Background and Objectives: There is increasing interest in the effects of particular foods and/or nutrients on age-associated cognitive decline. This requires tests that can be used in experimental trials which are valid, reliable and sensitive measures of cognitive function and ideally can also act as valid surrogates or bio-markers of the neural processes underlying major domains of cognition. The ILSI Europe Nutrition & Mental Performance Task Force Expert Group (EG) aimed to evaluate tests specific to various cognitive domains and suitability of these for nutrition intervention studies, particularly in the elderly where cognitive abilities decline. The EG proposed guidance to select the most suitable tests for nutritional intervention studies using cognitive outcomes.

Methods:
- Tests in the domains of memory (verbal, visual, spatial, and articulated working memory), selective and sustained attention, executive function, information processing speed, and global cognitive function were reviewed;
- Tests were evaluated for applicability of the validation criteria developed by ILSI Europe (see column headers of Table 1);
- Examples of findings with cognitive tests used in intervention trials with specific nutrients is documented.

Results:

Table 1. Application of essential criteria for validation of cognitive function tests

<table>
<thead>
<tr>
<th>Cognitive Domain</th>
<th>Everyday functional or behavioral reference</th>
<th>Neuronal mechanisms</th>
<th>Appropriate target populations</th>
<th>Established testing paradigms</th>
<th>Utility, validity, and reliability</th>
<th>Established sensitivity to nutraceuticals</th>
<th>Long-term studies or changes in disease state</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive</td>
<td>Information processing, planning, judgment, short- or long-term recall, reaction time, tracking, neglect</td>
<td>Frontal lobes and subcortical motor systems, executive controls, prefrontal cortex</td>
<td>Healthy children and adults, MCI, mild or moderate Alzheimer’s disease, other dementias</td>
<td>Reaction time, tracking tasks, decision making, working memory, inhibition</td>
<td>Improved reaction time, reaction time decrease following caffeine, low GI versus high GI breakfast, low vs highy saturated, soy Isoflavones</td>
<td>Improved reaction time, reaction time decrease following caffeine, low GI versus high GI breakfast, low vs highy saturated, soy Isoflavones</td>
<td>Improved reaction time, reaction time decrease following caffeine, low GI versus high GI breakfast, low vs highy saturated, soy Isoflavones</td>
</tr>
<tr>
<td>Memory</td>
<td>Information processing, planning, judgment, short- or long-term recall, reaction time, tracking, neglect</td>
<td>Frontal lobes and subcortical motor systems, executive controls, prefrontal cortex</td>
<td>Healthy children and adults, MCI, mild or moderate Alzheimer’s disease, other dementias</td>
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</tr>
<tr>
<td>Attention</td>
<td>Information processing, planning, judgment, short- or long-term recall, reaction time, tracking, neglect</td>
<td>Frontal lobes and subcortical motor systems, executive controls, prefrontal cortex</td>
<td>Healthy children and adults, MCI, mild or moderate Alzheimer’s disease, other dementias</td>
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</tr>
<tr>
<td>Sensory</td>
<td>Information processing, planning, judgment, short- or long-term recall, reaction time, tracking, neglect</td>
<td>Frontal lobes and subcortical motor systems, executive controls, prefrontal cortex</td>
<td>Healthy children and adults, MCI, mild or moderate Alzheimer’s disease, other dementias</td>
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</tr>
<tr>
<td>Visual</td>
<td>Information processing, planning, judgment, short- or long-term recall, reaction time, tracking, neglect</td>
<td>Frontal lobes and subcortical motor systems, executive controls, prefrontal cortex</td>
<td>Healthy children and adults, MCI, mild or moderate Alzheimer’s disease, other dementias</td>
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</tr>
<tr>
<td>Auditory</td>
<td>Information processing, planning, judgment, short- or long-term recall, reaction time, tracking, neglect</td>
<td>Frontal lobes and subcortical motor systems, executive controls, prefrontal cortex</td>
<td>Healthy children and adults, MCI, mild or moderate Alzheimer’s disease, other dementias</td>
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</tbody>
</table>

Conclusions: When selecting tests of cognitive function for nutrition intervention studies, the following questions should be asked:
- Which cognitive domain(s) is the nutrition intervention expected to affect?
- Is it a well standardized cognitive test?
- Is its sensitivity to the nutrient known, or its ability to discriminate between the groups under test?
- Are the underlying neural correlates of the cognitive domain understood and how does the biological mechanism of action of the nutrient on cognition relate to these?
- Which everyday functional activities does the nutrient enhance or deplete?

Overall, the field of cognitive function assessment is in need of further alignment of measures in each domain to enable valid comparisons of study outcomes, particularly for nutrition intervention studies.

References:

Keywords: cognition, memory, attention, executive function, nutrition, validation

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