LipoScale: a novel advanced lipoprotein test based on 2D diffusion-ordered ^{1}H NMR spectroscopy

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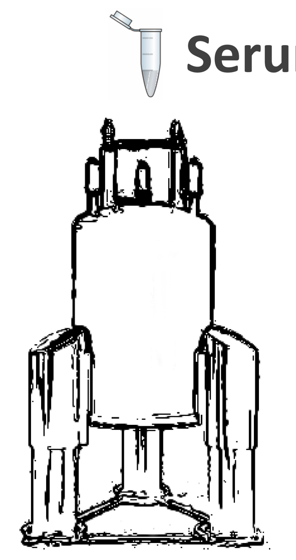
1. BACKGROUND AND AIM

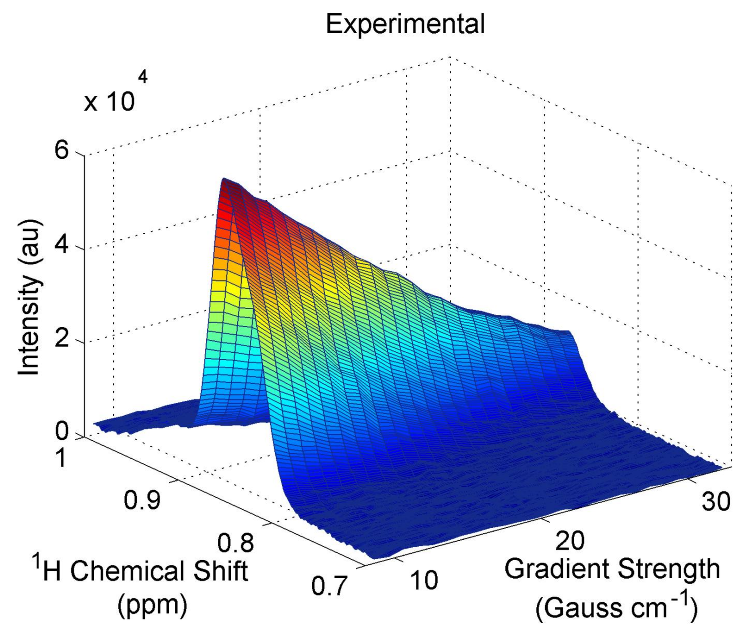
- Type 2 diabetic subjects (T2DM) tend to present atherogenic dyslipidemia (AD). Moreover, the LDL particle number (LDL-P) has been suggested to be a better predictor of cardiovascular risk than LDL cholesterol (LDL-C).
- Our aim was to develop and use **The Liposcale Test**, a novel NMR-based advanced lipoprotein test (ALT) that quantifies lipoprotein-related parameters. This new methodology uses diffusion experiments which measure the size of lipoprotein particles directly.

2. THE LIPOSCALE TEST

Serum/plasma sample



NMR measurement



Data processing

- The Liposcale test provides the mean particle sizes, total particle numbers, and total cholesterol and triglyceride concentrations of the main lipoprotein classes (**VLDL**, **LDL**, and **HDL**).
- It also provides the particle numbers of three subclasses for each main class (large, medium, and small).

