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Special series on “effects of board games on health education and promotion” board games as a promising tool for health   
promotion: a review of recent literature

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Abstract

Board games are played by moving game pieces in particular ways on special boards marked with patterns. To clarify the possible roles of board game use in psychosomatic medicine, the present review evaluated studies that investigated the effects of this activity on health education and treatment. A literature search conducted between January 2012 and August 2018 identified 83 relevant articles; 56 (67%) targeted education or training for health-related problems, six (7%) examined basic brain mechanisms, five (6%) evaluated preventative measures for dementia or contributions to healthy aging, and three (4%) assessed social communication or public health policies. The results of several randomized controlled trials indicated that the playing of traditional board games (e.g., chess, Go, and Shogi) helps to improve cognitive impairment and depression, and that the playing of newly developed board games is beneficial for behavioral modifications, such as the promotion of healthy eating, smoking cessation, and safe sex. Although the number of studies that have evaluated board game use in terms of mental health remains limited, many studies have provided interesting findings regarding brain function, cognitive effects, and the modification of health-related lifestyle factors.

Keywords: Board game, Chess, Dementia, Go, Lifestyle modification, Shogi

Introduction engagement in this type of activity has been shown to

Board games are played by moving game pieces in par-ticular ways on special boards marked with patterns [1].

protect against dementia and cognitive decline in elderly individuals [2]. For example, a 20-year prospective

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| For example, one game originated in northern India in | population-based | study | conducted | in | southwestern |

the sixth century AD and spread to Eastern as well as Western countries. In the West, it spread to Persia and then to Spain via the Moorish conquest, and then throughout Europe, where it ultimately became “chess.”In the East, this game became “Xiangqi” in China,“Shogi” in Japan, and a variety of similar games in other countries. Other popular board games that use two pat-terns for the game pieces include “Go” and “Othello,”also known as “Reversi.”  
 In the field of psychosomatic medicine, board game playing is sometimes regarded as a leisure activity, and

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France investigated the relationship between the playing of board games and the risk of subsequent dementia [3]. Of the 3675 participants without dementia in that study, 1176 (32%) reported regular board game playing and 840 (23%) developed dementia during the follow-up period. The risk of dementia was 15% lower in board game players than in non-players, and board game players exhibited lesser declines in Mini-Mental State Examination (MMSE) scores and less incident depres-sion than did non-players. Although the mechanisms underlying the reduced risk of dementia in board game players have yet to be elucidated fully, these games re-quire players to be proactive and to anticipate, thinking several steps ahead, during play. These processes may

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| --- | --- | --- | --- | --- | --- | --- |
| enhance | logical | thinking | and | prevent | declines | in |

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| Nakao BioPsychoSocial Medicine (2019) 13:5 | | | | also | engage | in | Page 2 of 7 |
| cognitive | function. | Individuals | may | communication or public health policies. The major |

non-verbal communication while playing board games, and players are more likely to have the opportunity to gather and participate in a fun activity with others. These factors could enhance individuals’ social networks,

studies that investigated the effects of traditional board game use are shown in Table 1 [10–33]; some of the articles listed in the table were identified in the reference sections of the original 56 articles or

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| --- | --- | --- | --- | --- | --- |
| which also protects against cognitive decline. Further- | other databases. | studies | investigating | brain | magnetic |
| more, in terms of leisure activities, board game playing | Experimental |

may also be a form of stress management [4], as the fight-or-flight response is regulated safely within the sophisticated structures of match-type games. Board game playing could also be a form of art therapy, similar to miniature garden therapy [5], facilitating infinite internal manifestations within a narrow space.

In terms of education, the playing of board games may help children learn to follow rules and stay seated for a certain amount of time, and it may increase children’s concentration levels [6]. For students and trainees, board game use can enhance health education by stimulating players’ interests and motivation. A search of the Cochrane Database of Systematic Reviews [7] identified a total of 2079 unique citations related to educational games, such as board games and games based on televi-sion shows. Of these citations, 84 were potentially eligible for review based on methodological quality, number of participants, interventions, and outcomes of interest, and two randomized controlled trials (RCTs) were chosen. The first study [8] was based on the televi-sion game show “Family Feud” and focused on infection control; the group that was randomized to play the game

