Genomic Signals of Adaptation in the Northern Ural and Western Siberian Populations

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Introduction

Humans adapted to environmental pressures via phenotypic and genetic mechanisms. The genotypes of ten indigenous Siberian populations have been scanned for positive selections with iHS, XP-EHH, and PBS tests [1]. The loci associated with genes involved in energy metabolism, vascular smooth muscle contraction, and DNA damage response against UV radiation were reported. We are interested in studying of the neighboring regions with extreme climate. These regions are home to Udmurts, Mari, Komi, Mansi, Khanty and Nenets people. The genetic variations in these populations are not yet studied appropriately. Their genome-wide data on single nucleotide polymorphisms (SNP) can be useful for searching for genomic «footprints» of natural selection driven by extreme conditions.

Methods

PBS statistics shows the differentiation of population W from two outgroup populations X and Y as the result of adaptation [2].
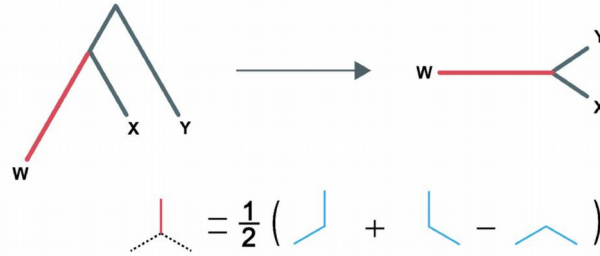
$$PBS = \frac{1}{2}(T_{WX} + T_{WY} - T_{XY})$$

$$T = -\log 10(1 - F_{ST})$$

F_{ST} was estimated with Plink –fst [3]

- We estimated PBS for Khanty (42), Mansi (37), and Nenets (41) peoples. CEU population from HapMap III project [4] and a group of Vietnamese people [1] were used as outgroups. The number of common SNPs consisted of 450467 (Khanty-CEU-Viet), 445231 (Mansi-CEU-Viet), and 434777 (Nenets-CEU-Viet).
- Top 0.1% of 100 kbp windows containing the highest values of PBS were annotated in terms of genes
- The genes thus selected were further tested for overrepresentation in MSigDB v.7.1 [5].

Results

- Developed a pipeline to estimate the PBS values and validated it using the data published previously [1]

- Identified 26 top ranked genomic regions having 0.1% of the highest PBS values for Kanty, Mansi, and Nenets populations.

- Revealed the following genes over-represented in GO:0042572 process, which relates to retinol metabolism: ADH1A, ADH1C, ADH1B, and PLB1 (FDR = 1.65×10^{-04}) in the case of Khanty and ADH1A, ADH1C, ADH1B, and ADH6 (FDR = 7.13×10^{-05}) in the case of Nenets.

the peak associated with 4 genes over-represented in retinol metabolism
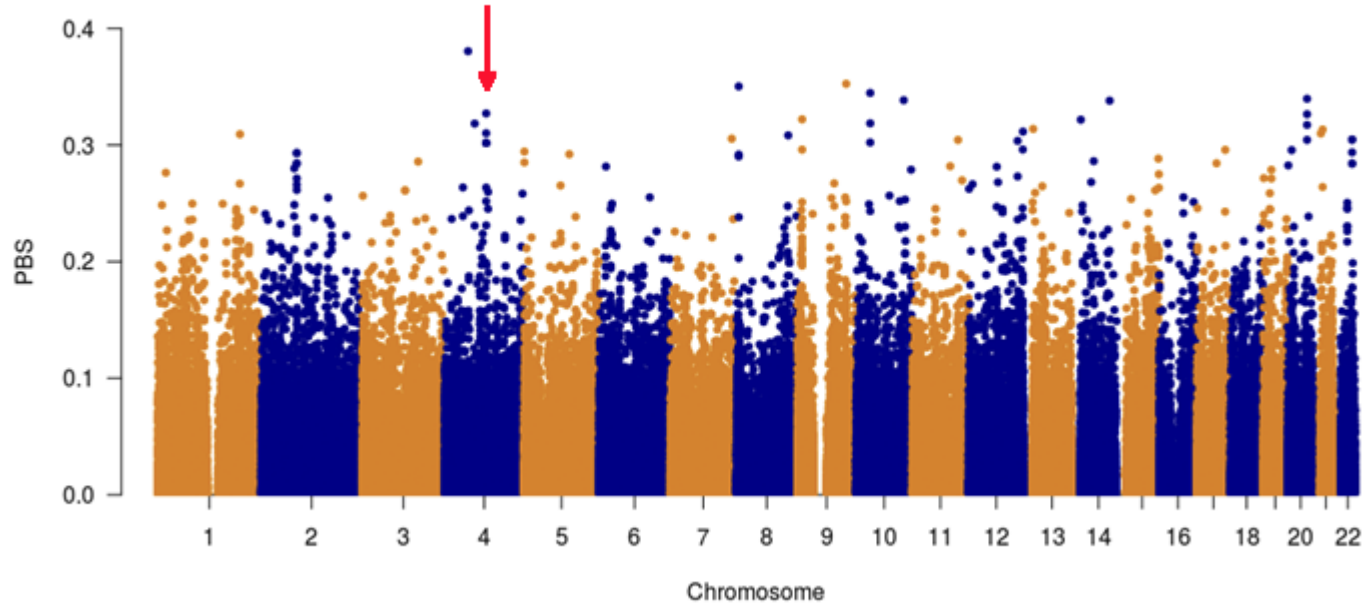
Figure. The Manhattan Plot of PBS for Khanty population

Discussion

The indigenous people of Khanty-Mansi Autonomous Okrug have lower content of vitamin A compared to people arrived into the region [6]. The authors proposed the observation can result from inadequate intake.

We believe the peak of PBS at the chromosome 4 (see Figure) is the genomic signal of adaptation of people from Northern Ural and Western Siberia to low level of vitamin A.

Acknowledgment

References

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