3. RESULTS

3.1 Validation of the Liposcale test

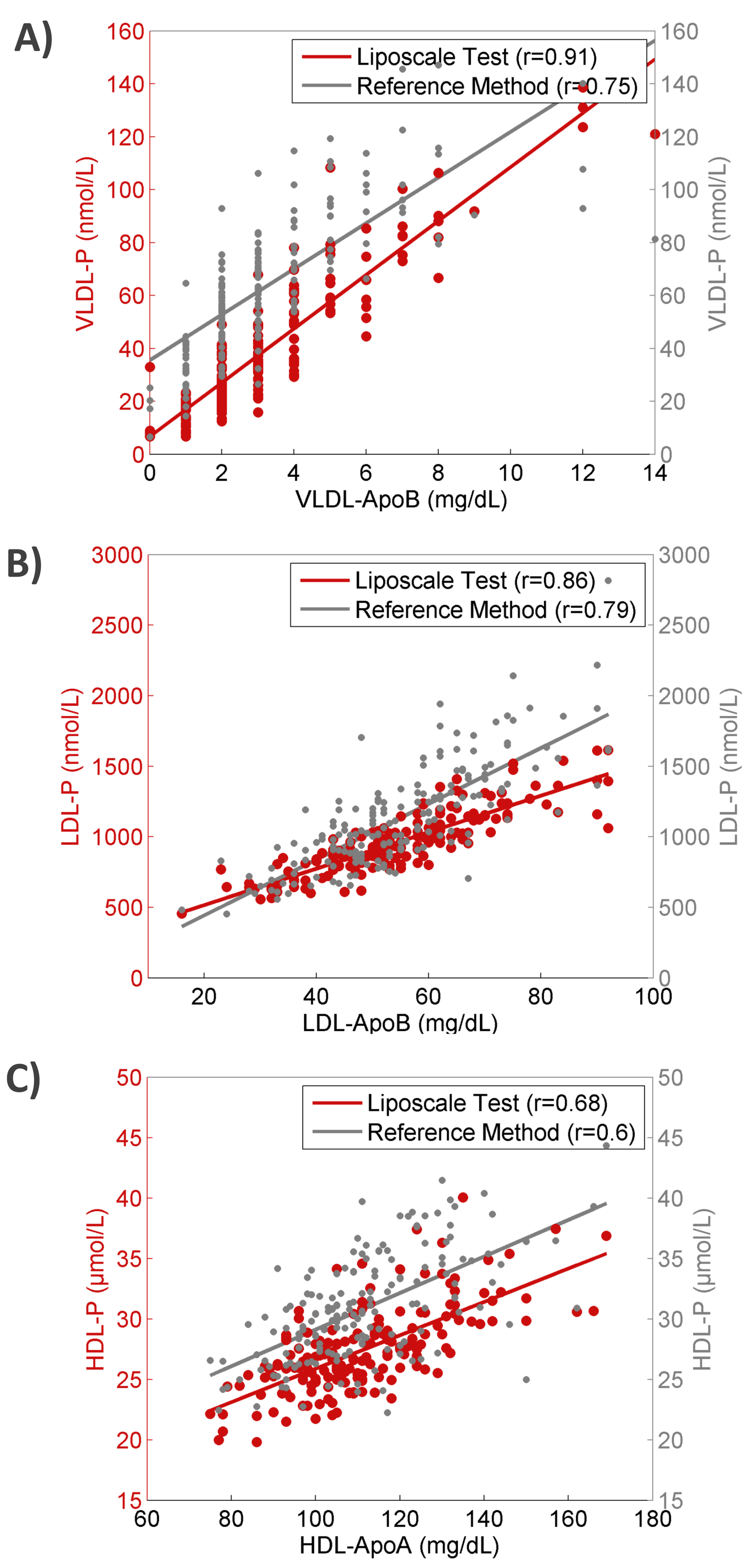


Figure 1. Correlations between the particle number and the apolipoprotein concentration of A) VLDL, B) LDL, and C) HDL fractions on a cohort of 177 healthy subjects.

3.2 Characterization of atherogenic dyslipidemia

Table 1. Anthropometric and clinical characteristics

	T2DM (n=222)	T2DM with AD (n=100)
BMI, kg/m^2	32.6 ± 0.5	32.7 ± 0.6
Age, years	62 ± 1	58.2 ± 1
SBP, mmHg	141 ± 1	143 ± 2
Sex, %	51	55
Hypertension, %	75	73
Smoking, %	48	49
Total Cholesterol, mg/dL	205 ± 4	229 ± 6
Triglycerides, mg/dL	123 ± 5	301 ± 22
HDL, mg/dL	51 ± 1	36 ± 1