resonance imaging (MRI) or electroencephalographic (EEG) signals in professional board game players [10, 22, 26–28, 31] demonstrated that the basal ganglia play an important role in the ability to rapidly determine, or in-tuit, the best subsequent move in a game situation [24]. Additionally, variations in heart rate and eye movements were examined as physiological parameters during chess play [10, 14, 16]. In case studies and case-control stud-ies, board games were shown to effectively improve symptoms in individuals who experience panic attacks [11], as well as those with attention-deficit/hyperactivity disorder (ADHD) [21] and Alzheimer’s disease (AD) [29]. On the other hand, one study revealed possible hazardous effects associated with the playing of “Go” in individuals with seizure disorders [23]. The amounts of real and virtual playing of board games have increased recently and, as a result, the number of published studies assessing the effects of board game use has also in-creased [12, 13, 17, 19]. The increase in game play is likely due to the prevalence of computer systems in the current age of information and communication technol-ogy (ICT) and artificial intelligence (AI).

had significantly higher scores on a knowledge test. The

second study [9] compared game-based learning (using“Snakes and Ladders”) with traditional case-based learn-ing of stroke prevention and management information. Although the two study groups did not have significantly different knowledge test scores immediately or 3 months after the intervention, the reported level of enjoyment was higher in the game-based learning group. The find-ings of an original review of articles published through

Recent RCTs evaluating board game use   
According to a recent meta-analysis of four studies that investigated chess play [14], age and skill have differen-tial effects on two tasks during game play: selecting the best move for chess positions and recalling chess game positions. The authors found that age was associated negatively, whereas skill was associated positively, with performance in both tasks. Another RCT showed that an

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| --- | --- | --- | --- | --- | --- | --- |
| January 2012 [7] neither confirmed nor refuted the | intervention | using | Go | improved | depression | and |

utility of game playing as a teaching strategy for health professionals. Thus, the present study aimed to clarify the possible roles of board game use in psychosomatic medicine through a literature search for articles pub-lished after 2012 that focused on the effects of board game playing on health-related issues.

Mind/body changes due to board game use   
Using “board game” as a PubMed search term, 83 stud-ies published between January 2012 and August 2018 were identified; 56 (67%) articles targeted education or training for health-related problems, six (7%) exam-ined basic brain mechanisms, five (6%) evaluated preventative measures for dementia or contributions

increased serum levels of brain-derived neurotrophic factor (BDNF) in patients with AD [20]. Similarly, players’ depression and anxiety levels were shown to de-crease significantly during a 6-week stress management intervention that utilized Shogi games [25]. Although these data have been presented only at a scientific con-ference, they will soon be published in this special series. The authors also reported that several patterns of nega-tive cognitive distortion (e.g., lower levels of activity) sig-nificantly improved following completion of the Shogi program compared with those in a wait-list control group. An RCT showed that the playing of “Ska,” a traditional board game in Thailand [32], enhanced cog-nitive function in terms of memory and attention in

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| to | healthy | aging, | and | three | (4%) | assessed | social | elderly subjects. |

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Table 1 Examples of recent studies using traditional board games

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Authors (years) | Countries | Study design | Subjects or materials | Outcomes or variables | Impact |

Chess:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Fuentes JP et al. | Spain | Experimental, | Expert chess player, | EEG changes, decreased | Increased cortical arousal by critical flicker |
| (2018) [10] | single case | male, 33 years old | heart rate variability | fusion threshold, decreased heart rate |

variability during chess play

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Barzegar K & | Iran | Clinical case | Middle-aged man | Clinical course, including | No symptom of nausea, vomiting, or panic |
| Barzegar S (2017) | Argentina | Database | with panic attack after | subjective physical | attack after cell-phone chess play |
| [11] | post-traumatic stress | symptoms |
| Cattuto’s model well described long-range |
| Schaigorodsky AL | 1.4 million chess | Long-range correlations, |
| et al. (2016) [12] | UK | Database | games played by | inter-event time | memory used in opening chess lines |
| humans | distributions |
| Chassy P & Gobet F | Buddhist experts used riskiest strategy |
| 667,599 chess games | Conflict avoidance, risk- |
| (2015) [13] | Canada | Experimental | played by experts | taking behaviors during | nearly 35% more vs. Jewish experts |
| from 11 civilizations | open aggression |
| Sheridan H & | Only experts distinguished relevant and |
| 41 chess players (17 | Eye movements in 8 |
| Reingold EM (2014) | experts, 24 novices) | chess problems | irrelevant information during early trial |

