

Peak metabolic equivalent (MET) levels achieved during graded exercise testing of patients with OHT approximate only 60% of those achieved by age-matched controls. Mandak and colleagues<sup>10</sup> also reported that exercise capacity is markedly improved after heart transplantation although it remains impaired compared with healthy individuals. In general, patients achieve their maximal exercise capacity by 1 year after transplantation. Osada and colleagues<sup>11</sup> measured 140 patients who had undergone heart transplantation up to 9 years. The results revealed that the physiological improvement seen at 6 months did not significantly change over the 9 years of follow-up.

In addition to physiological changes after OHT, there is a growing awareness of the need to focus on psychological parameters, which may be related to the heart recipient's full recuperation. Before transplantation, 53% of patients reported an increase in anxiety, and 34% of patients recorded scores that indicated mild-to-moderate levels of depression. Thirty-seven percent of patients showed a deterioration in the quality of life, and 34% of patients had negative body images.<sup>12</sup> Zenati et al.<sup>13</sup> stated that even if cardiac transplantation does not appear to be associated with serious psychological morbidity, it is important to assess the recipient's anxiety, depression, body image, and quality of life. Results of previous studies also show that 23% of patients reported that, since transplantation, sexuality had become a problem for them.<sup>14</sup> In Bunzel's study, 21% of subjects stated that their personality had indeed changed.<sup>15</sup> Duitsman and Cychoz<sup>16</sup> reported that females displayed significantly more anxiety and were much more dissatisfied with their body image than were males. In addition, it was found that the employed group reported higher self-esteem, quality of life, and body satisfaction than did the unemployed group.<sup>17</sup>

Exercise training has been shown to be useful and effective in improving exercise tolerance in patients with OHT.<sup>18-19</sup> Niset et al.<sup>20</sup> recruited 62 patients with OHT and demonstrated increases in  $VO_{2max}$  (33%), peak heart rate (11%), peak systolic blood pressure (18%), and a reduction (25%) in the ventilation quotient for oxygen during submaximal exercise after 1 year of exercise training. A recent well-controlled trial

study<sup>21</sup> also revealed that peak oxygen consumption and workload significantly improved after a 6-month exercise training program.

Although physiological adaptations in patients with OHT after exercise training have been demonstrated, few researchers have reported the influence of exercise training on body image and exercise self-efficacy in patients with OHT. In Taiwan, due to the lack of cardiac rehabilitation programs, the effects of exercise training on heart transplantation patients remain unclear. Therefore, the purposes of this study were to examine physiological and psychological adaptations after a 10-week exercise training program in Taiwanese patients with OHT.

## MATERIALS AND METHODS

A one-group pretest-posttest design was used. Clinical indicators of physiological measurements included parameters of lung function (FEV1, FEV1% predicted, FVC, FVC% predicted, and FEV1/FVC%), estimated maximal oxygen consumption ( $VO_{2max}$ ), hemodynamic changes during the graded exercise testing, and ability to perform daily activities. Parameters of psychological measurements included body image, signs/symptoms, and exercise self-efficacy.

### Lung-function Test

A lung-function test was performed by using a spirometer before and after 10 weeks of exercise training. Forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC) were measured. For data analysis, FEV 1% predicted, FVC% predicted, and FEV1/FVC% were calculated by the equations set up in the spirometer software (FEV1% predicted:  $[0.0344 \times BH] - [0.033 \times \text{age}] - 1$  for men and  $[0.0267 \times BH] - [0.027 \times \text{age}] - 0.54$  for women; FVC% predicted:  $[27.63 - 0.112 \times \text{age}] \times BH/1000$  for men and  $[21.78 - 0.101 \times \text{age}] \times BH/1000$  for women).

### Exercise Test

A symptom-limited treadmill-graded exercise test with modified Naughton protocol was used to measure each subject's functional capacity (estimated  $VO_{2max}$ ).