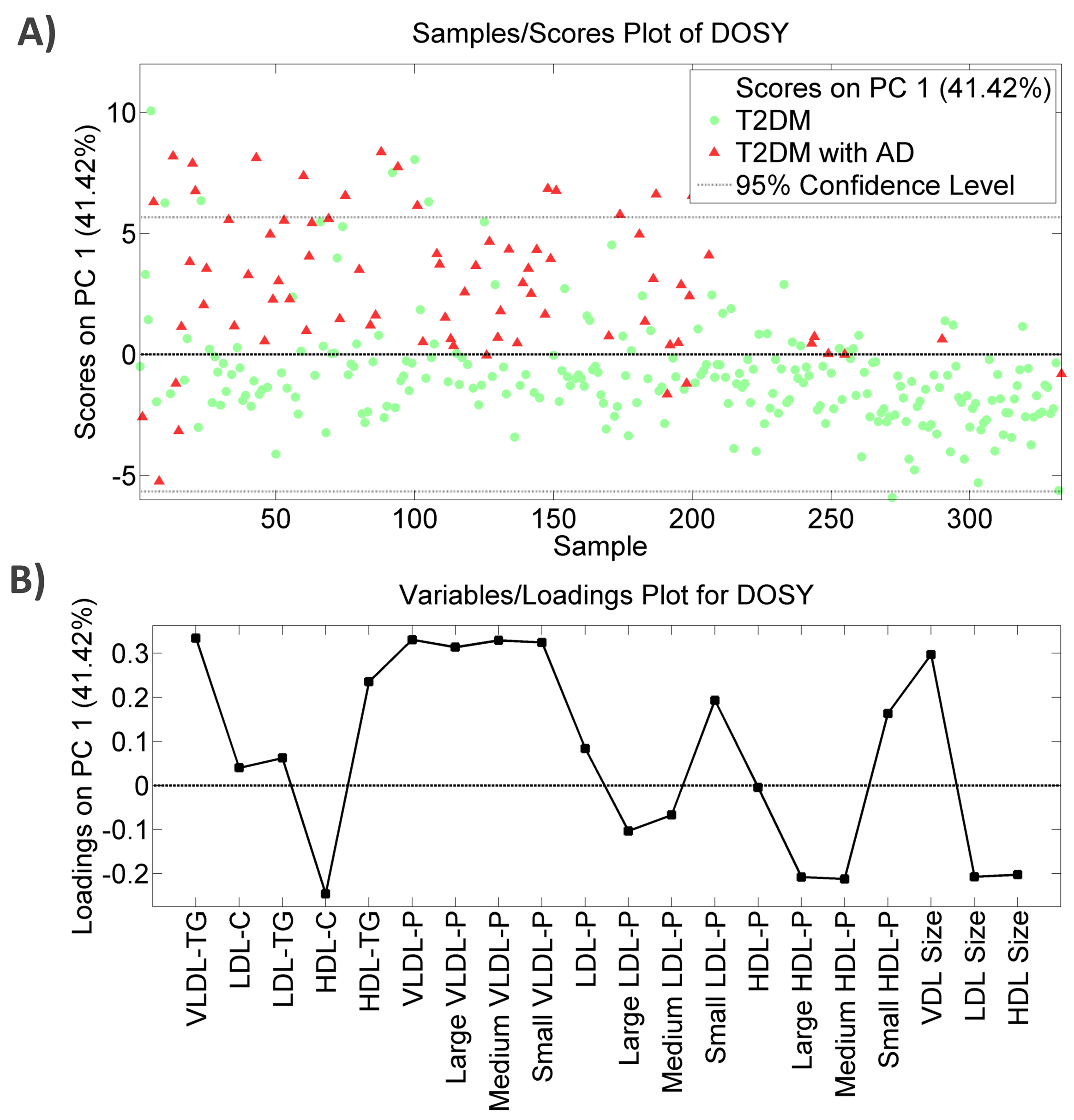


Figure 2. Principal component analysis of the Liposcale test: A) Scores plot and B) Loadings plot.