[14]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Moxley JH & | USA | Meta-analysis | 4 studies of age and | Age, chess skill, move | Best-move, recall tasks associated |
| Charness N (2013) | skill effects in chess | selection, chess recall | negatively with aging, positively with skill |

[15]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Leone MJ et al. | Argentina | Experimental | 25 chess games | Heart rate variation | Heart rate signals relevant cognitive |
| (2012) [16] | played by 9 subjects | episodes, e.g., objective choice correctness |

events

Go:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Barradas-Bautista D | Mexico | Computer | Ising Hamiltonian | Two-player scenarios, | Go, Ising model provided elements for |
| et al. (2018) [17] | Republic of | simulation | model of black, white | cancer vs. immune | characterization of cancer invasion, |
| Go stones fighting | system | reduction, metastasis |
| Bae J et al. | Questionnaire |
| 63 subjects predicting | Network density, game | Game predictions more accurate in low- |
| (2017) [18] | Korea | survey | outcome of AlpaGo | predictions | density vs. high-density group |

vs. Sedol Lee match

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Silver D et al. | UK | AI Go program | Search algorithm of | Go win rate | AlphaGo had 99.8% win rate against other |
| (2016) [19] | Monte Carlo | Go programs, defeated human Go |
| simulation and | champion |

networks

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Lin Q et al. | China | RCT | 147 patients with | Cognitive impairment, | Go ameliorated Alzheimer’s disease |
| (2015) [20] | Alzheimer’s disease | depression, anxiety, | symptoms, with BDNF up-regulation |

serum BDNF level

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Kim SH et al. | Republic of | Case-control | 17 children with | Cognitive function, brain | Right theta/beta change in prefrontal |
| (2014) [21] | Korea | study | ADHD, 17 age-, sex- | EEG changes during Go | cortex during study period greater in |
| Jung WH et al. | Republic of | Experimental | matched controls | play–based education | ADHD group |
| 17 Go experts | Structural, functional MRI | Experts had increased gray-matter volume, |
| (2013) [22] | Korea | during working memory | functional connectivity around amygdala |

tasks

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Lee MK et al. | Republic of | Clinical case | 11 patients with reflex | MRI, EEG with clinical | Individualized strategies like game |
| (2012) [23] | Korea | epilepsy, including 6 | course | avoidance most effectively prevented |
| male Go players | seizures |

Shogi:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tanaka K | Japan | Review | Summary of data from | fMRI changes in game | Cingulate cortex essential for intuitive, |
| (2018) [24] | [26, 27, 30] | situations | strategic decision making for any given |

Shogi board position

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Nakao M et al. | Japan | Protocol, RCT | 65 men aged ≥65 | Cognitive-behavioral | Depression, anxiety levels lower during 6- |
| (2017) [25] | years | attitudes, depression, | week Shogi stress management program |

anxiety, well-being

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Wan X et al. | China | Experimental | 17 professional, 17 | fMRI signals during | In professional group, rostral frontal cortex |
| (2016) [26] | amateur Shogi players, | problem-solving tasks | activated only in post-decision period |

19 novices

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Wan X et al. | China | Experimental | 17 amateur Shogi | fMRI signals during quick | Rostral anterior, posterior cingulate |
| (2015) [27] | players | offense-vs.-defense | cortices encoded defense, attack strategy |

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Table 1 Examples of recent studies using traditional board games (Continued)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Authors (years) | Countries | Study design | Subjects or materials | Outcomes or variables | Impact |
| Nakanishi H & | Japan | Experimental | 12 professional, 12 | strategy decisions | values |
| EEG responses in quick | Frontal area responded only to |
| Yamaguchi Y | Japan | Clinical case | amateur Shogi players, | understanding of Shogi | meaningful game positions, in contrast to |
| (2014) [28] | 12 novices | game patterns | temporal area |
| Aoyagi M & Ogawa | Man with Alzheimer’s | Frequent chewing for | Shogi play encouragement useful for |
| T (2013) [29] | Japan | Experimental | disease aged 75–79 | aspiration pneumonia | education about frequent, smooth |
| years | prevention | chewing during eating |
| Wan X et al. |
| 20 men aged 20–22 | fMRI changes during | Activation in caudate nucleus head |
| (2012) [30] | years with little Shogi | Shogi training period | developed over training course |
| knowledge |

