Prediction of first year response to growth hormone treatment in neural network models

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Introduction and objective

Accurate prediction of responsiveness to growth hormone (GH) therapy is an important issue. The **1st year response** to treatment is regarded as significant predictor of the attained final height [1].

The aim of the study was to predict height velocity (HV) during 1st year of therapy (HV1) in GH treated children with isolated GH deficiency.

Material

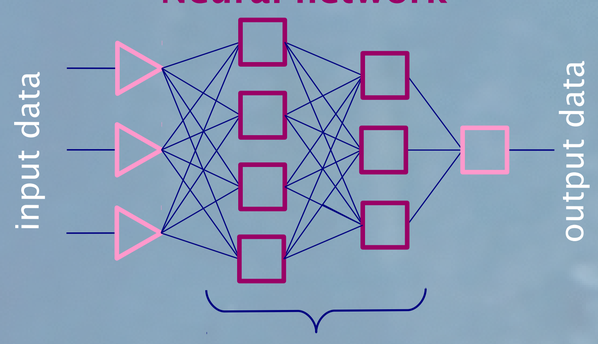
Our analysis comprised data of 253 patients (188 boys, 65 girls). Mean HV before treatment (HV0) in those patients was 4.2±1.3 cm/year, while during 1st year of treatment (HV1) 9.6±1.9 cm/year (4.9-17.0 cm/year).

Potential predictors

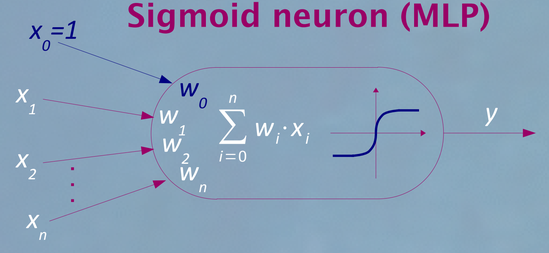
Predictor	Values
Height before treatment (H0)	127.4±15.3 [cm]
Height velocity before treatment (HV0)	4.2±1.3 [cm/year]
Mother's height (HM)	159.7±4.9 [cm]
Father's height (HF)	172.5±6.9 [cm]
IGF-I concentration	141.7±82.3 [ng/ml]
IGFBP-3 concentration	3.94±1.51 [µg/ml]
Age	11.5±2.8 [years]
Bone age (BA)	9.1±2.9 [years]
GH peak in clonidine test (GH clo)	7.2±4.6 [ng/ml]
GH peak in glucagon test (GH glu)	5.5±3.5 [ng/ml]
Gender (G)	0 – male 1-female

Methods

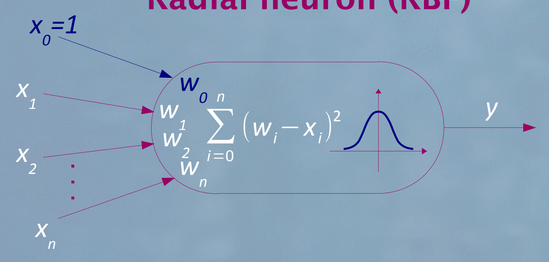
Neural network



Sigmoid neuron (MLP)



Radial neuron (RBF)



Prediction of HV1 was performed in multilayer perceptron (MLP) and radial basis function (RBF) neural networks [2]. Both are illustrated in figures above.

Data were divided into 3 separate sets for training, validation and testing.

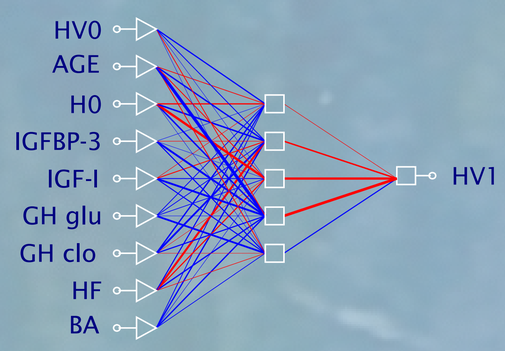
Results

MLP network

Root mean square error (RMSE):

- Training set: 1.77 cm/year
- Testing set: 1.70 cm/year

Range of answers: 7.4-12.4 cm/year



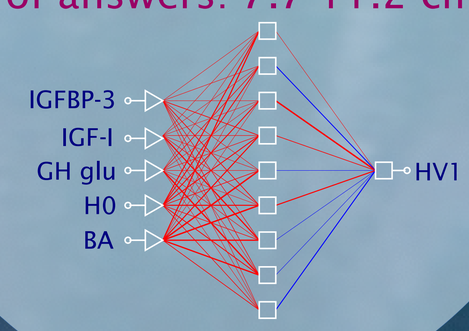
Network interpretation diagram (NID) for MLP network: colour indicates sign of coefficient – blue for negative, red for positive; similarly to method from [3].

RBF network

Root mean square error (RMSE):

- Training set: 1.76 cm/year
- Testing set: 1.77 cm/year

Range of answers: 7.7-11.2 cm/year



NID for RBF network

Conclusions

- Models tend to reproduce general, averaged tendencies rather than extreme values for particular patients. The range of answers they produced was narrower than in the case of real values.
- Together with obtained relatively low error, this feature may allow us to use neural models for identifying patients with poor response to treatment (since the model does not reproduce such exceptional results).
- Choice of predictors depends on model structure. However all predictors included in final RBF network (IGFBP-3, IGF-I, GH peak in glucagon test, height before treatment and bone age) were also present in MLP model, so they seem to be the most important ones.
- Further analysis is needed to confirm the findings about importance of particular

References

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