3.3 Discordance analysis

- We analyzed the cases when the LDL-P and LDL-C measures were discordant on the basis of population percentiles, as well as the cases when LDL-P and HDL-C measures were discordant (**Figure 3**).
- For those individuals with higher LDL-P percentiles than LDL-C or HDL-C, only LDL-P was associated with IMT (r=0.33 and r=0.35, respectively).
- We found a linear trend between concordant/discordant groups and mean IMT levels when samples were grouped according to LDL-P/HDL-C discordance (**Figure 3B**).

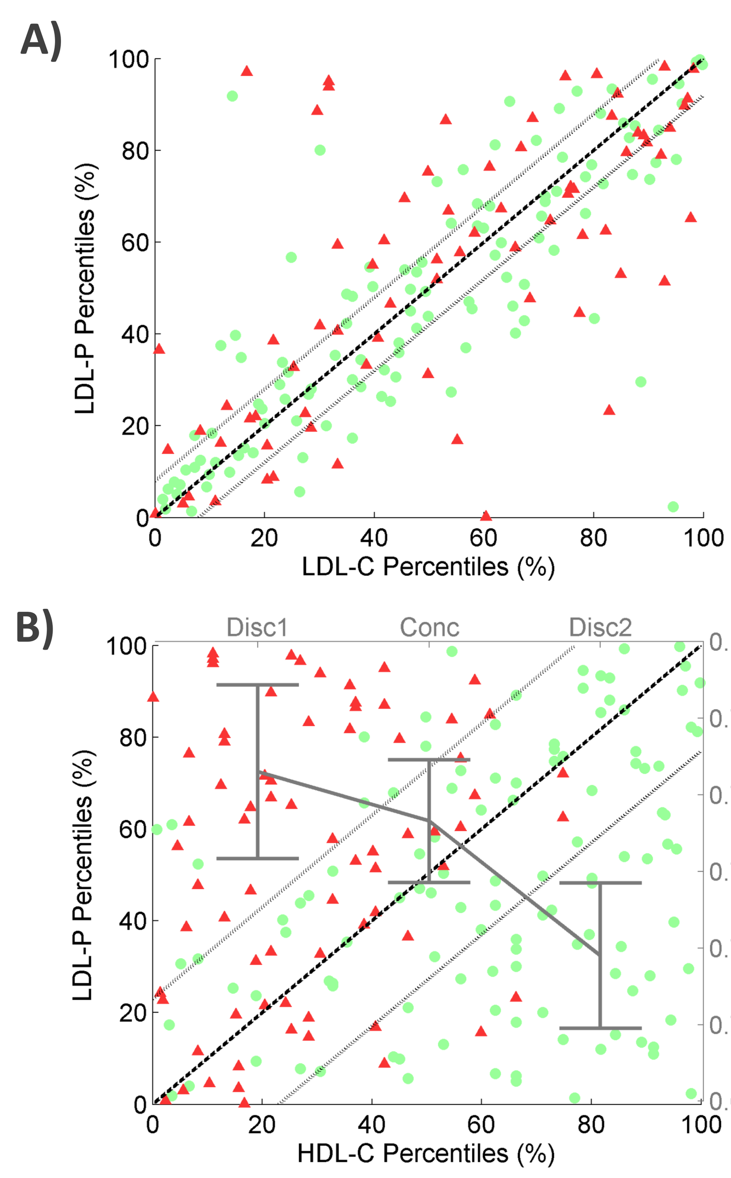


Figure 3. Discordance analysis between A) LDL-P and LDL-C and B) LDL-P and HDL-C.

4. CONCLUSIONS

- The Liposcale test showed a stronger correlation between lipoprotein particle number and apolipoprotein concentration than the Liposcience NMR method.
- For individuals with higher LDL-P percentiles than LDL-C or HDL-C, the LDL-attributable atherosclerotic risk was associated with LDL-P but not with LDL-C or HDL-C.
- The standardization of the different advanced lipoprotein tests, the definition of the population in which the use of LDL-P would be most valuable and the evaluation of the cost-effectiveness of using LDL-P are a must in order to incorporate their use in clinical practice.

REFERENCES

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CIBER de Diabetes y Enfermedades Metabólicas (CIBERDEM) is an initiative of ISCIII (Ministerio de Ciencia e Innovación).