Others:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Duan X et al. | China | Experimental | 20 expert Chinese- | Functional connectivity | Increased connectivity between basal |
| (2014) [31] | Thailand | RCT | chess players, 20 | networks assessed by | ganglia, thalamus, hippocampus and |
| novices | fMRI | parietal, temporal areas in experts |
| Panphunpho S et |
| 20 elderly Ska players, | Cognitive function | 16-week Ska group joiners had |
| al. (2013) [32] | 20 elderly controls | (memory, attention, | significantly better cognitive function |
| van den Dries S & | The | Computer | Combination of three | executive function) | scores |
| Evaluation functions | Method outperforms linear networks, fully |
| Wiering MA (2012) | Netherlands | algorithms of | structured neural | (simple linear networks, | connected neural networks or evaluation |
| [33] | learning to play | network techniques | multilayered perceptions) | functions evolved with algorithms |
| Othello |

Of the 83 articles identified in the present PubMed lit-erature search, 12 articles [34–45] report on RCTs that assessed non-traditional board games (Table 2). A variety of board games has been developed to aid in the health education of patients, children, and medical trainees; most of these games are focused on behavioral modifica-tions, such as the promotion of healthy eating [34, 38], smoking cessation [43], and safe sex [45]. For example, in a Swiss study [43], 240 current smokers were assigned randomly to a group participating in smoking cessa-tion program employing an educational board game (“Pick-Klop”) and a wait-list control group. Compared with those in the wait-list group, individuals in the board game group were less likely to remain smokers at the end of the program and at the 3-month follow-up assessment. The authors suggested that use of the board game would be an interesting alternative for the education of smokers in the precontemplation

example, more than half of Japanese elementary and junior-high school students play video games for more than 1 h on weekdays [46]. Thus, video game–based training will become more popular in the future.

On the other hand, a series of meta-analyses [47] found only small or null effect sizes in three models examining correlations between video game skills and cognitive ability, differences in cognitive ability between game players and non-players, and the effects of video game–based training on cognitive ability, respectively. Thus, examination of the clinical effects of real or virtual training using board games may provide more appropri-ate information for discussion of the advantages and disadvantages of each style of board game for future applications in clinical settings. A recent assessment of cognitive science research on board game playing [48] highlighted six suggestions for future studies: 1) do not forget about chess (i.e., a traditional board game for

stage. which large amounts of data have been collected), 2)

look beyond action games and chess, 3) use optimal play

Clinical applications of board games   
Based on the results of studies investigating traditional and non-traditional board games, it was hypothesized

to understand human play and players, 4) investigate social phenomena, 5) raise the standards for studies investigating game play as treatment, and 6) talk to real

that board game use would prevent cognitive impair- experts.

ment in elderly individuals and illness-prone behaviors   
in children and adults. Board game playing also seems to Conclusions

be an effective, fun means of delivering medical and safety education to students and trainees. Currently, many people spend large portions of their time playing games online and offline on television monitors, per-sonal computers, tablets, and/or smart-phones. For

Although the number of studies investigating board game use remains limited, interesting findings have recently been obtained in terms of brain function, cogni-tive effects, and health-related lifestyle modification. Board games may also be applicable as educational tools

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Table 2 Examples of recent RCTs using board games

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Authors (years) | Countries | Subjects | Board games | Control setting | Outcomes or | Impact |

variables

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Nederkoorn C et | The | 66 children | Age-appropriate | Play with large bowl | Acceptance of a | Jelly group ate significantly |
| al. (2018) [34] | Netherlands | aged 3–10 | memory-related board | filled with colorless, | food with a specific | more jelly dessert |
| years | game | odorless jelly (Jelly | texture |

group)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Fancourt D et al. | UK | 352 subjects | Board game requiring | Operating theater | Surgical speed, | Rock music impaired men’s |
| (2016) [35] | aged > 16 | removal of 3 organs | sound, classical | accuracy, and | performance of complex |
| years without | from Cavity Sam | music, or rock as | perceived | surgical procedures in |
| surgical | (experimental tool) | background music | distraction | board game |

