main variable

|  |  |  |
| --- | --- | --- |
| Exposure or covariate | VIF (Vitamin A as main variable) | VIF (RBP4 as main variable) |
| Vitamin A | 2.719392 | - |
| RBP4 | - | 2.120807 |
| MLR | 1.01394 | 1.01394 |
| PLR | 1.004854 | 1.004854 |
| age | 1.01282 | 1.01282 |
| BMI | 1.022301 | 1.022301 |
| CAR | 1.016112 | 1.016112 |
| CRP | 1.015784 | 1.015784 |
| ESR | 1.655816 | 1.655816 |
| gender | 1.002913 | 1.002913 |
| LCR | 1.020715 | 1.020715 |
| NAR | 1.052455 | 1.052455 |
| NLR | 1.009063 | 1.009063 |
| SII | 1.005024 | 1.005024 |

Abbreviations: VIF, Variance Inflation Factors; MLR, Monocyte-to-Lymphocyte Ratio; PLR, Platelet-to-Lymphocyte Ratio; CAR, C-Reactive Protein-to-Albumin Ratio; CRP, C-reactive protein; ESR, Erythrocyte sedimentation rate; LCR, Lymphocyte-to-C-Reactive Protein Ratio; NAR, Neutrophil-to-Albumin Ratio; NLR, Neutrophil-to-Lymphocyte Ratio; SII, Systemic Immune-inflammation Index.

**Table S6** Multiple linear regression analysis with vitamin A as the dependent variable

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Coefficient** | **Standard Error** | **t-value** | ***P*-value** |
| Constant | 0.1216 | 0.212 | 0.574 | 0.567 |
| BMI | 0.0051 | 0.01 | 0.534 | 0.594 |
| Age | 0.0003 | 0.001 | 0.526 | 0.6 |
| Gender | -0.008 | 0.019 | -0.427 | 0.671 |

**Table S7** Multiple linear regression analysis with RBP4 as the dependent variable

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Coefficient** | **Standard Error** | **t-value** | ***P*-value** |
| Constant | 223.7702 | 152.924 | 1.463 | 0.147 |
| BMI | -3.9886 | 6.900 | -0.578 | 0.565 |
| Age | -0.6240 | 0.453 | -1.378 | 0.171 |
| Gender | 6.1676 | 13.573 | 0.454 | 0.651 |

**Table S8 Firth’s penalized likelihood logistic regression for predictors of differentiating UC and control groups**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Predictor** | **Coefficient (Log Odds)** | **Standard Error** | **95% CI Lower** | **95% CI Upper** | **Chi-squared** | ***P*-value** |
| (Intercept) | 12.91 | 8.6 | -62.31 | 232.22 | 1.89 | 0.1697 |
| Vitamin A | -11.73 | 4.84 | -48.02 | 102.15 | 2.05 | 0.1525 |
| RBP4 | -0.0048 | 0.0115 | -0.2885 | 0.2778 | 0.15 | 0.6965 |
| sex(M) | -0.6307 | 0.91 | -8.49 | 57.54 | 0 | 1 |
| Age | -0.0975 | 0.031 | -0.5654 | -9.00E-04 | 3.92 | 0.0477 |
| BMI | -0.1792 | 0.34 | -9.49 | 4.59 | 0.55 | 0.4563 |
| CRP | 4.81 | 2.64 | -5.05 | 25.29 | 0.05 | 0.8159 |
| ESR | 0.0251 | 0.046 | -0.2692 | 1.03 | 0.5 | 0.4778 |
| SII | 0.0034 | 0.0033 | -0.0199 | 0.0802 | 1.01 | 0.3143 |
| NLR | -2.76 | 1.18 | -28.4 | 0.69 | 3.42 | 0.0646 |
| PLR | 0.0159 | 0.0146 | -0.1687 | 0.2805 | 0 | 1 |
| MLR | -3.96 | 2.16 | -31.82 | 129.65 | 0 | 1 |
| NAR | 31.63 | 12.07 | -5.57 | 251.92 | 2.42 | 0.1195 |
| LCR | 0.0379 | 0.0943 | -7.09 | 1.38 | 0 | 1 |
| CAR | -130 | 65.77 | -630 | 125.83 | 0.67 | 0.4135 |

Abbreviations: CI: Confidence Interval; CRP, C-reactive protein; ESR, Erythrocyte sedimentation rate; SII, Systemic Immune-inflammation Index; NLR, Neutrophil-to-Lymphocyte Ratio; PLR, Platelet-to-Lymphocyte Ratio; NAR, Neutrophil-to-Albumin Ratio; CAR, C-Reactive Protein-to-Albumin Ratio; MLR, Monocyte-to-Lymphocyte Ratio; LCR, Lymphocyte-to-C-Reactive Protein Ratio. *P* <0.05 was considered statistically significant

**Figure S1**. DAG for logistic regression: vitamin A, RBP4, covariates and UC status

DAG

**Figure S2** Expression levels of pro-inflammatory factors in inflamed and non-inflamed UC colon tissues from the GEO Database

分组比较图 