training

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Karbownik MS et | Poland | 124 medical | AntimicroGAME to | Lecture-based | Short-term | Long-term knowledge |
| al. (2016) [36] | students | learn bacteriology, | seminar | knowledge | retention greater in board |
| antimicrobial drug | retention about | game participants vs. |
| actions | pharmacology of | controls |

antimicrobial drugs

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sharps M & | UK | 143 children | Board game with | Board game with | Children’s fruit and | Health and social norm– |
| Robinson E | Italy | aged 6–11 | descriptive social | animal images | vegetable intake | based messages increased |
| (2016) [37] | years | norm–based or health | fruit and vegetable intake |
| message | vs. controls |
| No board game | Adolescent food |
| Viggiano A et al. | 3110 subjects |
| Kaledo board game to | Treatment group showed |
| (2015) [38] | Sweden | aged 9–19 | promote nutrition | during study period | habits and body | improved nutrition |
| years | education, improve | mass index | knowledge, healthy diet, |
| dietary behavior | food habits, physical activity |
| Fernandes SC et | Entertaining tools |
| 125 children | Children’s |
| Educational board | Educational group less |
| al. (2014) [39] | USA | aged 8–12 | game, video, or | with same formats | preoperative worries | worried about surgery, |
| years | booklet with surgery | (comparison group), | and parental anxiety | hospital procedures vs. |
| and hospitalization | no tool (control | other two groups |
| Laski EV & Siegler | information | group) |
| 42 | Children’s |
| Number line estimates, |
| Numerical board | Same game, standard |
| RS (2014) [40] | Belgium | kindergartners, | game, counting on | count-from-1 | knowledge of | numeral identification, |
| mean age 5.8 | from current number | procedure | numbers in the 0– | count-on skill improved |
| years | on board | 100 range | more in count-on group |
| Charlier N & De |
| Traditional lecture |
| 120 students | Board game to obtain | Students’ | Game condition was |
| Fraine B (2013) | first-aid knowledge | Knowledge of first | preferred, but lecture more |
| [41] | aids | effectively increased |

knowledge

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Swiderska N et al. | UK | 67 medical | Educational board | Normally provided | Students’ test scores | Neonatology test scores |
| (2013) [42] | students | game in neonatology | teaching | in neonatology | higher in game vs. control |

group (p = 0.09)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Khazaal Y et al. | Switzerland | 240 current | Pick-Klop game, cards | Psychoeducation to | Smoking-related | Game group less likely to |
| (2013) [43] | smokers aged | with smoking-related | stop smoking, wait- | attitudes and | remain smokers vs. wait-list |
| 18–65 years | questions, response | list control | behaviors | group |

options

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Cho KH et al. | Republic of | 24 stroke | Virtual reality training | Standard | Statics balance of | Significant improvement in |
| (2012) [44] | Korea | patients | with balance-board | rehabilitation | chronic stroke | dynamic balance in chronic |
| game system | program only | patients | stroke patients with virtual- |

reality balance training

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Wanyama JN et | Uganda | 180 HIV- | Educational board | Standardized health | Uptake of | Educational game improved |
| al. (2012) [45] | positive | game to impart health | talk | knowledge to HIV | uptake of HIV, sexually |
| participants | knowledge | and sexually | transmitted infection |
| transmitted | knowledge |
| infections |

for health professionals. Although a systematic review [7] neither confirmed nor refuted the utility of game playing as a teaching strategy for health professionals, these findings were published in 2013 and additional high-quality studies have been reported since then. Thus, it is time to re-evaluate the usefulness of games

made in modern society. Clinical medicine is closely linked to a public health approach, and medical practices should be undertaken within the limited human, time, and financial resources available [49]. In this sense, ap-propriate health education programs with a board game component would be useful for both preventive and

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| and | gamifications | following | technological | advances | therapeutic | intervention | for | cognitive-behavioral |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Nakao BioPsychoSocial Medicine (2019) 13:5 | | | | | | 10. | Page 6 of 7 |
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| BDNF: Brain-derived neurotrophic factor; EEG: Electroencephalographic; | 13. | chess database. PLoS One. 2016;11(12):e0168213. |
| HIV: Human immunodeficiency virus; ICT: Information and communication | Chassy P, Gobet F. Risk taking in adversarial situations: civilization |
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| for the decision to submit the manuscript for publication. The author read |
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| and approved the final manuscript. |
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